Designation: C612 – 14

Standard Specification for Mineral Fiber Block and Board Thermal Insulation[1]

This standard is issued under the fixed designation C612; 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 classification, composition, dimension, and physical properties of mineral fiber (rock, slag, or glass) semi-rigid and rigid board intended for the use as thermal insulation on surfaces operating at temperatures between 0°F (-18°C) and 1800°F (982°C). For specific applications, the actual temperature limits shall be agreed upon between the supplier and the purchaser.

1.2 For satisfactory performance, properly installed protective vapor retarder or barriers shall be used on below ambient temperature applications to reduce movement of water through or around the insulation towards the colder surface. Failure to use a vapor retarder or barrier can lead to insulation and system damage. Refer to Practice C921 to aid material selection. Although vapor retarder properties are not part of this specification, properties required in Specification C1136 are pertinent to applications or performance.

1.3 The orientation of the fibers within the boards is primarily parallel to the principal surface (face). This specification does not cover fabricated pipe and tank wrap insulation where the insulation has been cut and fabricated to provide a fiber orientation that is perpendicular to the surface (face).

1.4 This standard does not purport to provide the performance requirements of hourly-rated fire systems. Consult the manufacturer for the appropriate system.

1.5 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.

1.6 *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

C303 Test Method for Dimensions and Density of Preformed Block and Board–Type Thermal 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

C447 Practice for Estimating the Maximum Use Temperature of Thermal Insulations

C518 Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

C665 Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing

C680 Practice for Estimate of the Heat Gain or Loss and the Surface Temperatures of Insulated Flat, Cylindrical, and Spherical Systems by Use of Computer Programs

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

C921 Practice for Determining the Properties of Jacketing Materials for Thermal Insulation

C1045 Practice for Calculating Thermal Transmission Properties Under Steady-State Conditions

C1058 Practice for Selecting Temperatures for Evaluating and Reporting Thermal Properties of Thermal Insulation

C1101/C1101M Test Methods for Classifying the Flexibility or Rigidity of Mineral Fiber Blanket and Board 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.

TABLE 1 Physical Property Requirements[A]

Properties	Type IA	Type IB	Type II	Type III	Type IVA	Type IVB	Type V Grade A and B
Maximum use temperature[B] °F (°C)	450 (232)	450 (232)	850 (454)	1000 (538)	1200 (649)	1200 (649)	1800 (982)
Apparent thermal conductivity, max, Btu in./h ft^2 °F (W/m K)							
Mean temperatures °F (°C)							
25 (-4)	0.22 (0.032)	0.21 (0.030)	0.21 (0.030)	0.21 (0.030)	0.21 (0.030)	0.23 (0.033)	0.44 (0.063)
75 (24)	0.26 (0.037)	0.26 (0.037)	0.25 (0.036)	0.25 (0.036)	0.25 (0.036)	0.24 (0.035)	0.45 (0.064)
100 (38)	0.28 (0.040)	0.27 (0.039)	0.27 (0.039)	0.27 (0.039)	0.27 (0.039)	0.25 (0.036)	0.45 (0.064)
200 (93)	0.36 (0.052)	0.34 (0.049)	0.35 (0.050)	0.35 (0.050)	0.34 (0.049)	0.30 (0.043)	0.47 (0.068)
300 (149)	0.46 (0.066)	0.42 (0.060)	0.44 (0.063)	0.44 (0.063)	0.44 (0.063)	0.36 (0.052)	0.49 (0.071)
400 (204)			0.55 (0.079)	0.55 (0.079)	0.55 (0.079)	0.42 (0.061)	0.52 (0.075)
500 (260)			0.70 (0.101)	0.70 (0.101)	0.70 (0.101)	0.53 (0.076)	0.55 (0.080)
600 (316)				0.90 (0.130)	0.85 (0.123)	0.63 (0.091)	0.59 (0.085)
700 (371)					1.00 (0.144)	0.75 (0.108)	0.63 (0.091)
800 (427)							0.67 (0.097)
Minimum Compressive resistance at 10 % deformation, min, lb/ft^2 (kPa)							
Category I	no compressive resistance requirement						
Category 2	N. A.[C]	25 (1.2)	25 (1.2)	12 (0.6)	50 (2.4)	50 (2.4)	1000 (48)
Linear shrinkage, at maximum use temperature, %	2.0	2.0	2.0	2.0	2.0	2.0	4.0
Water vapor sorption, max, %	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Surface burning characteristics:							
Flame spread index, max	25	25	25	25	25	25	25
Smoke developed, max	50	50	50	50	50	50	50

[A] Refer to Section 7 for additional physical property requirements.
[B] See **Warning** in 6.2.1.
[C] N. A. indicates not applicable.

C1104/C1104M Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation
C1114 Test Method for Steady-State Thermal Transmission Properties by Means of the Thin-Heater Apparatus (Withdrawn 0)[3]
C1136 Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
C1304 Test Method for Assessing the Odor Emission of Thermal Insulation Materials
C1335 Test Method for Measuring Non-Fibrous Content of Man-Made Rock and Slag Mineral Fiber Insulation
C1338 Test Method for Determining Fungi Resistance of Insulation Materials and Facings
C1617 Practice for Quantitative Accelerated Laboratory Evaluation of Extraction Solutions Containing Ions Leached from Thermal Insulation on Aqueous Corrosion of Metals
E84 Test Method for Surface Burning Characteristics of Building Materials

2.2 *Other Referenced Document:*
CAN/ULC-S102 Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies[4]

3. Terminology

3.1 *Defintions*—For definitions used in this specification, refer toTerminology C168.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *delivered thickness*—the actual thickness of the product shipped by the manufacturer or the seller and received by the purchaser.

3.2.2 *mean temperature*—the sum of the cold surface temperature and the hot surface temperature divided by two.

3.2.3 *shot*—is defined, for the purposes of this specification, as that material which cannot be brushed or mechanically shaken through No. 100 (150-µm) sieve.

4. Classification

4.1 Mineral fiber board insulation covered by this specification shall be classified into seven types with two grades for Type V and two categories, shown in Table 1. This classification is based upon the maximum use temperature, maximum apparent thermal conductivity, minimum compressive resistance, maximum linear shrinkage, maximum water vapor sorption, and maximum surface burning characteristics for the insulations.

4.1.1 *Category 1*—No compressive resistance (load-bearing) properties are required.

4.1.2 *Category 2*—Minimum compressive resistance (load-bearing) properties are required.

4.1.3 *Type V, Grade A*—Requires no heat-up schedule.

4.1.4 *Type V, Grade B*—Heat-up schedule is required. **Warning—**Grade B may not be suitable for applications requiring hot installation capability at the maximum temperature indicated. In general, products having a Grade B designation are designed to be used with a heat-up schedule. Failure to use a heat-up schedule with Grade B products may lead to an exothermic reaction. This is dependent on thickness and temperature. Consult the manufacturer or manufacturer's literature for special heat rate considerations.

[3] The last approved version of this historical standard is referenced on www.astm.org.
[4] Available from Underwriters Laboratories of Canada, 7 Crouse Road, Scarborough, Ontario, Canada M1R 3A9.

5. Ordering Information

5.1 The type, category, grade for Type V, and dimensions shall be specified by the purchaser.

6. Materials and Manufacture

6.1 *Composition*—Mineral fiber block and semi-rigid and rigid board insulation shall be composed of rock, slag, or glass processed from the molten state into fibrous form and bonded with an organic or inorganic binders or both. Asbestos shall not be used as an ingredient or component part of the product.

6.2 *Facings:*

6.2.1 The purchaser shall specify whether the insulation shall be supplied plain or with facings and, if faced, shall specify the type and its requirements. (**Warning**—The user is advised that it is possible that the maximum use temperature of facings and adhesives is lower than the maximum use temperature of the insulation. The user shall ensure that sufficient thickness shall be installed so none of these accessory items (facings and adhesives) are exposed to temperatures above their maximum use temperature.)

6.2.2 The vapor retarder facings shall be in accordance with Specification C1136.

6.2.3 Typical facings are as follows (others are available):

6.2.3.1 Aluminum foil, reinforced fiberglass scrim, and natural (brown) kraft paper laminate (facing) is known as FRK or FSK.

6.2.3.2 White kraft paper, reinforced fiberglass scrim, and aluminum foil laminate (facing) is known as ASJ (All Service Jacket).

6.2.3.3 Aluminum foil, reinforced fiberglass scrim, and plastic film (example: polyethylene) laminate (facing) is known as FSP (Foil-Scrim-Polyethylene).

6.2.3.4 Aluminum foil, and

6.2.3.5 Vinyl film.

7. Physical Properties

7.1 The insulation type shall conform to the following requirements in Table 1: maximum use temperature, apparent thermal conductivity, compressive resistance, linear shrinkage, water vapor sorption, and surface burning characteristics.

7.1.1 *Apparent Thermal Conductivity*— Test in accordance with 12.3.

7.1.2 *Compressive Resistance*—Test in accordance with 12.4.

7.1.3 *Linear Shrinkage*—Test in accordance to 12.5.

7.1.4 *Water Vapor Sorption*—Test in accordance with 12.6.

7.1.5 *Surface Burning Characteristics*—Test in accordance with 12.7.

7.2 *Odor Emission*—A detectable odor of objectionable nature recorded by more than two of five panel members shall constitute rejection of the material when tested in accordance with 12.8.

7.3 *Corrosiveness to Steel*—When tested and evaluated in accordance with Specification C665 in 12.9, the corrosion resulting from insulation in contact with steel plates shall be judged to be no greater than for comparative plates in contact with sterile cotton. Test the composite insulation material (with facing and adhesive) when a facing is factory adhered by the manufacturer or the fabricator. (**Warning**—There are adhesives that can cause corrosion to steel when they are in contact with water or water vapor and the steel. Currently, there is not a test method available to satisfy every potential corrosion application.)

7.3.1 The use of Practice C1617 is an acceptable alternative to the test procedure in 7.3, with the mass loss corrosion rate of steel test sample exposed to the unfaced insulation extract not to exceed that of the 5 ppm chloride solution.

7.4 *Stress Corrosion to Austenitic Stainless Steel*—When specified, shall be tested and evaluated in accordance with 12.10.

7.5 *Semi-rigid or Rigid*—When tested and evaluated at its delivered thickness in accordance with 12.11, all mineral fiber (rock, slag, and glass) board and block must qualify to be semi-rigid or rigid.

7.6 *Non-Fibrous (Shot) Content*—The averaged maximum shot content of rock or slag mineral fiber products, Types IA through IVB as shown in Table 1, shall not exceed 25 % by weight as defined in 12.2. Type V products contain other ingredients which invalidates the way shot content is determined. Non-fibrous content is not applicable to glass mineral fiber products.

7.7 *Maximum Use Temperature*—Shall be tested in accordance with 12.1, the board and block insulation shall not warp, flame, or glow during hot surface exposure. No evidence of melting or fiber degradation shall be evident upon posttest inspection.

7.8 *Maximum Exothermic Temperature Rise*—Shall be tested in accordance with 12.1, the internal temperature shall not at any time exceed the hot surface temperature by more than 200°F (111°C). The 200°F criterion applies during heat-up as well as steady state conditions. Exceeding this limit constitutes noncompliance to this specification and rejection.

7.9 *Fungi Resistance*—Shall be tested in accordance with 12.12; growth no greater than that on a comparative item (white birch wood) shall be considered to have passed the test method criteria.

8. Qualification Requirements

8.1 The following requirements shall be employed for the purpose of initial product qualification:

8.1.1 Maximum use temperature,

8.1.2 Apparent thermal conductivity,

8.1.3 Compressive resistance,

8.1.4 Linear shrinkage,

8.1.5 Water vapor sorption,

8.1.6 Surface burning characteristics,

8.1.7 Odor emission,

8.1.8 Corrosiveness,

8.1.9 Rigidity, and

8.1.10 Shot content.

8.1.11 Fungi resistance.

TABLE 2 Standard Sizes and Tolerances[A]

Mineral Fiber Board and Block for Types by Length, Width, and Thickness	Sizes, in. (mm)	Tolerance, in. (mm)
Length—Types IA through IVB	36 (914), 48 (1219)	±½ (12.7)
Length—Type V	36 (914), 48 (1219)	±½ (12.7)
Width—Types IA through IVB	24 (610), 36 (914), 48 (1219)	±¼ (6.4)
Width—Type V	12 (305), 24 (610),	±¼ (6.4)
Thickness—All Types	1 (25.4) to 4 (102) in ½-in. (12.7-mm) increments	−⅛ (3.2) + ¼ (6.4)

[A] Other sizes available upon request.

9. Dimensions, Mass, and Permissible Variations

9.1 The standard sizes and tolerances of mineral fiber board insulation are listed in Table 2. Specific sizes and tolerances shall be agreed upon between the purchaser and the supplier.

9.2 The maximum density (determined in accordance with Test Method C303) specified in Table 3 for Type(s) IA through Type V are for weight design purposes only.

10. Workmanship, Finish, and Appearance

10.1 The insulation shall have good workmanship and shall not have defects which adversely affect its installation and performance qualities.

11. Sampling

11.1 Inspection and qualification of the insulation shall be in accordance with Practice C390 or as otherwise specified in the purchase order or contract as agreed between the purchaser and seller.

11.2 *Shot Content Test Samples*—A minimum of three specimens must be tested to determine average shot content for any single shipment.

12. Test Methods

12.1 *Maximum Use Temperature and Exothermic Rise Temperatures*—Test in accordance with Test Method C411 and the hot surface performance of Practice C447 at the maximum use temperature of the insulation. All types shall be tested without jacketing at 8-in. (203-mm) thickness or at the manufacturer's stated maximum thickness, in either single or multiple layer configurations.

12.1.1 The test surface shall be for all Types at maximum use temperature specified in Table 1, when the insulation is applied. For Type V Grade B material, any special requirement for heat-up specified by the manufacturer shall be used.

12.2 *Non-Fibrous (Shot) Content of Inorganic Fibrous Thermal Insulation*—Shall be tested in accordance with Test Method C1335.

12.3 *Apparent Thermal Conductivity:*

12.3.1 The thermal conductivity as a function of temperature for the representative specimens shall be determined with data obtained from a series of thermal tests utilizing Test Methods C177, C518, or C1114 as appropriate for the material under study. Specimen shall be tested unfaced and at a maximum thickness of 2 in. (51 mm) unless the manufactured minimum thickness of the insulation material cannot abide by this requirement; whereby test at the minimum thickness representative of the product.

12.3.1.1 Test Method C518 shall not be used at temperatures or resistances other than those in the range of the calibration.

12.3.1.2 Test Method C1114 shall not be used at temperatures or resistance ranges other than those with comparable results to Test Method C177.

12.3.2 The test method selected shall have proven correlation with Test Method C177 over the temperature range of conditions used. In cases of dispute, Test Method C177 shall be considered as the final authority for material having flat geometry.

12.3.3 It is possible to use Practice C1058 to obtain recommended test temperature combinations for testing purposes.

12.3.4 As specified in Practice C1045, the range of test conditions must include at least one test where the hot surface temperature is greater than, or equal to, the hot limit of the temperature range of desired data and at least one test where the cold surface temperature is less than, or equal to, the cold limit of the temperature range desired. At least two additional tests shall be distributed somewhat evenly over the rest of the temperature range.

12.3.5 Final analysis of the thermal data shall be conducted in accordance with Practice C1045 to generate a thermal conductivity versus temperature relationship for the specimen.

12.3.6 Final step of Practice C1045 analysis would be to calculate the thermal conductivity using the equations generated at a set of mean temperatures for comparison to the specification.**Warning—** While it is recommended that the specification data be presented as thermal conductivity versus temperature, several existing specifications may contain mean temperature data from tests conducted at specific hot and cold surface temperatures. In these cases, the conductivity as a function of temperature from the Practice C1045 analysis may provide different results. To ensure that the data is compatible, a Practice C680 analysis, using the thermal conductivity versus temperature relationship from Practice C1045 and the specific hot and cold surface temperatures, is required to determine the effective thermal conductivity for comparison to the specification requirements.

12.4 *Compressive Resistance*—Test 2-in. (51-mm) thick material in accordance with Test Method C165. Pre-load the horizontal loading surface with 2.5-lb/ft^2 (0.12-kPa) weight before measuring thickness.

NOTE 1—At conditions above 450°F (232°C) hot surface temperatures, the compressive resistance of the installed insulation material may decrease. Contact the manufacturer for reduced compression resistances at maximum temperature conditions.

12.5 *Linear Shrinkage*—Test in accordance with Test Method C356 except use a 6-in. (152-mm) by 12-in. (305-mm) by single layered product thickness test specimen and measure the linear shrinkage in the 12-in. dimension.

12.6 *Water Vapor Sorption*—Test in accordance with Test Method C1104/C1104M.

TABLE 3 Maximum Density for Design Purposes Only

	Type IA	Type IB	Type II	Type III	Type IVA	Type IVB	Type V
Maximum density, lb/ft^3 (kg/m^3), for weight design purposes only	8 (128)	8 (128)	8 (128)	10 (160)	12 (192)	12 (192)	20 (320)

12.7 *Surface Burning Characteristics*—Test in accordance with Test Method E84. For Canada, test in accordance with Test Method CAN/ULC-S102. When the referenced Canadian document in this specification is referred to in applicable Canadian building codes, the editions, referenced by those building codes, shall govern. Test with facing and adhesive in place, if facing is intended to be the end product.

12.8 *Odor Emission*—Test in accordance with the odor emission test of Test Method C1304.

12.9 *Corrosiveness to Steel*—Test in accordance with the corrosiveness test of Specification C665 or Practice C1617.

12.10 *Stress Corrosion Performance for Use on Austenitic Stainless Steel*—When requested, test in accordance with Specification C795. All test specimens must include the facing and adhesive if intended to be the end product.

12.11 *Rigidity or Semi-rigidity*—Test in accordance with Test Method C1101/C1101M for semi-rigidity and rigidity only. A product that sags more than ½ in. (13 mm) and not remain supported between the two ½-in. NPS iron pipes for a minimum period of 5 min, the test for rigidity or semi-rigidity has failed and the product is rejected.

12.12 *Fungi Resistance*—Test in accordance with Test Method C1338.

13. Inspection

13.1 The following requirements are employed for purposes of acceptance sampling of lots or shipments of qualified insulation.

13.1.1 Dimensional tolerance.

13.1.2 Workmanship.

14. Rejection

14.1 Failure to conform to the requirements in this specification shall constitute cause for rejection. Rejection shall be reported to the manufacturer or the seller promptly and in writing. The manufacturer and supplier have the right to verify rejected products.

15. Certification

15.1 When specified in the purchase order or contract, the purchaser shall be furnished certification that samples representing each lot have been either tested or inspected as directed in this specification and the requirements have been met. When specified in the purchase order or contract, a report of the test results shall be furnished.

16. Packaging and Package Marking

16.1 *Packaging*—Unless otherwise specified, the insulation shall be packed in the standard commercial container provided by the manufacturer.

16.2 *Marking*—Unless otherwise specified, each container shall be marked with the name and address of the manufacturer, the product name, quantity, nominal dimensions, and the manufacturer lot or date code identification for the material in the container. When specified in the purchase order or contract, each container shall also be marked with appropriate specification alphanumeric number, type, category, and grade when applicable.

17. Keywords

17.1 block; board; high temperature; mineral fiber insulation; rock fiber; shot; shot content; slag fiber