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## Standard Specification for Mineral Fiber Block and Board Thermal Insulation<sup>1</sup>

This standard is issued under the fixed designation C 612; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

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

### 1. Scope

1.1 This specification covers the classification, composition, dimension, and physical properties of mineral fiber (rock, slag, or glass) semirigid and rigid board insulation for the use on cooled surfaces and on heated surfaces up to 1800°F (982°C). For specific applications, the maximum and minimum temperature limits shall be agreed upon between the supplier and the purchaser.

1.2 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 principal large surface (face).

1.3 For satisfactory performance, properly installed protective vapor retarders must be used in low-temperature (below ambient) applications to prevent movement of water vapor through or around the insulation towards the colder surface.

1.4 The values stated in inch-pound units are to be regarded as the standard. The SI equivalents of inch-pound units are given in parentheses for information only and may be approximate.

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 and health practices and determine the applicability of regulatory limitations prior to use.*

### 2. Referenced Documents

2.1 *ASTM Standards:*

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<sup>1</sup> This specification is under the jurisdiction of ASTM Committee C-16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.20 on Homogeneous Inorganic Thermal Insulation.

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- C 165 Test Method for Measuring Compressive Properties of Thermal Insulations<sup>2</sup>
- C 168 Terminology Relating to Thermal Insulating Materials<sup>2</sup>
- C 177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus<sup>2</sup>
- C 303 Test Method for Density of Preformed Block-Type Thermal Insulations<sup>2</sup>
- C 356 Test Method for Linear Shrinkage of Preformed High-Temperature Thermal Insulation Subjected to Soaking Heat<sup>2</sup>
- C 390 Criteria for Sampling and Acceptance of Preformed Thermal Insulation Lots<sup>2</sup>
- C 411 Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation<sup>2</sup>
- C 447 Practice for Estimating the Maximum Use Temperature of Thermal Insulations<sup>2</sup>
- C 518 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by means of the Heat Flow Meter Apparatus<sup>2</sup>
- C 665 Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing<sup>2</sup>
- C 680 Practice for Determination of Heat Gain or Loss and the Surface Temperatures of Insulated Pipe and Equipment Systems by the Use of a Computer Program<sup>2</sup>
- C 795 Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel<sup>2</sup>
- C 1045 Practice for Calculating Thermal Transmission Properties Under Steady-State Conditions<sup>2</sup>
- C 1058 Practice for Selecting Temperatures for Evaluating and Reporting Thermal Properties of Thermal Insulation<sup>2</sup>
- C 1101/C 1101M Test Methods for Classifying the Flexibility or Rigidity of Mineral Fiber Blanket and Board Insulation<sup>2</sup>
- C 1104/C 1104M Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation<sup>2</sup>
- C 1114 Test Method for Steady-State Thermal Transmission Properties by Means of the Thin-Heater Apparatus<sup>2</sup>
- C 1136 Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation<sup>2</sup>
- C 1304 Test Method for Assessing the Odor Emission of Thermal Insulation Materials<sup>2</sup>
- C 1335 Test Method for Measuring the Non-Fibrous Content of Man-Made Rock and Slag Mineral Fiber Insulation<sup>2</sup>
- E 84 Test Method for Surface Burning Characteristics of Building Materials<sup>3</sup>

## 2.2 Other Referenced Documents:

CAN/ULC-S102–M88 Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies<sup>4</sup>

### 3. Terminology

3.1 For definitions used in this specification see Terminology C 168.

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*—for the purposes of this specification, as that material which cannot be brushed or mechanically shaken through No. 100 (150- $\mu$ m) sieve.

### 4. Classification

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

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.

### 5. Ordering Information

5.1 The type, category, and dimensions shall be specified by the purchaser.

### 6. Materials and Manufacture

6.1 *Composition*—Mineral fiber block and semirigid 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 binder, 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.

**Caution: requirements. (Warning—The user is advised that the maximum use temperature of facings and adhesives may be lower than the maximum use temperature of the insulation. The user shall ensure that sufficient thickness shall be**

<sup>2</sup> Annual Book of ASTM Standards, Vol 04.06.

<sup>3</sup> Annual Book of ASTM Standards, Vol 04.07.

<sup>4</sup> Available from Underwriters Laboratories of Canada, 7 Crouse Road, Scarborough, Ontario, Canada M1R 3A9.

**TABLE 1 Physical Property Requirements<sup>A</sup>**

Properties	Type IA	Type IB	Type II	Type III	Type IVA	Type IVB	Type V
Maximum use temperature <sup>B</sup> F (°C)	450 (232)	450 (232)	850 (454)	1000 (538)	1200 (649)	1200 (649)	1800 (982)
Apparent thermal conductivity, max, Btu in./h ft <sup>2</sup> °F (W/m K)							
Mean temperatures °F (°C)							
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)	
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)	
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)	0.35 (0.050)
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)	0.42 (0.061)
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)	0.64 (0.092)
600 (316)				0.90 (0.130)	0.85 (0.123)	0.63 (0.091)	0.72 (0.104)
700 (371)					1.00 (0.144)	0.75 (0.108)	0.79 (0.114)
800 (427)							0.95 (0.137)
Category I			no compressive resistance requirement				
Category 2	N. A. <sup>C</sup>	25 (1.2)	25 (1.2)	12 (0.6)	50 (2.4)	50 (2.4)	1000 (48)
Minimum Compressive resistance at 10 % deformation, min, lb/ft <sup>2</sup> (kPa)							
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

<sup>A</sup> Refer to Section 7 for additional physical property requirements.

<sup>B</sup>See **Caution** in 6.2.1.

<sup>C</sup>N. A. indicates not applicable.

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 C 1136.

6.2.3 Typical facings are as follows:

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

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

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

## 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.

7.2 *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 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.

**Caution: 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.)**

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

7.5 *Semirigid 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 semirigid 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 30 % by weight as defined in 12.2. Type V products usually contain other ingredients which invalidates the way shot content can be determined. Non-fibrous content is not applicable to glass mineral fiber products.

7.7 *Maximum Use Temperature*—When tested in accordance with 10.1, 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*—When tested in accordance with 10.1, the midpoint 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.

## 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.

## 9. Dimensions, Mass, and Permissible Variations

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

9.2 The maximum density (determined in accordance with Test Method C 303) 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 service qualities.

## 11. Sampling

11.1 Inspection and qualification shall be in accordance with Criteria C 390. Other provisions for sampling can be agreed upon between the purchaser, seller, and the manufacturer.

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 C 411 and the hot surface performance of Practice C 447 at the insulation’s maximum use temperature and at the manufacturer’s maximum recommended thickness. The test surface shall be at the intended surface temperature when testing begins. No special requirements for heat-up shall be specified by the manufacturer.

12.2 *Non-Fibrous (Shot) Content of Inorganic Fibrous Thermal Insulation*—Test in accordance with Test Method C 1335.

12.3 *Apparent Thermal Conductivity:*

12.3.1 Determine the thermal conductivity as a function of temperature for the representative specimens with data obtained from a series of thermal tests utilizing Test Methods C 177, C 518, or C 1114 as appropriate for the material under study. Test the specimen unfaced and at a maximum thickness of 2 in. (51 mm).

12.3.1.1 Test Method C 518 shall not be used at temperatures or resistances other than those in the range of the calibration.

12.3.1.2 Test Method C 1114 shall not be used at temperatures or resistance ranges other than those with comparable results to Test Method C 177.

12.3.2 The test method selected shall have proven correlation with Test Method C 177 over the temperature range of conditions used. In cases of dispute, Test Method C 177 shall be considered as the final authority for material having flat geometry.

12.3.3 Practice C 1058 may be used to obtain recommended test temperature combinations for testing purposes.

12.3.4 As specified in Practice C 1045, 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. Additional tests, at least two additional, shall be distributed somewhat evenly over the rest of the temperature range.

**TABLE 2 Standard Sizes and Tolerances<sup>A</sup>**

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)

<sup>A</sup>Other sizes available upon request.

**TABLE 3 Maximum Density for Design**

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

12.3.5 Conduct the final analysis of the thermal data in accordance with Practice C 1045 to generate a thermal conductivity versus temperature relationship for the specimen.

12.3.6 The final step of Practice C 1045 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 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 C 1045 analysis may provide different results. To ensure that the data is compatible, a Practice C 680 analysis, using the conductivity versus temperature relationship from Practice C 1045 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 C 165. Pre-load the horizontal loading surface with 2.5-lb/ft<sup>2</sup> (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 C 356 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 C 1104/C 1104M.

12.7 *Surface Burning Characteristics*—Test in accordance with Test Method E 84. For Canada, test in accordance with Test Method CAN/ULC-S102–M88. 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 C 1304.

12.9 *Corrosiveness to Steel*—Test in accordance with the corrosiveness test of Specification C 665.

12.10 *Stress Corrosion Performance for Use on Austenitic Stainless Steel*—When requested, test in accordance with Specification C 795. All test specimens must include the facing and adhesive if intended to be the end product.

12.11 *Rigidity or Semirigidity*—Test in accordance with Test Method C 1101/C 1101M for semirigidity and rigidity only. Should the product sag 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 semirigidity has failed and the product is rejected.

### 13. Inspection

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

13.1.1 Dimensional tolerance.

13.1.2 Workmanship.

### 14. Rejection

14.1 Material that fails to conform to the requirements of this specification may be rejected. Rejection should 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 manufacturer’s standard commercial container.

16.2 *Marking*—Unless otherwise specified, each container shall be marked with the manufacturer’s name and address, the product name, quantity, nominal dimensions, and the manufacturer’s 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, and category.

### 17. Keywords

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

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