



Designation: C553 – 13

## Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications<sup>1</sup>

This standard is issued under the fixed designation C553; 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, physical properties, and dimensions of mineral fiber (rock, slag, or glass) blanket intended for use as thermal insulation on surfaces operating at temperatures between 0°F (-18°C) and 1200°F (649°C). For specific applications, the actual temperature limits shall be agreed upon between the supplier and the purchaser.

1.2 The orientation of the fibers within the blanket 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).

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

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 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:<sup>2</sup>

- C167 Test Methods for Thickness and Density of Blanket or Batt 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
- 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
- C1104/C1104M Test Method for Determining the Water

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto: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<sup>A</sup>**

Properties	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII
Maximum Use Temperature °F (°C) See Paragraph 6.2.1 - Note 1	Up to 450 (232)	Up to 450 (232)	Up to 450 (232)	Up to 850 (454)	Up to 1000 (538)	Up to 1000 (538)	Up to 1200 (649)
Apparent Thermal Conductivity Max. Btu-in./h-ft <sup>2</sup> -°F (W/m-K)							
Mean Temperatures							
°F (°C)							
25 (-4)	0.35 (0.051)	0.30 (0.043)	0.25 (0.036)	0.24 (0.035)	0.30 (0.043)	0.25 (0.036)	0.24 (0.035)
75 (24)	0.36 (0.052)	0.31 (0.045)	0.26 (0.038)	0.25 (0.036)	0.31 (0.045)	0.26 (0.038)	0.25 (0.036)
100 (38)	0.39 (0.056)	0.33 (0.048)	0.28 (0.040)	0.27 (0.039)	0.33 (0.048)	0.28 (0.040)	0.27 (0.039)
200 (93)	0.55 (0.079)	0.44 (0.063)	0.36 (0.052)	0.34 (0.049)	0.44 (0.063)	0.36 (0.052)	0.34 (0.049)
300 (149)	0.76 (0.110)	0.60 (0.087)	0.46 (0.066)	0.43 (0.062)	0.60 (0.087)	0.46 (0.066)	0.43 (0.062)
400 (204)				0.55 (0.079)	0.89 (0.128)	0.60 (0.087)	0.55 (0.079)
500 (260)				0.70 (0.101)	1.10 (0.159)	0.80 (0.115)	0.70 (0.101)
600 (316)					1.50 (0.216)	1.05 (0.151)	0.89 (0.128)
700 (371)							1.13 (0.163)
Water Vapor Sorption <sup>B</sup> % by Weight, 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 Index, max	50	50	50	50	50	50	50

<sup>A</sup>Additional physical property requirements, refer to Section 7.

<sup>B</sup>It is possible that water sorption characteristics will change after the product is subject to elevated temperatures within normal service conditions.

#### Vapor Sorption of Unfaced Mineral Fiber Insulation

**C1114** Test Method for Steady-State Thermal Transmission Properties by Means of the Thin-Heater Apparatus

**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 Documents:

**CAN/ULC-S102** Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies<sup>3</sup>

### 3. Terminology

3.1 *Definitions*—For definitions used in this specification, refer to Terminology **C168**.

#### 3.2 Definitions of Terms Specific to This Standard:

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

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

### 4. Classification

4.1 Mineral fiber blanket insulation covered by this specification shall be classified into seven types shown in **Table 1**.

The classification is based upon the maximum use temperature and apparent thermal conductivity of the insulations.

### 5. Ordering Information

5.1 The type, dimensions, maximum use temperature, and facing shall be specified by the purchaser. A product certification (if required) shall be specified in the purchase order.

### 6. Materials and Manufacture

6.1 *Composition*—Mineral fiber blanket insulation shall be composed of rock, slag, or glass processed from the molten state into fibrous form 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 facing, and if faced, shall specify the type and its requirements.

NOTE 1—The user of this specification is advised that the maximum use temperature of facing and adhesives may be lower than the maximum use temperature of the insulation. The user of this specification shall ensure that sufficient insulation thickness is installed so that none of these accessory items (facings and adhesives) are exposed to temperatures above their maximum use temperature. Practice **C680** can be used to determine surface temperatures.

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

6.2.3 Typical facing is as follows (others are available):

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

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

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

6.2.3.4 Aluminum foil, and

<sup>3</sup> Available from Underwriters Laboratories (UL), 2600 N.W. Lake Rd., Camas, WA 98607-8542, <http://www.ul.com>.



### 6.2.3.5 Vinyl film.

## 7. Physical Property Requirements

7.1 The insulation shall be classified as flexible, when tested in accordance with 11.7.

7.2 The insulation type shall conform to the following requirements in Table 1:

7.2.1 *Apparent Thermal Conductivity*—Test in accordance with 11.2.

7.2.2 *Maximum Use Temperature*—Test in accordance with 11.3.

7.2.3 *Surface Burning Characteristics*—Test in accordance with 11.4.

7.2.4 *Water Vapor Sorption*—Test in accordance with 11.8.

7.3 *Odor Emission*—A detectable odor of objectionable nature recorded by more than two of the five panel members shall constitute rejection of the material when tested in accordance with 11.5.

7.4 *Corrosiveness to Steel*—When tested and evaluated in accordance with Specification C665 in 11.6, any corrosion resulting from the unfaced insulation in contact with steel plates shall be judged to be no greater than for comparative plates in contact with sterile cotton.

7.4.1 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.

NOTE 2—There are facing adhesives that can cause corrosion to steel when in contact with water or water vapor and the steel. Currently, there is no test method available to satisfy every potential corrosion application.

7.5 *Non-Fibrous (Shot) Content*—The averaged maximum shot content of rock or slag mineral fiber products, Types I through VII as shown in Table 1, shall not exceed 25 % by weight as defined in 11.1. Non-fibrous content is not applicable to glass mineral fiber products.

7.6 *Maximum Use Temperature*—Shall be tested in accordance with 11.3, the insulation with facing shall not warp, flame or glow during hot surface exposure. No evidence of melting or fiber degradation shall be evident upon post-test inspection.

7.7 *Maximum Exothermic Temperature Rise*—Shall be tested in accordance with 11.3, the internal temperature shall not at any point in time exceed the hot surface temperature by more than 200°F (111°C). The 200°F (111°C) criterion applies during heat-up as well as steady state conditions. Exceeding this limit shall constitute non-compliance to specification and rejection.

7.8 *Stress Corrosion to Austenitic Stainless Steel*—When specified, shall be tested and evaluated in accordance with 11.9.

7.9 *Fungi Resistance*—Shall be tested in accordance with 11.10; growth no greater than that on a comparative item (white birch wood) shall be considered to have passed the test method criteria.

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

Mineral Fiber Blanket		
	Sizes	Tolerances
Length		
Rolls	50 ft. (15 m)	−0 in., excess permitted
	75 ft. (23 m)	
	100 ft. (30 m)	
	150 ft. (48 m)	
	200 ft. (61 m)	
Blanket	24 in. (610 mm)	±½ in. (12.7 mm)
	36 in. (914 mm)	
	48 in. (1219 mm)	
	96 in. (2438 mm)	
Width		
Rolls	24 in. (610 mm)	±½ in. (12.7 mm)
	48 in. (1219 mm)	
	96 in. (2438 mm)	
Blanket	12 in. (305 mm)	±½ in. (12.7 mm)
	24 in. (610 mm)	
	36 in. (914 mm)	
	48 in. (1219 mm)	
Thickness		
	1 in. (25.4 mm) to 6 in. (152 mm) in ½ in. (12.7 mm) increments	−⅛ in. (3.2 mm) excess permitted

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

## 8. Dimensions and Permissible Variations

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

8.2 The maximum density (determined in accordance with Test Method C167) specified in Table 3 for Type(s) I through Type VII are for weight design purposes only.

## 9. Workmanship

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

## 10. Sampling

10.1 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 upon between the purchaser and the supplier.

## 11. Test Methods

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

11.2 *Apparent Thermal Conductivity*:

11.2.1 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.



**TABLE 3 Maximum Density for Weight Design Purposes Only**

	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII
Maximum density, lb/ft <sup>3</sup> (kg/m <sup>3</sup> ), for weight design purposes only	6.0 (96)	6.0 (96)	6.0 (96)	8.0 (128)	10 (160)	10 (160)	12 (192)

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

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

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

11.2.3 Practice **C1058** shall be used to obtain recommended test temperature combinations for testing purposes.

11.2.4 As specified in **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. Additional tests, at least two additional, shall be distributed somewhat evenly over the rest of the temperature range.

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

11.2.6 Final step of **C1045** analysis would be to calculate the thermal conductivity using the equations generated at a set of mean temperatures for comparison to the specification.

11.2.6.1 While it is recommended that the specification data be presented as conductivity versus temperature, several existing specifications shall 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 **C1045** analysis may provide different results. To insure that the data is compatible, a **C680** analysis, using the conductivity versus temperature relationship from **C1045** and the specific hot and cold surface temperatures, is required to determine the effective thermal conductivity for comparison to the specification requirements.)

11.3 *Maximum Use Temperature and Exothermic Temperature Rise*—Shall be tested in accordance with Test Method **C411** and the hot surface performance section of Practice **C447** at the manufacturer's maximum recommend thickness for each temperature. The test surface shall be at the intended surface temperature when test begins. No special requirements for heat-up shall be specified by the manufacturer to qualify product compliance with either maximum use temperature or maximum exothermic temperature rise.

11.4 *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 on the end product.

11.5 *Odor Emission*—Test in accordance with Test Method **C1304**.

11.6 *Corrosion to Steel*—Test in accordance with the corrosiveness method of Specification **C665** or Practice **C1617**.

11.7 *Flexibility and Rigidity*—Test in accordance with Test Method **C1101/C1101M** (except use 1 in. (25.4 mm) thick material) for classifying the flexibility of mineral fiber blanket insulation.

11.8 *Water Vapor Sorption*—Test in accordance with Test Method **C1104/C1104M** for determining the water vapor sorption of unfaced mineral fiber insulation.

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

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

## 12. Qualification Requirements

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

- 12.1.1 Flexibility,
- 12.1.2 Maximum use temperature,
- 12.1.3 Apparent thermal conductivity,
- 12.1.4 Water vapor sorption,
- 12.1.5 Odor emission,
- 12.1.6 Surface burning characteristics,
- 12.1.7 Corrosiveness,
- 12.1.8 Shot content, and
- 12.1.9 Fungi resistance

## 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 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 packaged in standard commercial containers from the manufacturer.

16.2 *Markings*—Unless otherwise specified, each container shall be plainly marked with the name of the manufacturer, the address of the manufacturer, the product name, type, quantity, nominal dimensions, facings, and lot date identification from the manufacturer for the material in the container.

16.3 When specified in the purchase order or contract, each container shall also be marked with the appropriate Specification alphanumeric number and type.

## 17. Keywords

17.1 blanket; glass fiber; high temperature; mineral fiber insulation; rock fiber; shot; shot content; slag fiber

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