



Designation: C892 – 17

# Standard Specification for High-Temperature Fiber Blanket Thermal Insulation<sup>1</sup>

This standard is issued under the fixed designation C892; 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 reappraisal. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

## 1. Scope

1.1 This specification covers high-temperature fiber blanket thermal insulation for use from ambient up to 3000°F (1649°C).

1.2 When the potential exists that the installation or use of thermal insulation materials, accessories, and systems will pose safety or health problems, the manufacturers shall provide the user with appropriate current information regarding any known problems associated with the recommended use of the products, and shall also recommend protective measures to be employed in their safe utilization. The user shall establish appropriate safety and health practices and determine the applicability of regulatory requirements prior to use.

1.3 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are mathematical conversions to SI units which 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *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:*<sup>2</sup>

C71 Terminology Relating to Refractories

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

C201 Test Method for Thermal Conductivity of Refractories

C209 Test Methods for Cellulosic Fiber Insulating Board

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

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

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 Vapor Sorption of Unfaced Mineral Fiber Insulation

C1335 Test Method for Measuring Non-Fibrous Content of Man-Made Rock and Slag Mineral Fiber Insulation

## 3. Terminology

3.1 *Definitions*—Terminology C71 and Terminology C168 shall be considered as applying to the terms used in this standard.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *fibers*—the fibers shall be refractory oxides, processed from a molten state into fibrous form.

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee C16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.23 on Blanket and Loose Fill Insulation.

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<sup>2</sup> 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.

3.2.2 *high-temperature fiber thermal insulation*—a thermal insulation, varying in flexibility, composed of refractory inorganic fibers, with or without binder added, and furnished in either flat sheets or rolls.

#### 4. Classification

4.1 The general-type product governed by this specification is blanket or batt composed of inorganic refractory fibers.

4.2 *Types*—The product is separated into types based upon temperatures of use (Table 1).

4.3 *Grades*—The product is separated into grades based upon its maximum Apparent Thermal Conductivity values (see Table 2) and minimum Tensile Strength values (see Table 3).

#### 5. Ordering Information

5.1 High-temperature fiber blanket thermal insulation is normally purchased on the basis of brand name, type, grade, length, width, thickness, and total square footage as specified in the purchase order.

5.2 The type and grade for the intended service shall be as specified by the user with the assistance of the supplier where desirable.

5.3 The purchaser shall be permitted to specify, inspect and sample the material.

5.4 When a certification or test report, or both, is required, this shall be specified by the purchaser.

#### 6. Materials and Manufacture

6.1 *Composition*—High temperature fiber thermal insulation shall be composed of fibers, made of metallic oxides of, but not limited to, silicon, aluminum, calcium, and magnesium. The raw materials, processed from the molten state into spun fibers, are then mechanically interlocked through a needling process into insulation blanket felts with out the use of chemical binders.

#### 7. Physical and Mechanical, and Chemical Properties Requirements

7.1 *Apparent Thermal Conductivity* shall conform to the requirements of Table 2 when tested in accordance with 11.1.2.

7.2 *Tensile Strength*—shall conform to the requirements of Table 3 when tested in accordance with 11.1.5.

7.3 *Flexibility*—shall be classified as flexible when tested in accordance with 11.1.8.

7.4 *Maximum Use Temperature*—shall conform to the requirements of 4.2 when tested in accordance with 11.1.4.

7.5 *Non-fibrous content (shot)*—shall be limited to a maximum of 30% by weight when testing in accordance with 11.1.3.

7.6 *Linear Shrinkage*—shall be limited to a maximum of 5%, after exposure to the Maximum Use Temperature, in accordance with 11.1.4.

#### 8. Dimensions, Mass, and Permissible Variations

8.1 Rolls or flat sheets of blanket are normally furnished in standard dimensions as shown in Table 4, Table 5, and Table 6.

8.2 The standard length, width, and thickness combinations available are a function of the type and grade. Contact the supplier for information on standard or non-standard dimension and combinations.

8.3 The maximum density (determined in accordance with Test Method C167) specified in Table 4 for Grades 3, 4, 6, 8, 10, and 12 are for weight design purposes only.

#### 9. Workmanship, Finish, and Appearance

9.1 The insulation shall indicate good workmanship in fabrication by a uniform appearance, shall not have visible defects such as tears and holes that will adversely affect the service quality, and shall be free from foreign materials.

#### 10. Sampling

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

#### 11. Test Methods

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

11.1.1 *Dimensional Measurement and Density*—Test Methods C167. Density is based on nominal thickness.

11.1.2 *Apparent Thermal Conductivity*—Test in accordance with Test Method C177 or C201 (modified by the procedure shown in Annex A1).

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

11.1.2.2 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. The exception to this requirement is given in 11.1.2.2(1) below. At least two additional tests shall be distributed somewhat evenly over the rest of the temperature range.

(1) In cases where the maximum temperature of the C177 test device is exceeded by the required hot surface temperature as stipulated in 11.1.2.2, it is acceptable to operate one hot plate at the C177 upper temperature limit and the other hot plate at the lower temperature that gives the target mean temperature.

11.1.2.3 Final analysis of the thermal data shall be conducted in accordance with Practice C1045 to generate a

**TABLE 1 Classification by Type**

Type	Temperature of use, °F (°C), maximum
I	1350 (732)
II	1600 (871)
IIA	2000 (1093)
III	2300 (1260)
IV	2600 (1427)
V	3000 (1649)

**TABLE 2 Apparent Thermal Conductivity, maximum Btu in./h-ft<sup>2</sup>-F (W/m-K) at Mean Temperature, °F (°C)**

Grade	75 (24)	200 (93)	400 (204)	800 (427)	1200 (649)	1600 (871)	2000 (1093)
3	0.52 (0.075)	0.56 (0.081)	0.73 (.105)	1.32 (.190)	2.42 (.348)	4.05 (.583)	5.94 (.855)
4	0.50 (0.072)	0.54 (0.078)	0.68 (0.098)	1.13 (.163)	2.15 (.349)	3.53 (.508)	5.47 (.787)
6	0.42 (0.060)	0.47 (0.068)	0.59 (0.086)	1.03 (.149)	1.91 (.276)	3.06 (.440)	4.75 (.604)
8	0.41 (0.059)	0.46 (0.066)	0.56 (0.081)	1.01 (.146)	1.67 (.241)	2.60 (.374)	4.18 (.682)
10	0.40 (0.058)	0.45 (0.065)	0.55 (0.079)	0.98 (.141)	1.61 (.231)	2.31 (.333)	3.63 (.523)
12	0.37 (0.053)	0.43 (0.062)	0.53 (0.076)	0.96 (.138)	1.43 (.206)	2.11 (.304)	3.14 (.451)

**TABLE 3 Tensile Strength, Minimum**

Grade	Tensile Strength, lb/in. <sup>2</sup> (KPa)
3	1.0 (6.9)
4	1.5 (10.3)
6	2.0 (13.8)
8	3.0 (20.7)
10	4.0 (27.6)
12	5.0 (34.5)

**TABLE 4 Density, Maximum and Minimum**

Grade	Minimum Density, lbs/ft. <sup>3</sup> (kg/m <sup>3</sup> ) <sup>A</sup>	Maximum Density, lbs/ft. <sup>3</sup> (kg/m <sup>3</sup> ) <sup>B</sup>
3	2.5 (41)	4 (64)
4	3.4 (54)	5.5 (88)
6	5.1 (82)	8 (128)
8	6.8 (109)	10.5 (168)
10	8.5 (136)	13 (208)
12	10.2 (163)	16 (256)

<sup>A</sup> Minimum density limitations is for the purpose of maintaining structural properties.

<sup>B</sup> Maximum density limitations are for the purpose of providing design information for stress analyses of pipe and equipment.

**TABLE 5 Thickness Dimensions**

Thickness, in. (mm)	Tolerance
1/16 (1.6)	+ 1/32, -1/64 in. (+0.8, -0.4mm)
1/8 (3.2)	+ 1/16, -1/32 in. (+1.6, -0.8mm)
3/16 (4.8)	+ 3/32, -3/64 in. (+2.4, -1.2mm)
1/4 (6.4)	+1/4, -1/8 in. (+6.4, -3.2 mm)
3/8 (9.5)	+3/8, -1/8 in. (+9.5, -3.2 mm)
1/2 (12.7)	+1/2, -1/8 in. (+12.7, -3.2 mm)
3/4 (19.1)	+3/4, -1/8 in. (+19.1, -3.2 mm)
1 (25.4)	+3/4, -1/8 in. (+19.1, -3.2 mm)
1 1/2 (38.1)	+3/4, -1/8 in. (+19.1, -3.2 mm)
2 (51.0)	+3/4, -1/4 in. (+19.6, -6.4 mm)

**TABLE 6 Width Dimensions**

Width, in. (mm)	Tolerance, %
12 (305)	-2, +10
18 (457)	-2, +10
24 (610)	-2, +10
36 (914)	-2, +10
39 (991)	-2, +10
42 (1067)	-2, +10
48 (1219)	-2, +10
72 (1829)	-2, +10

thermal conductivity versus mean temperature relationship for the specimen. Practice C1045 and the specific hot and cold surface temperatures is required to determine the effective thermal conductivity for comparison to the specification requirements.

**TABLE 7 Length Dimensions**

Length, in. (mm)	Tolerance <sup>A</sup>
36 (914)	-0
48 (1219)	-0
84 (2134)	-0
96 (2438)	-0
144 (3658)	-0
150 (3810)	-0
180 (4572)	-0
288 (7315)	-0
300 (7620)	-0
312 (7925)	-0
600 (15240)	-0

<sup>A</sup> Not limited—excess is permitted.

11.1.2.4 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.

(I) While it is recommended that the specification data be presented as conductivity versus temperature, it is possible that several existing specifications will contain mean temperature data from tests conducted at specific hot and cold surface temperatures. In these cases, it is possible that the conductivity will be a as a function of temperature and that the Practice C1045 analysis will provide different results. To ensure that the data is compatible, a Practice C680 analysis, using the 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.

11.1.3 *Non-Fibrous Content (Shot)*—Test Method C1335 Procedure B, with the following exceptions.

11.1.3.1 Use U.S. Standard Sieves No. 30, 50, and 70. The specimen shall first be fired in a furnace at the maximum use temperature for the particular Type for a duration of 5h. After passing all particles and fine fiber through Sieve No. 50, mechanically shake Sieve No. 70 for 30 min.

11.1.3.2 For the purposes of this specification, the non—fibrous content (that is, shot) are those not passing through a U.S. Standard No. 70 sieve (210 µm opening). The shot content is the cumulative weight of shot remaining on 30-, 50-, and 70-mesh screens.

11.1.4 *Linear Shrinkage and Temperature of Use*—Test Method C356, except that dimensions shall be determined by Test Methods C167. The temperature of test shall be the temperature of use, as specified in 4.2.

11.1.5 *Tensile Strength*—Test Methods C209, Section 12 (parallel to surface), except that rate of separation of the jaws shall be 1 to 2 in./min (25 to 50 mm/min).