



Designation: C665 – 23

# Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing<sup>1</sup>

This standard is issued under the fixed designation C665; 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 U.S. Department of Defense.*

## 1. Scope

1.1 This specification covers the composition and physical properties of mineral-fiber blanket insulation used to thermally or acoustically insulate ceilings, floors, and walls in light frame construction and manufactured housing. The requirements cover fibrous blankets and facings. Values for water-vapor permeance of facings are suggested for information that will be helpful to designers and installers.

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:*<sup>2</sup>

**B152/B152M** Specification for Copper Sheet, Strip, Plate, and Rolled Bar

**C167** Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations

**C168** Terminology Relating to Thermal Insulation

<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.

**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

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

**C653** Guide for Determination of the Thermal Resistance of Low-Density Blanket-Type Mineral Fiber Insulation

**C1104/C1104M** Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation

**C1304** Test Method for Assessing the Odor Emission of Thermal Insulation Materials

**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

**E96/E96M** Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials

**E970** Test Method for Critical Radiant Flux of Exposed Attic Floor Insulation Using a Radiant Heat Energy Source

**G1** Practice for Preparing, Cleaning, and Evaluating Corrosion Test Specimens

## 3. Terminology

3.1 *Definitions*—For definitions of terms used in this specification, see Terminology **C168**.

## 4. Classification

4.1 Typical mineral-fiber thermal insulation is classified into the following types, classes, and categories:

4.1.1 *Type I*—Blankets without facings.

4.1.2 *Type II*—Blankets with nonreflective facings.

4.1.2.1 *Class A*—Facing with a flame spread index of 25 or less.

(1) *Category 1*—Facing is a vapor retarder.

(2) *Category 2*—Facing is not a vapor retarder.

4.1.2.2 *Class B*—Facing with a flame propagation resistance; critical radiant flux of 0.12 W/cm<sup>2</sup> (.11 Btu/ft<sup>2</sup>·s) or greater.

(1) *Category 1*—Facing is a vapor retarder.

(2) *Category 2*—Facing is not a vapor retarder.

4.1.2.3 *Class C*—Facing not rated for flame propagation resistance (for use in nonexposed applications only).

(1) *Category 1*—Facing is a vapor retarder.

(2) *Category 2*—Facing is not a vapor retarder.

4.1.3 *Type III*—Blankets with reflective facings:

4.1.3.1 *Class A*—Facing with a flame spread index of 25 or less.

(1) *Category 1*—Facing is a vapor retarder.

(2) *Category 2*—Facing is not a vapor retarder.

4.1.3.2 *Class B*—Facing with a flame propagation resistance; critical radiant flux of 0.12 W/cm<sup>2</sup> (.11 Btu/ft<sup>2</sup>·s) or greater.

(1) *Category 1*—Facing is a vapor retarder.

(2) *Category 2*—Facing is not a vapor retarder.

4.1.3.3 *Class C*—Facing not rated for flame propagation resistance (for use in nonexposed applications only).

(1) *Category 1*—Facing is a vapor retarder.

(2) *Category 2*—Facing is not a vapor retarder.

4.2 Mechanically attached field installed facing shall be classified into *Type/Class/Category* as follows:

(1) *Type I* insulation used in conjunction with a field installed non-reflective facing having a 25 flame spread or less on both sides is considered functionally equivalent to a *Type II/Class A/Category 1* insulation composite.

(2) *Type I* insulation used in conjunction with a field-installed perforated, or vapor breathable, nonreflective facing having a 25 flame spread or less on both sides is considered functionally equivalent to *Type II/Class A/Category 2* insulation composite.

(3) *Type I* insulation used in conjunction with a field-installed reflective facing (reflective side exposed) having a 25 flame spread or less on both sides is considered equivalent to a *Type III/Class A/Category 1* insulation composite.

(4) *Type I* insulation used in conjunction with a field-installed perforated, or vapor breathable, reflective facing (reflective side exposed) having a 25 flame spread or less on both sides is considered functionally equivalent to a *Type III/Class A/Category 2* insulation composite.

## 5. Ordering Information

5.1 For specific installations, thermal resistance, length, width, and facing suited to the intended use shall be specified by the purchaser.

## 6. Materials and Manufacture

6.1 *Basic Material*—The basic material shall be fibers made from mineral substances such as rock, slag, or glass processed from the molten state into a fibrous form.

6.2 *Manufacture*—Insulation blankets shall consist of flexible units composed of felted, bonded, or unbonded fibers formed into rolls or flat cut pieces (batts), with or without various adhered facings, and with or without a means for attachment of the blanket to applicable constructions.

## 7. Physical Properties

7.1 *Thermal Resistance*—The standard thermal resistance values in °F · h · ft<sup>2</sup>/Btu (K · m<sup>2</sup>/W) are: 4, 7, 11, 13, 19, 22, 30, and 38 (0.7, 1.2, 1.9, 2.3, 3.3, 3.9, 5.3, and 6.7). *R* values other than those listed shall be agreed upon between the supplier and the purchaser. The product must be produced to the label *R* value. The thermal resistance, *R*, for the average of any four randomly selected samples shall not be more than 5 % below the listed *R* value when tested in accordance with 13.2, nor shall any single specimen be more than 10 % below the listed *R* value.

### 7.2 Surface Burning Characteristics:

7.2.1 Insulation blankets exclusive of facing, when tested in accordance with Test Method E84, shall have a flame spread index no greater than 25, and a smoke developed index no greater than 50.

7.2.2 Insulation blankets with facings intended for exposed application, when tested in accordance with Test Method E84, shall have a flame spread index no greater than 25, and a smoke developed index no greater than 50.

7.3 *Critical Radiant Flux*—Insulation blankets, when tested in accordance with 13.4, shall have a critical radiant flux-flame propagation resistance  $\geq 0.12$  W/cm<sup>2</sup> (0.11 Btu/ft<sup>2</sup>·s). Blankets with facing on both surfaces, shall be tested on the surface to be left exposed and shall be marked on either surface.

7.4 *Water-Vapor Permeance*—When tested in accordance with 13.5, vapor retardant facings shall have a vapor permeance of no more than 1 perm ( $5.7 \times 10^{-11}$  kg·Pa<sup>-1</sup>·s<sup>-1</sup>·m<sup>-2</sup>) and vapor-permeable facing shall have a vapor permeance of no less than 5 perm ( $2.9 \times 10^{-10}$  kg·Pa<sup>-1</sup>·s<sup>-1</sup>·m<sup>-2</sup>).

7.5 *Water Vapor Sorption*—The water vapor sorption of the insulation without facing shall be not more than 5 % by weight, when tested in accordance with 13.6.

7.6 *Odor Emission*—A detectable odor of strong objectionable nature recorded by more than two of the five panel members shall constitute rejection of the material when tested in accordance with 13.7.

### 7.7 Corrosiveness:

7.7.1 When tested in accordance with 13.8, the metal plates in contact with the insulation shall show no corrosion greater than that observed on the comparative plates in contact with sterile cotton.

7.7.2 *Alternative test – Steel only*—When tested in accordance with 13.9, the mass loss corrosion rate of the unfaced insulation extract shall not exceed that of the 5-ppm chloride solution.

NOTE 1—The use of alternative metals such as copper and aluminum have been evaluated using Practice C1617. The task group will continue to investigate the potential for using Practice C1617 as an alternative to 7.7.1 for these metals.

NOTE 2—The pass/fail criteria established in section 7.7.2 is for materials which claim compliance with Specification C665. The corrosion procedure as detailed in 7.7.1 is referenced in multiple Mineral Fiber material standards. The use of the alternative procedure and the establishment of pass/fail criteria using section 7.7.2 should be addressed by each specific material standard.

7.8 *Fungi Resistance*—When tested in accordance with 13.10, the insulation shall have growth no greater than that observed on the white birch tongue depressor comparative item.

## 8. Other Requirements

8.1 *Qualification Requirements*—The following requirements are generally used for purposes of initial material or product qualification:

- 8.1.1 Thermal resistance,
- 8.1.2 Surface burning characteristics,
- 8.1.3 Critical radiant flux,
- 8.1.4 Water-vapor permeance,
- 8.1.5 Water vapor sorption,
- 8.1.6 Odor emission,
- 8.1.7 Corrosiveness, and
- 8.1.8 Fungi resistance.

8.2 *Inspection Requirements*—The following requirements are generally used for purposes of acceptance sampling of lots or shipments of qualified thermal insulation:

- 8.2.1 Dimensional tolerances, and
- 8.2.2 Workmanship.

## 9. Dimensions

9.1 The material shall conform to the standard dimensions and tolerances prescribed in Table 1.

## 10. Workmanship and Finish

10.1 Although all properties of the insulation blanket are not presented in this specification, it is understood that the insulation will essentially be free of defects that adversely affect thermal performance, such as local compressed areas, low density areas, tears and holes.

10.2 Although the general properties of the facings and means for attachment are not included in this specification,

they are presumed to be free of excessive tears, rips, holes, and other defects that will adversely affect their performance.

## 11. Significance and Use

11.1 This specification applies to products that are used in buildings. While products that comply with this specification are used in various constructions, they are adaptable primarily, but not exclusively, to wood frame construction.

11.2 Since the property of thermal resistance for a specific thickness of blanket is only part of the total thermal performance of a building element such as a wall, ceiling, floor, and so forth, this specification states only general classifications for thermal resistance of the fibrous blanket itself. Facings that provide additional resistance to water-vapor transfer can affect system performance.

## 12. Sampling

12.1 Sampling of the insulation shall be in accordance with Practice C390. Specific provision for sampling shall be agreed upon between the purchaser and the supplier.

## 13. Test Methods

13.1 *Dimensions*—Test in accordance with Test Methods C167.

13.2 *Thermal Resistance*:

13.2.1 Test in accordance with Test Method C177 or Test Method C518 at  $75 \pm 2^\circ\text{F}$  ( $24 \pm 1^\circ\text{C}$ ) mean temperature. If Test Method C518 is used, the manufacturer shall certify that recent calibrations have been made.

NOTE 3—See Guide C653. The thermal resistance is a function of mean temperature. As an option, determine the thermal resistance at additional mean temperatures as agreed upon by the purchaser and the manufacturer.

13.2.2 In case of question, determine referee test values in accordance with Test Method C177, with resistances reported at  $75 \pm 2^\circ\text{F}$  ( $24 \pm 1^\circ\text{C}$ ) mean temperature. The precision and bias of the apparatus used for referee tests must be verified by measuring the *R*-value of a standard reference material of light density thermal insulation obtained from the National Institute of Standards and Technology.<sup>3</sup> Determine thermal resistance at the thickness marked on the product if its measured thickness is equal to or greater than this value. Determine thermal resistance at actual thickness if less than the thickness marked on the product. Always test at a thickness within the design accuracy limits of the test apparatus. For marked thicknesses appreciably greater than apparatus design, some materials can be split and both sections tested, but this procedure is often undesirable.

13.2.3 If the blanket is furnished with adhered facings, remove the facings by a means that provides a surface equivalent to the surface that the material would have before application of the facing.

13.3 *Surface Burning Characteristics*—Determine the surface burning characteristics in accordance with Test Method E84.

<sup>3</sup> Contact National Institute of Standards and Technology (NIST), 100 Bureau Dr., Stop 3460, Gaithersburg, MD 20899-3460.

**TABLE 1 Dimensions and Tolerances<sup>A</sup>**

Element	Dimension	Tolerance
Length, in. (mm)	cut pieces up to 96 in. (2 m)	$-\frac{1}{2}$ in. (13 mm), excess permitted
	cut pieces up to 144 in. (4 m)	$-1.0$ in. (25 mm), excess permitted
	rolls over 144 in. (4 m)	$-0.5\%$ , excess permitted
Width, in. (mm)	pieces and rolls up to 24 in. (0.6 m)	$-\frac{1}{4}$ in. (6 mm), $+\frac{1}{2}$ in. (13 mm)
	rolls 24 to 144 in. (0.6 to 4 m)	$-\frac{1}{4}$ in. (6 mm), $+\frac{1}{2}$ in. (13 mm)
Thickness	as required for thermal resistance <sup>B</sup>	consistent with tolerances of thermal resistance <sup>C</sup>

<sup>A</sup> All sizes listed are not always available from all manufacturers. For sizes other than those listed, consult manufacturers.

<sup>B</sup> Thicknesses of the various mineral fiber insulations available can differ to provide rated thermal resistance. Products are generally available in a range of thicknesses from 3 to 12 in. (75 to 305 mm). Thickness required to attain a rated performance shall not exceed that of the cavity into which the material shall be installed.

<sup>C</sup> Blanket insulation manufactured to provide a designated thermal resistance are produced by varying one or more of the factors of density, thickness, or fiber characteristics. Therefore, blankets having the same designated thermal resistance but different manufacturing sources may vary in one or more of these factors.



13.4 *Critical Radiant Flux*—Determine the critical radiant flux in accordance with Test Method **E970**.

13.5 *Water-Vapor Permeance*—Test the permeance of the facing material in accordance with Test Methods **E96/E96M**, Procedure A.

13.6 *Water Vapor Sorption*—Determine the water vapor sorption of the test specimen in accordance with Test Method **C1104/C1104M**.

13.7 *Odor Emission*—Determine the Odor Emission in accordance with Test Method **C1304**.

### 13.8 *Corrosiveness:*

13.8.1 *Scope*—This method provides a qualitative measure of the corrosiveness of mineral-fiber insulation by comparison to a control.

#### 13.8.2 *Summary of Test Method:*

13.8.2.1 Individually sandwich five each of specially cleaned steel, copper, and aluminum test plates between pieces of insulation. Hold the insulation uniformly against each side of the test plate with wire screens and rubber bands.

13.8.2.2 Sandwich an equal number of cleaned metal test plates between pieces of washed sterile cotton in an identical manner.

13.8.2.3 Vertically suspend the samples in a humidity test chamber at  $95 \pm 3\%$  relative humidity and temperature of  $120 \pm 3^\circ\text{F}$  ( $49 \pm 2^\circ\text{C}$ ) for time periods determined by the type of metal being tested. Steel is tested for  $96 \pm 2$  h. Copper and aluminum are tested for  $720 \pm 5$  h.

13.8.2.4 After the appropriate test period, compare the test plates exposed to the insulation to the control plates exposed to sterile cotton for severity of corrosion. The insulation is considered to have passed this test if the corrosion attributed to the insulation is not significantly worse than that of the washed sterile cotton controls. The criterion for acceptance is predetermined through the use of non-parametric statistics and a 90 % confidence level ( $\alpha = 0.10$ ).

#### 13.8.3 *Significance and Use:*

13.8.3.1 The fiber composition and the type of binder used in the manufacture of mineral fiber insulation can sometimes create a potential for corrosion on certain metals in the presence of water or water vapor.

13.8.3.2 This method is used to determine the relative corrosion potential of mineral fiber insulation on specific metals under elevated temperature and high humidity conditions.

#### 13.8.4 *Apparatus:*

13.8.4.1 *Test Plates*—The dimensions of all metal test plates shall be 1 by  $4 \pm \frac{1}{4}$  in. ( $25$  by  $100 \pm 6.3$  mm):

(1) *Steel Plates*, shall be  $0.02 \pm 0.005$  in. ( $0.5$  mm  $\pm 0.13$  mm) thick, bright No. 2 finish, cold-rolled low-carbon strip steel, quarter hard, temper No. 3.

(2) *Aluminum Plates*, shall be  $0.025 \pm 0.005$ -in. ( $0.6 \pm 0.13$  mm) thick, Type 3003-0.

(3) *Copper Plates*, shall be  $0.032 \pm 0.005$ -in. ( $0.8 \pm 0.13$  mm) thick, in accordance with Specification **B152/B152M** Type ETP, No. 110 soft copper.

13.8.4.2 *Woven Wire Screen*,  $1\frac{1}{2} \pm \frac{1}{4}$  by  $4\frac{1}{2} \pm \frac{1}{4}$  in. ( $38 \pm 6.3$  by  $114 \pm 6.3$  mm), made of Type 304 stainless steel,

$0.063 \pm 0.005$ -in. ( $1.60 \pm 0.13$ -mm) wire,  $\frac{7}{16} \pm \frac{1}{16}$ -in. ( $11 \pm 1.6$ -mm) open-square grid.

13.8.4.3 *Rubber Bands*, No. 12.

13.8.4.4 *Humidity Test Chamber*, clean, well maintained, and capable of controlling temperature at  $120 \pm 3^\circ\text{F}$  ( $49 \pm 2^\circ\text{C}$ ), and humidity at  $95 \pm 3\%$  relative humidity.

13.8.5 *Test Specimens*—Two pieces of the material to be tested shall comprise one specimen. Each piece shall measure  $1\frac{1}{2} \pm \frac{1}{4}$  by  $4\frac{1}{2} \pm \frac{1}{4}$  in. ( $38 \pm 6.3$  by  $114 \pm 6.3$  mm) by  $\frac{1}{2} \pm \frac{1}{8}$  in. ( $13 \pm 3.2$  mm) thick, when compressed against the metal test plates. As a guideline, cut board type insulations to a thickness of  $\frac{1}{2} \pm \frac{1}{16}$  in. ( $12.7 \pm 1.6$  mm); cut blanket type insulations to a thickness of  $1 \pm \frac{1}{16}$  in. ( $25.4 \pm 1.6$  mm). For each type of metal tested, make five specimens out of test insulation and five control specimens out of washed sterile cotton.

#### 13.8.6 *Test Method:*

13.8.6.1 Clean the metal test plates until the surface is free of water breaks. Take care to avoid excessive handling of the surfaces of the metal plates. Do not touch them at all once completing the final cleaning step. The use of plastic surgical gloves or their equivalent are recommended to facilitate the handling of the plates. Specific cleansing instructions for each type of metal is as follows:

(1) *Steel*—First clean the test plates by vapor degreasing for 5 min using 1-1-1 trichloroethane or chloroprene. After degreasing, wipe the residue from both sides of the coupons using paper laboratory wipes. Next, immerse for 15 min in a hot caustic solution (15 % potassium hydroxide (KOH) by weight), rinse thoroughly in distilled water, and immediately dry using paper laboratory wipes.

(2) *Copper*—Degrease the test plates in the same manner as the steel plates, then clean again in a hot acidic solution (10 % nitric acid by volume) for 15 min. Then rinse and dry the copper plates in the same manner as described in 13.8.6.1 (1).

(3) *Aluminum*—Clean the test plates with a 5 % solution of all-purpose laboratory detergent and water, then rinse in distilled water and dry with laboratory wipes.

(4) *Wire Screens*—Clean the wire screens before use in the same manner as the aluminum plates; that is, wash in detergent, rinse in distilled water, and dry.

13.8.6.2 Make five test specimens, each one consisting of one piece of metal placed between two pieces of insulation. Next, compress this assembly between two pieces of woven wire screen and secure near each end with a No. 12 rubber band or other means to ensure that the compressed thickness of this assembly measures  $1 \pm \frac{1}{8}$ -in. ( $25 \pm 3$  mm).

13.8.6.3 Assemble 5 control specimens, each consisting of one piece of metal placed between two  $1\frac{1}{2}$  by  $4\frac{1}{2}$  by  $\frac{1}{2}$ -in. ( $38$  by  $114$  by  $13$ -mm) pieces of sterile cotton. The sterile cotton shall have previously been solvent extracted in reagent grade acetone<sup>4</sup> for 48 h, and then vacuum dried at low heat. Identify

<sup>4</sup> *Reagent Chemicals, American Chemical Society Specifications*, American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary*, U.S. Pharmaceutical Convention, Inc. (USPC), Rockville, MD.