Designation: C 665 – 06

Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing[1]

This standard is issued under the fixed designation C 665; 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 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 the standard. The values given in parentheses are provided for information only.

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

2. Referenced Documents

2.1 *ASTM Standards:* [2]

B 152/B 152M Specification for Copper Sheet, Strip, Plate, and Rolled Bar

C 167 Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations

C 168 Terminology Relating to Thermal Insulation

C 177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus

C 390 Practice for Sampling and Acceptance of Thermal Insulation Lots

C 518 Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

C 653 Guide for Determination of the Thermal Resistance of Low-Density Blanket-Type Mineral Fiber Insulation

C 1104/C 1104M Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation

C 1304 Test Method for Assessing the Odor Emission of Thermal Insulation Materials

C 1338 Test Method for Determining Fungi Resistance of Insulation Materials and Facings

E 84 Test Method for Surface Burning Characteristics of Building Materials

E 96/E 96M Test Methods for Water Vapor Transmission of Materials

E 970 Test Method for Critical Radiant Flux of Exposed Attic Floor Insulation Using a Radiant Heat Energy Source

G 1 Practice for Preparing, Cleaning, and Evaluating Corrosion Test Specimens

3. Terminology

3.1 *Definitions*—For definitions of terms used in this specification, see Terminology C 168.

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.

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

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

4.1.2.4 *Category 1*—Facing is a vapor retarder.

4.1.2.5 *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.

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

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

[1] 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.

Current edition approved May 1, 2006. Published May 2006. Originally approved in 1970. Last previous edition approved in 2001 as C 665 – 01$^{\epsilon 1}$.

[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.

4.1.3.4 *Category 1*—Facing is a vapor retarder.
4.1.3.5 *Category 2*—Facing is not a vapor retarder.

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^2/Btu (K · m^2/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 E 84, 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 E 84, 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 ≥0.12 W/cm ^{2} (0.11 Btu/ft^2·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 (5.7×10^{-11} kg·Pa^{-1}·s^{-1}·m^{-2}) and vapor-permeable facing shall have a vapor permeance of no less than 5 perm (2.9×10^{-10} kg·Pa^{-1}·s^{-1}·m^{-2}).

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*— 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.

7.8 *Fungi Resistance*— When tested in accordance with 13.9, 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,

TABLE 1 Dimensions and Tolerances[A]

Element	Dimension	Tolerance
Length, in. (mm)	cut pieces up to 96 in. (2 m)	–½ 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)	–¼ in. (6 mm), + ½ in. (13 mm)
	rolls 24 to 144 in. (0.6 to 4 m)	–¼ in. (6 mm), + ½ in. (13 mm)
Thickness	as required for thermal resistance[B]	consistent with tolerances of thermal resistance[C]

[A] All sizes listed are not always available from all manufacturers. For sizes other than those listed, consult manufacturers.

[B] 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.

[C] 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.

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 Criteria C 390. 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 C 167.

13.2 *Thermal Resistance*:

13.2.1 Test in accordance with Test Method C 177 or Test Method C 518 at 75 ± 2°F (24 ± 1°C) mean temperature. If Test Method C 518 is used, the manufacturer shall certify that recent calibrations have been made.

NOTE 1—See Guide C 653. 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 C 177, with resistances reported at 75 ± 2°F (24 ± 1°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.[3] 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 E 84.

13.4 *Critical Radiant Flux*—Determine the critical radiant flux in accordance with Test Method E 970.

13.5 *Water-Vapor Permeance*—Test the permeance of the facing material in accordance with Test Methods E 96/E 96M.

13.6 *Water Vapor Sorption*—Determine the water vapor sorption of the test specimen in accordance with Test Method C 1104/C 1104M.

13.7 *Odor Emission*—Determine the Odor Emission in accordance with Test Method C 1304.

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 ± 3 % relative humidity and temperature of 120 ± 3°F (49 ± 2°C) for time periods determined by the type of metal being tested. Steel is tested for 96 ± 2 h. Copper and aluminum are tested for 720 ± 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 ± ¼ in. (25 by 100 ± 6.3 mm):

(1) Steel Plates, shall be 0.02 ± 0.005 in. (0.5 mm ± 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 ± 0.005-in. (0.6 ± 0.13 mm) thick, Type 3003-0.

(3) Copper Plates, shall be 0.032 ± 0.005-in. (0.8 ± 0.13 mm) thick, in accordance with Specification B 152/B 152M Type ETP, No. 110 soft copper.

13.8.4.2 *Woven Wire Screen*, 1½ ± ¼ by 4½ ± ¼ in. (38 ± 6.3 by 114 ± 6.3 mm), made of Type 304 stainless steel, 0.063 ± 0.005-in. (1.60 ± 0.13-mm) wire, 7⁄16 ± 1⁄16-in. (11 ± 1.6-mm) open-square grid.

[3] Contact National Institute of Standards and Technology (NIST), 100 Bureau Dr., Stop 3460, Gaithersburg, MD 20899-3460.

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 ± 3°F (49 ± 2°C), and humidity at 95 ± 3 % relative humidity.

13.8.5 *Test Specimens*— Two pieces of the material to be tested shall comprise one specimen. Each piece shall measure 1½ ± ¼ by 4½ ± ¼ in. (38 ± 6.3 by 114 ± 6.3 mm) by ½ ± ⅛ in. (13 ± 3.2 mm) thick, when compressed against the metal test plates. As a guideline, cut board type insulations to a thickness of ½ ± 1⁄16 in (12.7 ± 1.6 mm); cut blanket type insulations to a thickness of 1 ± 1⁄16 in. (25.4 ± 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 ± ⅛-in. (25 ± 3 mm).

13.8.6.3 Assemble 5 control specimens, each consisting of one piece of metal placed between two 1½ by 4½ by ½-in. (38 by 114 by 13-mm) pieces of sterile cotton. The sterile cotton shall have previously been solvent extracted in reagent grade acetone[4] for 48 h, and then vacuum dried at low heat. Identify the outer surface of the cotton as rolled. After cleaning, place the outer cotton surface against the metal coupons in the same manner as the insulation specimen. Then compress and secure these specimens in exactly the same manner as the insulation test specimens using wire screens and No. 12 rubber bands or other suitable means to maintain sample thickness.

13.8.6.4 Vertically suspend the five test specimens and the five control specimens in an atmosphere free of contaminants, having a relative humidity of 95 ± 3 %, and a temperature of 120 ± 3°F (49 ± 2°C) for the specified test period (96 ± 2 h for steel, and 720 ± 5 h for copper and aluminum). Keep the humidity chamber for the entire test period. If the chamber must be opened, take care to ensure that the relative humidity does not rise sufficiently high to cause condensation within the chamber. At the conclusion of the test period, remove the specimens from the chamber, disassemble and mark them to distinguish individual plates from each other.

13.8.6.5 Closely examine the surfaces of each of the test and control plate for the following characteristics:

(1) Steel—The presence and relative severity of red rust and pitting. Surface blush shall not be weighed strongly.

(2) Aluminum—The presence and relative severity of pitting, scaling, or other evidence of attack. The generation of oxide is a protective mechanism of aluminum and shall be disregarded. Remove the oxide by scrubbing with a nonabrasive implement of rubber under running water or immersing into a 70 % solution of nitric acid.

(3) Copper—Presence and relative severity of scaling, pitting, deposits or encrustation, severe discolorations, or general uniform attack. Surface blush and slight discolorations shall be ignored and removed by scrubbing with a nonabrasive implement of rubber under running water or immersing into a 10 % solution of sulfuric acid.

NOTE 2—Additional guidance for evaluating the plates can be found in Practice G 1.

13.8.7 *Interpretation of Results*:

13.8.7.1 Because of the subjectivity inherent in the judging of these plates, nonparametric statistical methods are employed to identify those materials that are conclusively more corrosive than sterile cotton.

13.8.7.2 The ten metal plates (five test, five control), shall be examined by at least four judges with experience in corrosion evaluation. Each judge shall independently rank all ten plates in order from least severe corrosion to most severe corrosion. The judges shall receive no indication as to which plates are control and which are test specimens. The judges' rankings shall be based on their own best estimate of the severity of the corrosion visible on each plate.

13.8.7.3 Upon completion of the judges' ratings, the arithmetic sum of all of the rankings for each plate shall be calculated. These sums shall then be ranked from 1 (lowest total) to 10 (highest total), with any ties being assigned the arithmetic mean of the rankings involved (for example, two plates tied for third = (3 + 4)/2 = 3.5; three plates tied for fourth = (4 + 5 + 6)/3 = 5). The new rankings thus established shall then be totaled for the control plates only; if this sum is less than 21, then the control plates are judged to be significantly better than the test plates and the insulation tested is considered to have *failed* the test. Any sum of the rankings for the five control plates ≥21 indicates that there is no statistical

[4] *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.

difference between the control and test plates, and the insulation is considered to have *passed*.

13.8.8 *Precision and Bias*—Assuming that there is no bias involved in the judges' rankings, this test method will identify those materials that are significantly worse than sterile cotton with a statistical confidence of $\alpha = 0.10$. This means that a material that is judged to be more corrosive to a metal than sterile cotton has at most a 10 % chance of being incorrectly failed. This test method can make no estimate of the probability that an insulation that is more corrosive than sterile cotton will not be identified as such.

13.9 *Fungi Resistance*—Determine fungi resistance in accordance with Test Method C 1338.

14. Inspection

14.1 Inspection of the insulation shall be made as agreed upon by the purchaser and the manufacturer as part of the purchase agreement.

15. Product Marking

15.1 *Warning Statements*—When tested in accordance with Test Method E 84, insulation with a facing shall have the flame spread index (FSI) printed a minimum of every 8 ft, 0 in. (2.4 m) on the facing. If the manufacturer elects not to print the flame spread ratings, then a warning statement shall be printed every 8 ft, 0 in. on the facing indicating that the facing is flammable and shall not be left exposed.

16. Packaging and Package Marking

16.1 *Packaging*—Unless otherwise specified, the insulation shall be packaged in the manufacturer's standard commercial containers.

16.2 *Packge Marking*— The markings shall be clear and legible. Unless otherwise specified, each container shall be marked with the manufacturer's name, the blanket width and length, square footage of material in the container, *R* (thermal resistance) value, the required thickness to obtain the *R* value, and the facing type if one is employed.

17. Keywords

17.1 blanket; light frame construction; manufactured housing; mineral fiber; thermal insulation