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Standard Specification for Fibrous Glass Thermal Insulation and Sound Absorbing Blanket and Board for Military Applications[1]

This standard is issued under the fixed designation C 1139; 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.

1. Scope

1.1 This specification covers unfaced flexible fibrous glass blanket and faced board used for thermal and sound absorbing insulation at temperatures up to 450°F (232°C) for military applications as a replacement for MIL-I-22023D.

1.2 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

1.3 The following hazard caveat pertains only to the test method section of this specification. *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:*

C 167 Test Methods for Thickness and Density of Blankets or Batt Thermal Insulations[2]

C 168 Terminology Relating to Thermal Insulation[2]

C 177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus[2]

C 390 Criteria for Sampling and Acceptance of Preformed Thermal Insulation Lots[2]

C 411 Test Method for Hot-Surface Performance of High Temperature Thermal Insulation[2]

C 423 Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method[2]

C 518 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus[2]

C 612 Specification for Mineral Fiber Block and Board Thermal Insulation[2]

C 665 Specification for Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing[2]

C 1101/C1101M Test Method for Classifying the Flexibility or Rigidity of Mineral Fiber Blanket and Board Insulation[2]

E 84 Test Method for Surface Burning Characteristics of Building Materials[3]

2.2 *U.S. Military Standards:*

MIL-STD-167-1 Mechanical Vibrations of Shipboard Equipment (Type 1 Environmental and Type II Internally Excited)[4]

MIL-Y-1140 Yarn, Cord, Sleeving, Cloth and Tape-Glass[4]

MIL-A-3316 Adhesives, Fire Resistant, Thermal Insulation[4]

3. Terminology

3.1 Definitions—Terminology C 168 shall apply to the terms used in this specification.

4. Classification

4.1 The fibrous glass felt shall be of the following types and grades:

Type I, Unfaced Thermal Blanket	Nominal Density, lb/ft^3(kg/m^3)
Grade 1	0.75 (12)
Grade 2	1.00 (16)
Grade 3	1.50 (24)
Grade 4	2.00 (32)
Grade 5	2.50 (40)
Grade 6	3.00 (48)
Type II, Unfaced Sound Absorbing Blanket	Nominal Density, lb/ft^3(kg/m^3)
Grade 1	0.75 (12)
Grade 2	1.00 (16)
Grade 3	1.50 (24)
Grade 4	2.00 (32)
Grade 5	2.50 (40)
Grade 6	3.00 (48)
Type III, Faced, Thermal and Sound Absorbing Board	Density shall be 2.8 (45) lb/ft^3(kg/m^3)

[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.

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[2] *Annual Book of ASTM Standards*, Vol 04.06.

[3] *Annual Book of ASTM Standards*, Vol 04.07.

[4] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094.

5. Ordering Information

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

6. Materials and Manufacture

6.1 *Composition*:

6.1.1 The insulation shall be composed of glass, processed from a molten state into a fibrous form, bonded with a chemical binder. Asbestos shall not be used as an ingredient or component part of the product.

6.1.2 The facing shall be a polyester film reinforced with glass yarns (MIL-I-1140). The laminating adhesive shall conform to the requirements of MIL-A-3316. Asbestos shall not be used as an ingredient or component part of the product.

7. Physical Requirements

7.1 A 1-in. (25-mm) thick sample of the insulation shall be flexible when tested in accordance with 11.1.

7.2 The insulation shall be of the nominal density specified for its grade with a tolerance of ±10 %. Density shall be determined in accordance with 11.2.

7.3 *Maximum Temperature of Use*—When tested in accordance with 11.10 at the insulation's maximum use temperature of 450°F (232°C), the insulation shall not crack, warp, flame, glow, smolder, or show evidence of fused fibers.

7.4 The nonfibrous material (shot) content shall not be greater than 1.5 % by weight when tested in accordance with 11.3.

7.5 *Binder Content*—When tested in accordance with 11.4, the binder content shall not exceed 30 % by weight.

7.6 *Corrosiveness to Steel*—When tested in accordance with 11.6, steel plates in contact with the insulation shall show no corrosion greater than comparative plates in contact with sterile cotton.

7.7 *Surface Burning Characteristics Type I and II*—The insulation shall have a flame spread index not greater than 25 and a smoke developed index not greater than 50 when tested in accordance with Test Method E 84.

7.8 *Quarter Scale Room Fire Test of Type III*—Type III shall meet the requirements of the Quarter-Scale Room-Fire Test Method described in 11.12.

7.9 *Apparent Thermal Conductivity*—The thermal conductivities for Type I, Grade 1 through 6 and Type III materials shall not exceed the values shown in Table 1. Thermal conductivity shall be determined by Test Methods C 177 or C 518.

7.10 *Vibration Resistance of Type II Materials*—There shall be a maximum of 0.50 % weight loss and the insulation shall not settle and lose thickness when subjected to the vibration test described in 11.9.

7.11 *Acoustical Performance of Type II Materials*—The coefficients of absorption shall be not less than those shown in Table 2 when Type II material is tested in accordance with 11.8.

7.12 *Kerfing*—Type III panels shall be capable of being kerfed with a 90° *V*-groove to facilitate bending when the panel is folded to a right angle. The facing material shall be flexible to form a neat square corner at the kerfed joint (see 11.11).

7.13 *Flashover Time*—Flashover time shall not occur within 10 min when tested in accordance with 11.12.4.5.

8. Dimensions and Permissible Variations

8.1 The standard sizes and tolerances of Types I, II, and III materials are listed in Table 3.

9. Workmanship, Finish, and Appearance

9.1 The insulation units shall indicate good workmanship and shall not have defects that adversely affect their installation and service qualities.

10. Sampling

10.1 Inspection and qualification shall be in accordance with Criteria C390. Other provisions for sampling can be agreed upon between the purchaser, seller, and manufacturer.

11. Test Methods

11.1 *Flexibility—Rigidity*—Test in accordance with Test Method C 1101/C 1101M.

11.2 *Density*—Test in accordance with Test Methods C 167.

11.3 *Nonfibrous Shot Content*—Test in accordance with the Annex in Specification C 612.

11.4 *Test Method for Determining Binder Content*:

11.4.1 *Scope*—This test method provides a test to determine the amount of organic binder present in the insulation.

11.4.2 *Summary of Test Method*—The percent binder by weight is measured by determining the weight lost by the insulation after it is placed in a 1000°F (538°C) furnace for 1 h.

11.4.3 *Significance and Use*—There is a susceptibility of the product to have an exothermic reaction at high temperature.

TABLE 1 Type I and Type III Thermal Insulation Blanket Physical Requirements

Type I	Type I Grade 1	Type I Grade 2	Type I Grade 3	Type I Grade 4	Type I Grade 5	Type I Grade 6	Type III
Nominal Density (lb/ft^3)	0.75	1.0	1.5	2.0	2.5	3.0	2.8
Thermal Conductivity, max Btu·in./h ft^2·°F (W/m·K)							
Mean Temperature,° F (°C)							
25 (−4)	0.27 (0.039)	0.26 (0.037)	0.24 (0.035)	0.22 (0.032)	0.22 (0.032)	0.22 (0.032)	0.22 (0.032)
50 (10)	0.29 (0.042)	0.28 (0.040)	0.26 (0.037)	0.24 (0.035)	0.23 (0.033)	0.23 (0.033)	0.23 (0.033)
75 (24)	0.32 (0.046)	0.30 (0.043)	0.27 (0.039)	0.25 (0.036)	0.24 (0.035)	0.24 (0.035)	0.24 (0.035)
100 (38)	0.35 (0.050)	0.32 (0.046)	0.29 (0.042)	0.27 (0.039)	0.26 (0.037)	0.25 (0.036)	0.26 (0.037)
200 (93)	0.49 (0.071)	0.43 (0.062)	0.38 (0.055)	0.34 (0.049)	0.31 (0.045)	0.30 (0.043)	0.31 (0.045)
300 (149)	0.70 (0.101)	0.58 (0.083)	0.50 (0.072)	0.44 (0.063)	0.38 (0.055)	0.37 (0.053)	0.38 (0.055)

TABLE 2 Coefficients of Sound Absorption Minimum, Using a Type "A" Mounting (Types II and III)

NOTE 1— Data on Type "A" Mounting is for comparison only and not meant to indicate characteristics in service.

Nominal Insulation Thickness, in. (mm)	Frequency, Hz						
	125	250	500	1000	2000	4000	Noise Reduction Coefficient (NRC)
Type II, All Grades							
0.75 (19)	0.04	0.10	0.20	0.40	0.55	0.55	0.30
1.0 (25)	0.06	0.20	0.45	0.65	0.65	0.64	0.50
2.0 (51)	0.15	0.40	0.75	0.75	0.75	0.70	0.65
3.0 (75)	0.20	0.60	0.90	0.80	0.80	0.75	0.80
4.0 (100)	0.25	0.65	0.95	0.85	0.85	0.80	0.85
Type III							
2 (51)	0.43	0.96	1.00	0.70	0.51	0.35	0.80

TABLE 3 Type I, II, and III Tolerances for Standard Sizes

	Standard Sizes Types I and II	Tolerances
Length ft (m)	4 (1.22), 8 (2.43)	±¼ in. (0.64 cm)
	50 (15.24), 75 (22.86), 100 (30.49), 150 (45.73), 200 (61)	±6 in. (15.24 cm)
Width in. (cm)	24 (61.68), 36 (91.44), 48 (122), 72 (183)	±¼ in. (0.64 cm)
Thickness in. (cm)	0.75 (1.9), 1.0 (2.54), 1.5 (3.8), 2.0 (5.1), 2.5 (6.35), 30 (7.62), 3.5 (8.9), 4.0 (10.2)	±⅛ in. (0.32 cm)
	Standard Sizes Types III	**Tolerances**
Length, in. (cm)	36 (91.44), 48 (122)	±¼ in. (0.64 cm)
Width, in. (cm)	24 (61.68)	±¼ in. (0.64 cm)
Thickness, in. (cm)	0.75 (1.9), 1.0 (2.54), 1.5 (3.8), 2.0 (5.1)	±⅛ in. (0.32 cm)

11.4.4 *Apparatus*:

11.4.4.1 *Furnace*, capable of maintaining a 1000°F (538°C) temperature.

11.4.4.2 *Scales*, accurate to 0.1 % of specimen weight.

11.4.5 *Test Specimen*:

11.4.5.1 Three test specimens shall be tested.

11.4.5.2 The test specimen shall be between 0.17 lb (75 g) and 0.33 lb (150 g).

11.4.6 *Procedure*:

11.4.6.1 Weigh the specimens; then place the specimens in the 1000°F (538°C) furnace for 1 h.

11.4.6.2 Remove the specimens from the furnace and let them cool to room temperature in the same laboratory atmosphere (temperature and relative humidity) as they were previous to placing them in the furnace.

11.4.6.3 Weigh the specimens when they have cooled to ambient temperature. The percent binder is the average of the following calculation for the three specimens:

$$B, \% = \frac{W_I - W_F}{W_I} \times 100$$

where:

B = percent binder,
W_I = initial weight, and
W_F = final weight after 1 h.

11.4.7 *Precision and Bias*—The precision of this test method is not known because interlaboratory data are not available. This test method may not be suitable for use in specifications or in case of disputed results as long as these data are not available.

11.5 *Thermal Conductivity*—Test in accordance with Test Methods C 177 or C 518.

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

11.7 *Surface Burning Characteristics*—Test in accordance with Test Method E 84.

11.8 *Acoustical Performance*—Test in accordance with Test Method C 423 using an "A" mounting.

11.9 *Test Method for Determining the Vibration Resistance of Fibrous Glass Insulation*:

11.9.1 *Scope*—This test method provides a test to determine the effect of vibration, at ambient temperature, on fibrous glass insulation.

11.9.2 *Summary of Test Method*—A 12-in. (30.5-cm) square specimen is subjected to a 0.13-in. (3-mm) amplitude vibration with a 12-Hz frequency in a horizontal plane for a period of 100 h. After the 100 h of vibration, the specimen is examined for weight loss and loss of thickness due to settling.

11.9.3 *Significance and Use*—This is a test method to test products that are installed in an above ambient temperature and vibrating environment.

11.9.4 *Apparatus*:

11.9.4.1 *Pin Probe*, as described in Test Methods C 167.

11.9.4.2 *Sheet Metal Box, 12-in. (30.5-cm) Square*, with a 16-mesh wire screen tightly stretched over one open side.

11.9.4.3 *Vibration Testing Fixture*, capable of vibrating at a 12 Hz frequency and a 0.13-in. (3-mm) amplitude in the horizontal plane.

11.9.5 *Test Specimen*—Cut a 12-in. (30.5-cm) square, full thickness sample of the insulation and blow it clean of all loose or cut surface particles.

11.9.6 *Procedure*:

11.9.6.1 Measure the thickness of the specimen in 5 places to the nearest 0.1 in. (2.5 mm) using a pin probe described in Test Methods C 167.

11.9.6.2 Subject the test specimen to the endurance test for Type I of MIL-STD-167-1 except that the total period of the test shall be 100 h at a frequency of 12 Hz with an amplitude of vibration of 0.13 ± 0.006 in. (3.3 mm ± 0.065 mm) only. In preparation for the test, the test specimen shall be blown clean of all loose or cut surface particles and weighed to the nearest 0.1 g (0.002 lb). After weighing, the test specimen shall be placed in a tight fitting five-sided sheet metal box covered with a No. 16-mesh wire screen tightly stretched and firmly attached to the box over the open side. The specimen shall be in intimate contact with the screen and five sides of the box. The method of attachment shall be in accordance with MIL-STD-167-1, allowing the test specimen to have the exposed face down and in a horizontal position. A pan shall be installed below the test specimen to catch all material particles that fall from the test specimen during the test. The test shall be conducted with the specimen in the horizontal position only. The vibration excitation shall be in the horizontal position only.

11.9.6.3 At the completion of the 100 h of vibration, remove the test specimen from its mounting attachments and sheet metal box. Weigh the specimen again to the nearest 0.002 lb

(0.1 g) and calculate the percent weight loss. Also measure the specimen's thickness again in 5 places to the nearest 0.1 in. (2.5 mm) and determine the percent loss in thickness.

11.9.7 *Precision and Bias*—The precision of this test method is not known because interlaboratory data are not available. This test method may not be suitable for use in specifications or in case of disputed results as long as these data are not available.

11.10 *Maximum Use Temperature*—Test in accordance with Test Method C 411.

11.11 *Kerfing*:

11.11.1 *Scope*—This test method provides a test to determine the suitability of a board to be kerfed.

11.11.2 *Summary of Test Method*—The insulation board is *V*-grooved with two sharp knives to facilitate bending when the board is folded to a right angle. The grooves shall be examined for smoothness of surface.

11.11.3 *Significance and Use*—A board must be capable of being kerfed properly to ensure an acceptable installation.

11.11.4 *Apparatus*:

11.11.4.1 *Two Sharp Kerf Cutting Blades*, positioned so they form an angle of 90° with each other so that the top of one knife is approximately ¼ in. (6 mm) in advance of the tip of the other knife are required. The knives are adjusted to reach just beneath the facing.

11.11.5 *Test Specimen*—One specimen 24 by 36 in. (610 by 910 mm) or 24 by 48 in. (610 by 1220 mm) shall be used.

11.11.6 *Procedure*:

11.11.6.1 Ninety degree *V*-grooves shall be kerfed in the sample board.

11.11.6.2 The grooves shall be examined for smoothness of surfaces. The board shall be folded, examined and the facings shall also be examined to determine if the corners are neat and square.

11.11.7 *Precision and Bias*—The precision of this test method is not known because interlaboratory data are not available. This test method may not be suitable for use in specifications or in case of disputed results as long as these data are not available.

11.12 *Determination of the Flashover Potential of a Lining Material Using a Quarter-Scale Room Fire Test*:

11.12.1 *Scope*—This test method describes a procedure to determine the flashover potential of materials in a room when subjected to a fire exposure. The test method described will yield a time from the introduction of the fire exposure until the moment of flashover. The information contained herein is intended for compliance.

11.12.2 *Significance and Use*—In the interest of reduction, both the set-up time and cost associated with fire testing in a full size room (defined as a 10 by 10 by 8-ft high room having a 30 by 80-in. high doorway), a one-quarter-scale room fire test was devised to predict flashover potential of lining materials exposed to fire.

11.12.3 *Apparatus*:

11.12.3.1 *The Quarter-Scale Room*—The quarter-scale room shall be constructed from a suitable ceramic insulation board and shall form an airtight box having a ceiling and four sides. The box shall sit on a floor fabricated with the same material. The interior dimensions of the fully lined quarter-scale room are 30 by 30 by 24 in. (76.2 by 76.2 by 61 cm) high. The doorway is located at the center of one wall and shall be 19.5 in. (49.5 cm) wide and 17 in. (43 cm) high to secure the proper ventilation and fire development. The height between the finished ceiling and the top of the doorway shall be 7 in. (18 cm). The floor of the model room shall extend at least 12 in. (30.5 cm) outside of the doorway. The box shall be removable to allow for application of ceiling and wall covering. The entire base of the box in contact with the floor shall be made airtight.

11.12.3.2 *Porous Plate Diffusion Flame Burner*—The burner shall be used as the fire source. The burner shall be 3.5 by 3.5 by 3 in. (9 by 9 by 7.6 cm) high, consisting of a horizontal porous plate area of 3 by 3 in. (7.6 by 7.6 cm) with a 0.25 in. (0.64-cm) wide steel plate perimeter and steel plate sides and bottom.

11.12.3.3 *Four 10-mil Chromel-Alumel Thermocouples*—Thermocouples placed 1 in. (2.54 cm) and 3 in. (7.6 cm) below the center of the overhead and 1 in. (2.54 cm) and 2 in. (5 cm) below the top of the doorway shall be used.

11.12.4 *Procedure*:

11.12.4.1 The test material shall fully line the walls and ceiling.

11.12.4.2 Prior to testing, the fully-lined test room shall be conditioned for at least 24 h at a relative humidity between 20 and 60 %, and a temperature of 73.4 ± 122°F (23 ± 50°C).

11.12.4.3 The fire source shall be positioned on the floor snugly against one near corner of the test room. A flow rate of 0.32 ft^3/min (0.0091/m^3/min) methane shall be used to produce a constant heat input to approximately 320 Btu for the duration of the test.

11.12.4.4 The test data from the four thermocouples shall be recorded as a continuous function of time.

11.12.4.5 The primary data generated by this test will be the time to flashover, if it occurs, and the maximum temperature if flashover is not reached. Flashover is characterized by thermal flux levels ≥2 W/cm^2(3.23 W/$in.^2$) at the floor level. This corresponds to interior temperatures of 1112°F (600°C) and higher, and doorway temperatures of 927°F (500°C) and higher. For this test purpose, flashover is defined as the fire condition when one of the interior thermocouple measurements reach 1112°F (600°C) or one of the doorway measurements reach 927°F (500°C), whichever occurs first. Flashover shall not occur within 10 min.

11.12.4.6 Color slides shall be taken before the test, at the point of maximum involvement and after the fire has been extinguished, and shall be included with the test report data.

11.12.5 *Report*:

11.12.5.1 The report shall contain the following information:

(1) Data from four thermocouples,

(2) If flashover occurs, flashover time, and

(3) Color slides.

11.12.6 *Precision and Bias*—The precision of this test method is not known because interlaboratory data are not available. This test method may not be suitable for use in specifications or in case of disputed results as long as these data are not available.

12. Qualification Requirements

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

12.1.1 Flexibility,
12.1.2 Maximum use temperature,
12.1.3 Density,
12.1.4 Nonfibrous shot content,
12.1.5 Binder content,
12.1.6 Corrosiveness,
12.1.7 Surface burning characteristics (Type I and II),
12.1.8 Thermal conductivity,
12.1.9 Vibration resistance,
12.1.10 Acoustical performance,
12.1.11 Kerfing, and
12.1.12 Flashover (Type III).

13. Inspection

13.1 The following requirements are generally employed for purposes of acceptance sampling of lots or shipments of qualified insulation:

13.1.1 Density,
13.1.2 Dimensional tolerances, and
13.1.3 Workmanship.

14. Rejection and Rehearing

14.1 Material that fails to conform to the requirements of this specification may be rejected. Rejection should be promptly reported in writing to the manufacturer or seller. In case of dissatisfaction with the results of the tests, the manufacturer or seller may make a claim for a hearing with the purchaser.

15. Certification

15.1 When specified in the purchase order or contract, the manufacturer's or supplier's certification shall be furnished to the purchaser stating that samples representing each lot have been manufactured, tested, and inspected in accordance with 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 Unless otherwise specified, insulation shall be packaged in the manufacturer's standard commercial container.

16.2 *Marking*—Unless otherwise specified, each container shall be plainly marked to include the following:

16.2.1 Name of manufacturer,
16.2.2 Name of product,
16.2.3 Type,
16.2.4 Quality,
16.2.5 Nominal dimensions, and
16.2.6 Facing and accessories, if any, of the material in the container.

17. Keywords

17.1 blanket; insulation; mineral fiber; ship insulation; thermal