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Standard Specification for Glass Fiber Blanket Insulation (Aircraft Type)¹

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This standard has been approved for use by agencies of the Department of Defense.

^{ε1} NOTE—Table 5 was editorially updated in May 2004.

1. Scope

1.1 This specification covers the composition, size, dimensions, and physical properties of glass fiber blanket thermal and acoustical insulation for use up to 700°F (370°C) in aircraft applications. For specific applications, the maximum temperature shall be agreed upon between the supplier and the purchaser.

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:

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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- C 167 Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations²
- C 168 Terminology Relating to Thermal Insulating Materials²
- C 177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus²
- C 390 Criteria for Sampling and Acceptance of Preformed Insulation Lots²
- C 411 Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation²
- C 518 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus²
- C 522 Test Method for Airflow Resistance of Acoustical Materials²
- C 1304 Test Method for Assessing the Odor Emission of Thermal Insulation Materials²
- C 1045 Practice for Calculating Thermal Transmission Properties Under Steady State Conditions²
- C 1058 Practice for Temperatures for Evaluating and Reporting Thermal Properties of Thermal Insulation²
- C 1510 Test Methods for Determining the Water Retention (Repellency) Characteristics of Glass Fiber Insulation (Aircraft Type)²
- D 5034 Test Methods for Breaking Strength and Elongation of Textile Fabrics (Grab Tests)³
- E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method⁴
- F 1110 Test Method for Sandwich Corrosion Test⁵
- 2.2 *Other Standards*
- 14 CFR FAR (Federal Aviation Regulations) 25.853 Appendix F, Part I⁶

3. Terminology

3.1 *Definitions*—Terminology C 168 shall be considered as applying to the terms used in this specification. Definitions in Test Method C 522 shall be considered as applying to the acoustical terms used in this standard.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *Wetting*—A condition where the water has penetrated into the insulation and fills the spaces between the fibers.

4. Classification

4.1 Glass fiber blanket insulation covered by this specification shall be classified into Types based on temperature limits, Classes based on acoustical properties, Grades based on nominal density and Groups based upon thickness as shown in Table 1.

4.2 The insulation may be either water repellent or non-water repellent.

5. Ordering Information

5.1 The type, class, grade, and group suited to the conditions of intended service shall be specified by the purchaser after consultation with the supplier. Type refers to service temperature, class refers to thermal/acoustical properties, grade refers to nominal density and group refers to thickness of insulation.

5.2 It shall also be specified whether the insulation is to be water repellent or non-water repellent.

6. Materials and Manufacture

6.1 *Composition:*

6.1.1 Fiber shall be glass processed from a molten state into fibrous form.

6.1.2 Binder shall be of a type and quantity to provide the properties and performance listed in this specification. Additives may be included to provide a degree of water repellency.

6.1.3 This product is typically supplied unfaced.

6.1.4 The basic product may also be obtained in uncured form for molding into special shapes other than blanket. However, not all requirements in this specification may apply. The purchaser should consult the supplier and agree on the portions of this specification and conditions that are applicable.

6.2 For sizes and densities other than those listed, the purchaser shall consult the material supplier.

7. Physical Requirements

7.1 The insulation shall conform to the requirements described in 7.2-7.11 and Tables 1-5.

7.2 *Density*—The insulation shall conform to the requirements shown in Table 1. The insulation shall have a maximum density tolerance when tested in accordance with 11.6 of + 15%, with no minimum limit.

7.3 *Handleability*—Each piece of insulation shall be sufficiently coherent to permit transportation and installation as a unit.

² Annual Book of ASTM Standards, Vol 04.06.

³ Annual Book of ASTM Standards, Vol 07.01.

⁴ Annual Book of ASTM Standards, Vol 14.02.

⁵ Annual Book of ASTM Standards, Vol 15.03.

⁶ Available from, National Archives and Records Administration 8601 Adelphi Road College Park, MD 20740-6001.

TABLE 1 Types, Classes, Grades and Groups

Type 1— For Use to 450°F (232°C) ClassAA							
Nominal Density		Maximum Density		Color (unless otherwise specified)	Nominal Thickness		
Grade	Lbs/ft ³	kg/m ³	Lbs/ft ³ (kg/m ³)		Group	in.	(mm)
A	0.34	(5.5)	0.39 (6.33)	Medium gray	1	0.38	(9.5)
B	0.42	(6.7)	0.48 (7.71)	Amber	2	0.50	(13)
C	0.50	(8.0)	0.58 (9.2)	Medium gray	3	1.00	(25)
D	0.60	(9.6)	0.69 (11.0)	Green	4	1.50	(38)
E	1.20	(19)	1.38 (21.9)	Medium gray	5	2.00	(51)
F	1.50	(24)	1.73 (27.6)	Amber			
G	1.00	(16)	1.15 (18.4)	Orange			

Class B							
Nominal Density		Maximum Density		Color	Nominal Thickness		
Grade	Lbs/ft ³	kg/m ³	Lbs/ft ³ (kg/m ³)		Group	in.	(mm)
A	0.50	(8.0)	0.58 (9.2)	Amber	1	0.38	(9.5)
B	0.60	(9.6)	0.69 (11.0)	Amber	2	0.50	(13)
C	1.00	(16)	1.15 (18.4)	Amber	3	1.00	(25)
					4	2.00	(50)

Type II-For Use to 700°F (370°C)							
Class AA							
Nominal Density		Maximum density		Color	Nominal Thickness		
Grade	Lbs/ft ³	kg/m ³	Lbs/ft ³ (kg/m ³)		Group	in.	(mm)
A	0.60	(9.6)	0.69 (11.0)	White to light tan	1	0.38	(9.5)
B	1.00	(16)	1.15 (18.4)	White to light tan	2	0.50	(13)
C	3.00	(48)	3.45 (55.2)	White to light tan	3	1.00	(25)

TABLE 2 Other Properties

Property	Requirement, max
<i>Wicking:</i>	
Before Aging and Before Leaching, in. (mm)	¼ (6.4)
After Aging, in. (mm)	¼ (6.4)
After Leaching, in. (mm)	¼ (6.4)
<i>Water Repellency, lb. (kg):</i> ^A	0.044 (0.020)

^A Average of three test specimens.

7.4 *Burning Characteristics*—The insulation shall conform to the requirements in FAR 25.853, Appendix F, Part I.

7.5 *Wicking (water-repellent insulation only)*—The insulation shall conform to the requirements in Table 2, when tested in accordance with 11.2.

7.5.1 Precipitates shall not form in the water bearing the wicking specimens.

7.5.2 Wetting of the submerged portion of the wicking specimens is permissible. Wicking is the distance of wetting above water surface.

7.5.3 Beads of water are not to be construed as a condition of wetting. The formation of beads of water on the insulation surface indicates water repellency.

7.5.4 Surface wetting is not considered as wicking, but cannot be more than 1 in. (25.4 mm) when measured from the waterline.

7.6 *Odor Emission*—A detectable odor of objectionable nature recorded by more than two of the five panel members shall constitute failure of the material, when tested in accordance with 11.3.

7.7 *Service Temperature*—The insulation shall conform to the requirements in Table 1, when tested in accordance with 11.7.

7.7.1 Insulation shall be serviceable up to the maximum temperature limitations as long as limited mechanical properties are required. At maximum or near-maximum service temperatures, some deterioration of the binder may be possible over extended periods of time.

7.8 *Apparent Thermal Conductivity*— Values shall not exceed those in Table 3, when tested in accordance with 11.9.

7.9 *Specific Transverse Airflow Resistance*—The insulation shall conform to the requirements in Table 4, when tested in accordance with 11.4.

7.10 *Breaking Strength*—The insulation shall conform to the requirements in Table 5, when tested in accordance with 11.5.

7.11 *Water Repellency (water-repellent insulation only)*—The insulation shall conform to the requirements of Table 4, when tested in accordance with 11.8.

7.12 The insulation shall be rated 0 (no visible corrosion) when tested per the requirements of Test Method F 1110 on non-clad aluminum (2024T3).

TABLE 3 Apparent Thermal Conductivity, max, Btu in./(h-ft²·°F) (W/(m·K))

Class AA					
Mean Temperature	Type I, Grades A&B (0.34pcf and 0.42pcf)	Type I Grades C&D (0.5pcf and 0.6pcf) and Type II Grade A (0.6pcf)	Type I Grades E&F (1.2pcf and 1.5pcf)	Type I, Grade G (1.0pcf) and Type II, Grade B (1.0pcf)	Type III, Grade C (3.0pcf)
25(-3.9)	0.26 (0.039)	0.24 (0.035)	0.22 (0.032)	0.23 (0.033)	0.22 (0.032)
50(10.0)	0.29 (0.041)	0.26 (0.038)	0.23 (0.033)	0.24 (0.035)	0.23 (0.033)
75 (23.9)	0.31 (0.044)	0.28 (0.040)	0.24 (0.035)	0.25 (0.036)	0.24 (0.035)
100 (37.8)	0.33 (0.047)	0.30 (0.043)	0.25 (0.036)	0.26 (0.039)	0.25 (0.036)
200 (93.3)	0.45 (0.065)	0.40 (0.057)	0.32 (0.046)	0.34 (0.049)	0.30 (0.043)
300 (148.9)	0.61 (0.087)	0.52 (0.075)	0.40 (0.057)	0.43 (0.062)	0.35 (0.051)
400 (204.4) ^A		0.69 (0.100)		0.55 (0.079)	0.42 (0.061)
500 (260.0) ^A		0.91 (0.132)		0.70 (0.101)	0.51 (0.073)

Class B			
Mean Temperature, °F (°C)	Grade A	Grade B	Grade C
25 (-3.9)	0.30 (0.043)	0.29 (0.041)	0.25 (0.036)
50 (10.0)	0.33 (0.047)	0.31 (0.044)	0.28 (0.040)
75 (23.9)	0.36 (0.053)	0.34 (0.050)	0.30 (0.043)
100 (37.8)	0.41 (0.058)	0.37 (0.054)	0.32 (0.046)
200 (93.3)	0.62 (0.089)	0.55 (0.079)	0.43 (0.062)
300 (148.9)	0.94 (0.135)	0.81 (0.118)	0.59 (0.086)

^AThese mean temperatures apply to Type II insulation only.

TABLE 4 Transverse Airflow Resistance

Type I	Airflow Resistance, Min. Rayls (N/m ²)(m/s)				
	Group 1	Group 2	Group 3	Group 4	Group 5
Class AA:					
Grade A			350		
Grade B		200	350		
Grade C			1000		
Grade D		340	680	1020	1360
Grade E	1500				
Grade F	1100				
Grade G		1220	2240		
Class B:					
Grade A		50	100		200
Grade B		70			
Grade C		140	290		580
Type II					
Class AA:					
Grade A		340	680		
Grade B			2000		
Grade C		3000			

8. Dimensions and Permissible Variations

8.1 *Length and Width*—The average measured length and width shall not differ from the manufacturer’s standard dimensions by more than the following:

Length—6 in. (152 mm), with excess permitted;

Width ±0.5 in. (13 mm).

8.2 *Thickness*—Insulation shall recover to within the following values of the nominal thickness:

Less than 1-in. (25.1-mm) thick ± 20 %

when tested per the requirements within C 167.

1 in. (25.4 mm) or greater in thickness ± 0.25 in. (6.4 mm)

8.3 *Dimensions shall be tested in accordance with 11.6.*

8.4 *Standard Sizes*—As agreed upon between customer and manufacturer.

TABLE 5 Breaking Strength-lb/in. (N/m) minimum

Type 1	Group 1		Group 2		Group 3		Group 4		Group 5	
Class AA:	MD ^A	XMD ^A	MD ^A	XMD ^A	MD ^A	XMD ^A	MD ^A	XMD ^A	MD ^A	XMD ^A
Grades A					0.6 (105)	0.3 (52)				
Grades B			0.3 (52)	0.1 (18)	0.8 (140)	0.3 (52)				
Grades C					1.0 (175)	0.4 (70)				
Grades D			0.5 (88)	0.4 (70)	1.0 (175)	0.8 (140)	1.2 (210)	1.0 (175)	1.5 (263)	1.3 (228)
Grades E	1.5 (263)	1.8 (140)								
Grades E	1.5 (263)	0.8 (140)								
Grades F	1.8 (316)	0.8 (140)								
Grade G			0.6(105)	0.5(88)	1.2 (210)	0.9 (158)				
Class B:										
Grade A			0.5(88)	0.5(88)	1.0 (175)	1.0 (175)			1.3 (228)	1.3 (228)
Grade B			0.5(88)	0.5 (88)					2.5 (438)	2.5 (438)
Grade C			1.0(175)	1.0 (175)	2.0 (350)	2.0 (350)				
Type II										
Class AA:										
Grade A			0.5(88)	0.3 (52)	1.0 (175)	0.5(88)				
Grade B					1.2 (210)	0.6 (105)				
Grade C			2.0 (350)	1.0 (175)						

^AMD= Machine Direction (length direction)
XMD= Cross machine direction (width direction)

9. Workmanship, Finish, and Appearance

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

10. Sampling

10.1 The insulation shall be sampled in accordance with Criteria C 390. Specific provision for sampling shall be as agreed upon between the purchaser and the supplier as part of the purchase contract.

11. Test Methods

11.1 Burning Characteristics:

Testing shall be conducted according to and burning characteristics shall meet the appropriate section of Federal Aviation Regulation 25.853, Appendix F Part I.

11.2 Wicking:

11.2.1 *Scope and Significance and Use*— This test method covers a laboratory procedure for evaluating the tendency of glass fiber blanket insulation to wick water.

11.2.2 *Test Specimens*—Cut six 1 by 6-in. (25.4 by 152.4-mm) specimens from the insulation material with the 6-in. length in the axis parallel to the length of the roll. Cut six similar specimens with the 6-in. length parallel to the width of the roll.

11.2.3 Procedure:

11.2.3.1 Fasten loosely, with fine wire, six specimens (three cut with the axis parallel to the length of the roll and three cut with the axis perpendicular to the length of the roll) to a grease-free 0.025 in. to 0.035-in. (0.64 mm to 0.89-mm), 4 by 4 mesh stainless steel wire screen and position this assembly in an upright position so that the ends of the specimens touch the bottom of the container. The specimens must not touch each other on the sides of the container. Pour distilled water into the container to a height of 1 in. (25.4 mm). The water shall be at room temperature.

11.2.3.2 Position the remaining six specimens similarly in another container. Pour distilled water into the container to a height of 1 in. (25.4 mm). Maintain the temperature of the water at 120 ± 5°F (48.9°C). Note degree of wicking every 24 h.

11.2.3.3 *Wicking After Oven Aging*—Insulation 8 in. by 14 in. (203 mm by 356 mm) shall be aged in a forced-air circulating oven, at 160 ± 5°F (71 ± 3°C) for two weeks. The aged insulation shall be tested in accordance with 11.2.3.

11.2.3.4 *Wicking After Leaching*—Insulation 8 in. by 14- in. (203 mm by 356-mm) shall be submerged in an immersion tank containing water at a temperature of 80 to 85°F (27 to 29°C), and allowed to remain immersed for a period of 24 h. (Immersion tank shall be of such a shape and size that the specimen can be submerged therein with all surfaces of the specimen having full access to the water, and a ratio of the specimen to water shall be not less than 1 to 100 by weight. A continuous flow of water shall

be supplied to the bottom of the container at a temperature of 80 to 85°F (27 to 29°C), and at a rate of about five changes per hour. At the end of the leaching period, the specimen shall be removed from the water and air dried. The leached insulation shall be tested in accordance with 11.2.3.

11.2.4 *Precision and Bias*—The precision and bias of this test procedure are being determined.

11.3 *Odor Emission*—Determine odor emission in accordance with Test Method C 1304.

11.4 *Specific Transverse Airflow Resistance*—Determine the specific transverse airflow resistance, r_t (of a nonisotropic homogeneous material), in SI rayls (newton/m²)/(m/s), in accordance with Test Method C 522. The term rayl is commonly used only in the metric system; therefore, no inch-pound customary units are given.

NOTE 1—Many literature references use cgs rayls (1 cgs rayl = 10 SI rayls).

11.5 *Breaking Strength*—Determine the breaking strength in accordance with Test Methods D 5034, except as follows:

11.5.1 The face of each jaw shall measure 1.0 ± 0.1 in. by 3.0 ± 0.1 in. (25.4 ± 2.54 mm by 76.2 ± 2.54 mm). Each sample shall measure 4.0 ± 0.2 in. by 6.0 ± 0.2 in. (101.6 ± 5.08 mm by 152.4 ± 5.08 mm) so that material overlaps the jaw and three superimposed pieces are broken at the same time. The distance between the jaws (known as the gage length) shall be 3.0 ± 0.2 in. (76.2 ± 5.08 mm) at the start of the test.

11.5.2 Report the average of five determinations of three specimens each as the breaking strength.

11.5.3 Calculate the breaking strength as follows:

$$\text{Breaking Strength} = \frac{\text{Breaking Force}}{\text{Jaw Length} \times 3} \quad (1)$$

11.6 *Thickness and Density*—Determine thickness and density in accordance with Test Methods C 167.

11.7 *Service Temperature*—The maximum service temperature of the insulation shall be evaluated in accordance with Test Method C 411.

11.8 *Water Repellency*:

Determine water repellency in accordance with Test Method C 1510.

11.9 *Apparent Thermal Conductivity* :

11.9.1 Determine in accordance with Test Methods C 177 or C 518.

11.9.2 Temperatures of test shall be in accordance with Practice C 1058.

11.9.3 See Practice C 1045 for requirements and guidelines for the determination of thermal transmission properties.

12. Qualification Requirements

12.1 The following requirements are generally employed for the purpose of initial material or product qualification:

12.1.1 Density,

12.1.2 Handleability,

12.1.3 Burning Characteristics,

12.1.4 Wicking,

12.1.5 Odor Emission,

12.1.6 Maximum Service Temperature,

12.1.7 Apparent Thermal Conductivity,

12.1.8 Specific Transverse Airflow Resistance, and

12.1.9 Breaking Strength.

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 Water Repellency (water-repellent material only),

13.1.3 Dimensions, and

13.1.4 Workmanship.

14. Rejection and Rehearing

14.1 Material that fails to conform to the requirements of the specification may be rejected. Rejection should be reported to the manufacturer or supplier promptly and in writing. In case of dissatisfaction with the results of the test, the manufacturer or supplier may make claim for a rehearing.

14.2 In case of rejection, the manufacturer or supplier shall have the right to reinspect the rejected shipment and resubmit the lot after removal of that portion of the shipment not conforming to the specified requirements.

15. Packaging and Package Marking

15.1 *Packaging*—Unless otherwise agreed or specified between the purchaser and the manufacturer or supplier, the insulation shall be packaged in the manufacturer's standard commercial containers.

15.2 *Marking*—Unless otherwise specified, containers shall be marked with the supplier’s name and designation, type, class, size and thickness, and quantity of the material contained.

16. Keywords

16.1 aircraft; aircraft insulation; airflow resistance; glass fiber; glass fiber insulation; thermal insulating materials-blanket; transverse; water repellency; wicking

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