

STANDARD SPECIFICATION
FOR
GLASS FIBER BLANKET INSULATION
(AIRCRAFT TYPE)
ASTM Designation: C-490-60

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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.

2. APPLICABLE DOCUMENTS:

- 2.1 The following documents form a part of this specification to the extent specified:
- ASTM C147 Tests for Thickness and Density of Thermal Insulations.
 - ASTM C168 Terms Relative to Thermal Insulating Materials.
 - ASTM C522 Standard Method of Test for Airflow Resistance of Acoustical Materials.
 - ASTM C177 Thermal Conductivity of Materials by Means of the Guarded Hot Plate.
 - ASTM C518 Thermal Conductivity of Materials by Means of the Heat Flow Meter.
 - ASTM D1682 Breaking Load and Elongation of Textile Fabrics.
 - ASTM 390 Sampling Preformed Thermal Insulation.
 - FAA, U. S. Dept. of Transportation 14 CFR Part 25.853.
 - FAA, U. S. Dept. of Transportation 14 CFR Part 25, Appendix F.
 - Federal Specification CCC-T-191b Method 5903T.

3. CLASSIFICATION:

- 3.1 Glass fiber blanket insulation covered by this specification shall be classified into types based on temperature limits, grades based on acoustical properties expressed as flow resistance in rays, and classes based on nominal density and thickness as shown in Table 1.

4. DEFINITIONS:

- 4.1 The definitions of glass fiber blanket thermal and acoustical insulation in ASTM Definitions C168, Terms Relating to Thermal Insulating Materials, and in ASTM C522, Standard Method of Test for Airflow Resistance of Acoustical Materials, shall be considered as applying to the terms used in this specification.

5. BASIS OF PURCHASE:

- 5.1 The type, grade, and class suited to the conditions of intended service shall be specified by the purchaser after consultation with the supplier.

6. MATERIALS AND MANUFACTURE:

- 6.1 **Composition** - The fiber shall be glass processed from a molten state into fibrous form. The 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. Facings are not normally provided on this type of blanket insulation. The basic product may also be obtained in uncured form for molding into special shapes other than blanket. However, not all of these specifications may apply. The purchaser should consult the supplier and agree on the portion of this specification and conditions which are applicable.
- 6.2 For sizes and densities other than those listed, consult the material supplier.

TABLE 1 - TYPES, GRADES AND CLASSES

Type I For use to 450 F (232 C)						Type II For use to 700 F (320 C)					
Class	Nom. Thickness		Nom. Density			Class	Nom. Thickness		Nom. Density		
	Inches	(mm)	lb/ft ³	(kg/m ³)			Inches	(mm)	lb/ft ³	(kg/m ³)	
Grade A	1	1/2"	(12.7)	.40	(6.4)	1	1/2"	(12.7)	0.60	(9.6)	
	2	1	(25.4)	.40	(6.4)	2	1	(25.4)	0.60	(9.6)	
	3	1/2	(12.7)	.60	(9.6)	3	1	(25.4)	1.00	(16.0)	
	4	1	(25.4)	.60	(9.6)	4	1/2	(12.7)	3.00	(48.0)	
	5	1-1/2	(38.1)	.60	(9.6)						
	6	2	(50.8)	.60	(9.6)						
	7	1/2	(12.7)	1.00	(16.0)						
	8	1	(25.4)	1.00	(16.0)						
	9	3/8	(9.5)	1.50	(24.0)						
	10	1/2	(12.7)	3.00	(48.0)						
Grade B	1	1/2	(12.7)	0.50	(8.0)						
	2	1	(25.4)	0.50	(8.0)						
	3	2	(50.8)	0.50	(8.0)						
	4	1/2	(12.7)	0.60	(9.6)						
	5	1/2	(12.7)	1.00	(16.0)						
	6	1	(25.4)	1.00	(16.0)						
	7	2	(50.8)	1.00	(16.0)						

7. PHYSICAL REQUIREMENTS:

- 7.1 The insulation shall conform to the physical requirements described in 7.2 through 7.11.2.
- 7.2 Density Tolerance - A tolerance of ± 15 percent of the nominal density shall be permitted as determined by ASTM C 167, Tests for Thickness and Density of Thermal Insulations.
- 7.3 Handleability - Each piece of insulation shall be sufficiently coherent to permit transportation and installation as a unit.
- 7.4 Burning Characteristics - The thermal and acoustical insulation blanket shall meet the following requirements. These requirements are established by the Federal Aviation Administration, U.S. Department of Transportation 14 CFR Part 25.853).
 - 7.4.1 "Thermal and acoustical insulation - must be self-extinguishing when tested vertically in accordance with the applicable portions of Appendix F of this part. The average burn length may not exceed 8 inches (203.2 mm) and the average flame time after removal of the flame source may not exceed 15 seconds. Drippings from the test specimen may not continue to flame for more than 5 seconds after falling" when tested in accordance with the method of test in Section 8.1.
- 7.5 Wicking
 - 7.5.1 Type I and II materials must not wick to greater than 1/4 inch (6.35 mm) above the water line in 168 hours when tested per Section 8.2. In addition, precipitates must not form in the water bearing the wicking specimens. Wetting of the submerged portion of the wicking specimens is permissible. Wetting is defined as a condition where the water has penetrated into the insulation and fills the spaces between the fibers. 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. Surface wetting is not considered as wicking, but cannot be more than 1 inch (25.4 mm) when measured from the waterline.
 - 7.5.2 Wicking After Oven Aging - Age batting material (approximately 8 inches [203.2 mm] x 14 inches [355.6 mm]) in a forced air circulating oven, at $160^{\circ}\text{F} \pm 5^{\circ}\text{F}$ for two weeks. Test the aged batting for wicking per 8.2.

7. PHYSICAL REQUIREMENTS

- 7.5.3 Wicking After Leaching - Leach bathing material (approximately 8 inches [203.2 mm] x 14 inches [355.6 mm]) per Federal Specification CC-T-191b, Method 5830. The insulation material may be held under water by placing it beneath a submerged galvanized wire screen. Air dry thoroughly and then test for wicking per 8.2.
- 7.6 Odor Emission
 - 7.6.1 Objectionable odor detection by more than two of the panel members constitutes failure of this test.
- 7.7 Service Temperature - This insulation will be serviceable up to the maximum temperature limitations as long as limited mechanical properties are required. At or near maximum service temperatures some deterioration of the binder may be possible over extended periods of time.
- 7.8 Thermal Conductivity - Shall be determined by test methods ASTM C177 or C518 and the maximum average values shall not exceed those shown in Table 2.

(Table 2)

TABLE 2 - THERMAL CONDUCTIVITY - MAXIMUM AVERAGE, TYPES I AND II

All values expressed as BTU in/hr ft² deg F (W/m-K)

GRADE A

Mean Temp. deg. F (deg C)	Class 1 and 2		Class 3, 4, 5, 6		Class 7 and 8		Class 9		Class 10	
	Nom. Density		Nom. Density		Nom. Density		Nom. Density		Nom. Density	
	lb/ft ³	(kg/m ³)	lb/ft ³	(kg/m ³)	lb/ft ³	(kg/m ³)	lb/ft ³	(kg/m ³)	lb/ft ³	(kg/m ³)
25 (-3.9)	0.40	(6.4)	0.60	(9.6)	1.0	(16.0)	1.50	(24.0)	3.00	(48.0)
50 (10.0)	0.24	(0.035)	0.22	(0.032)	0.21	(0.30)	0.20	(0.029)	0.20	(0.029)
75 (23.9)	0.26	(0.037)	0.24	(0.035)	0.22	(0.032)	0.21	(0.030)	0.21	(0.030)
100 (37.8)	0.28	(0.040)	0.25	(0.036)	0.23	(0.033)	0.22	(0.032)	0.22	(0.032)
200 (93.3)	0.30	(0.043)	0.27	(0.039)	0.24	(0.035)	0.23	(0.033)	0.23	(0.033)
300 (148.9)	0.41	(0.059)	0.36	(0.052)	0.31	(0.045)	0.29	(0.042)	0.27	(0.039)
400 (204.4)	0.55	(0.079)	0.47	(0.068)	0.39	(0.056)	0.36	(0.052)	0.32	(0.048)
500 (260.0)	0.75	(0.109)	0.63	(0.091)	0.50	(0.072)	0.45	(0.065)	0.38	(0.055)
	1.02	(0.147)	0.83	(0.120)	0.64	(0.092)	0.56	(0.081)	0.45	(0.065)

GRADE B

Mean Temp. deg. F. (deg. C)	Class 1, 2, 3		Class 4		Class 5, 6, 7	
	Nom. Density		Nom. Density		Nom. Density	
	lb/ft ³	(kg/m ³)	lb/ft ³	(kg/m ³)	lb/ft ³	(kg/m ³)
25 (-3.9)	0.50	(8.0)	0.60	(9.6)	1.0	(16.0)
50 (10.0)	0.27	(0.039)	0.26	(0.037)	0.23	(0.033)
75 (23.9)	0.30	(0.043)	0.28	(0.040)	0.25	(0.036)
100 (37.8)	0.33	(0.048)	0.31	(0.045)	0.27	(0.039)
200 (93.3)	0.37	(0.053)	0.34	(0.049)	0.29	(0.042)
300 (148.9)	0.56	(0.081)	0.50	(0.072)	0.39	(0.055)
400 (204.4)	0.85	(0.123)	0.74	(0.107)	0.54	(0.078)
	1.30	(0.187)	1.08	(0.156)	0.72	(0.104)

7. PHYSICAL REQUIREMENTS:

- 7.9 Specific Transverse Airflow Resistance - The specific transverse airflow resistance, r_t , (of a nonisotropic homogeneous material) SI rayls, (newton per square meter) per (meter per second) shall be determined in accordance with ASTM C522 Test for Airflow Resistance of Acoustical Materials. The term, rayl, is commonly only used in the metric system, therefore no English equivalents are given.

Note 1: Many literature references use CGS rayls (1 CGS rayl equals 10 SI rayls).

TABLE 3. AIRFLOW RESISTANCE - RAYLS $N \cdot s / m^2$ AVERAGE MINIMUM

<u>Type I</u>			<u>Type II</u>		
<u>Class</u>			<u>Class</u>		
Grade A	1	300	1	600	
	2	600	2	1200	
	3	600	3	2400	
	4	1200	4	7200	
	5	1800			
	6	2400			
	7	1200			
	8	2400			
	9	1800			
	10	7200			
<u>Class</u>					
Grade B	1	50			
	2	100			
	3	200			
	4	75			
	5	150			
	6	300			
	7	600			

- 7.10 Breaking Strength - The breaking strength shall be determined in accordance with ASTM D 1682, Breaking Load - Elongation of Textile Fabrics, Grab Test, except as follows: The face of each jaw must measure 1.0 ± 0.1 inches by 3.0 ± 0.1 inches (25.4 ± 2.54 by 76.2 ± 2.54 mm). Each sample must measure 4.0 ± 0.2 inches by 6.0 ± 0.2 inches (101.6 ± 5.08 by 152.4 ± 5.08 mm) so that material overlaps the jaw and three superimposed pieces are broken at the same time. The distance

- 7.10 between the jaws (gauge length) shall be 3.0 ± 0.2 inches (76.2 $\pm$ 5.08 mm.) at the start of the test. Report the average of five determinations of three specimens each as the breaking strength. Calculate the breaking strength as follows:

$$\text{Breaking Strength} = \frac{\text{Breaking Force}}{\text{Jaw Length} \times 3}$$

TABLE 4 BREAKING STRENGTH - lb/in (N/m) AVERAGE MINIMUM

TYPE I						TYPE II					
Class	Length			Width		Class	Length			Width	
	Direction			Direction			Direction			Direction	
Grade A	1	0.3	(52.5)	0.1	(17.5)	1	0.5	(87.6)	0.3	(52.5)	
	2	0.8	(140.1)	0.3	(52.5)	2	1.0	(175.1)	0.5	(87.5)	
	3	0.5	(87.6)	0.5	(87.6)	3	1.2	(210.2)	0.6	(105.1)	
	4	1.0	(175.1)	0.8	(140.1)	4	2.0	(350.2)	1.0	(175.1)	
	5	1.2	(210.1)	1.0	(175.1)						
	6	1.5	(262.7)	1.3	(227.6)						
	7	.6	(105.1)	.5	(87.6)						
	8	1.2	(210.1)	0.9	(157.6)						
	9	1.0	(175.1)	1.0	(175.1)						
	10	2.0	(350.2)	2.0	(350.2)						
Grade B	1	0.5	(87.6)	0.5	(87.6)						
	2	1.0	(175.1)	1.0	(175.1)						
	3	1.3	(227.7)	1.3	(227.7)						
	4	0.5	(87.6)	0.5	(87.6)						
	5	1.0	(175.1)	1.0	(175.1)						
	6	2.0	(350.2)	2.0	(350.2)						
	7	2.5	(437.8)	2.5	(437.8)						

- 7.11 Thickness - Thickness shall be tested in accordance with ASTM C 167, Tests for Thickness and Density of Thermal Insulations.

7.11.1 Grade A - Insulation less than 1 inch (25.4 mm) nominal shall recover to within ± 15 percent of the nominal thickness. Insulation 1 inch (25.4 mm) or greater nominal shall recover to within ± 0.25 inch (6.4 mm).

7.11.2 Grade B - Insulation less than 1 inch (25.4 mm) nominal shall recover to within ± 25 percent of the nominal thickness. Insulation 1 inch (25.4 mm) or greater nominal shall recover to within ± 0.25 inch (6.4 mm).

6. METHODS OF TEST

- 8.1. Burning Test - The following test method is taken from 14 CFR Part 25 Appendix F and is used to determine compliance with 14 CFR Part 25.853 (Section 7.4.1).
- 8.1.1. Conditioning - Specimens must be conditioned at 70°F, plus or minus 5° and at 50 percent plus or minus 5 percent relative humidity until moisture equilibrium is reached. Only one specimen at a time may be removed from the conditional environment immediately before subjecting it to the flame.
- 8.1.2. Specimen Configuration - Materials must be tested either as a section cut from a fabricated part as installed in the airplane or as a specimen simulating a cut section, such as: A specimen cut from a flat sheet of the material or a model of the fabricated part. The specimen may be cut from any location in a fabricated part. The specimen thickness must be no thicker than the minimum thickness to be qualified for use in the airplane.
- When performing the tests the specimen must be mounted in a metal frame so that in the vertical tests the two long edges are held securely. The exposed area of the specimen is at least 2 inches (50.8 mm) wide and 12 inches (304.8 mm) long, and the edge to which the burner frame is applied must not consist of the finished or protected edge of the specimen but must be representative of the actual cross-section of the material or part installed in the airplane.
- 8.1.3. Apparatus - Test must be conducted in a draft-free cabinet in accordance with Federal Specification CCC-T-191b Method 5903T (revised Method 5902) for the vertical test (available from the General Services Administration, Business Service Center, Region 3, Seventh and D Streets S.W., Washington, D.C. 20407).
- 8.1.4. Test Conditions - A minimum of three specimens must be tested and the results averaged. Each specimen must be supported vertically. The specimen must be exposed to a Bunsen or Tiril burner with a nominal 3/8 inch I.D. tube adjusted to give a flame of 1-1/2 inches (38.1 mm) in height. The minimum flame temperature measured by a calibrated thermocouple pyrometer in the center of the flame must be 1550°F. The lower edge of the specimen must be 3/4 inch above the top edge of the burner. The flame must be applied to the centerline of the lower edge of the specimen. The flame must be applied for 12 seconds and then removed.

8. METHODS OF TEST

8.1.4 Flame time, burn length and flaming time of drippings, if any, must be recorded. The burn length determined in accordance with 8.1.5 must be measured to the nearest 1/10 inch (2.54 mm).

8.1.5 Burn Length - Burn length is the distance from the original edge to the farthest evidence of damage to the test specimen due to flame impingement, including areas of partial or complete consumption, charring or embrittlement; but not including areas sooted, stained, warped, or discolored, nor areas where material has shrunk away from the heat source.

8.2 Wicking Test

8.2.1 Test Specimen - Cut six 1 inch (25.4 mm) by 6 inch (152.4 mm) specimens from the batting material with the 6 inch (152.4 mm) length in the axis parallel to the length of the roll. Cut six similar specimens with the 6 inch (152.4 mm) length parallel to the width of the roll.

8.2.2 Procedure - 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 to 0.035, 4 x 4 mesh galvanized 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 inch (25.4 mm). The water must be at room temperature.

8.2.3 Position the remaining six specimens similarly in another container. Pour distilled water into the container to a height of 1 inch (25.4 mm). Maintain the temperature of the water at 120F $\pm$ 5F. Note degree of wicking every 24 hours.

8.3 Odor Emission Test - A minimum of 50 grams of the material shall be subjected to a soaking temperature of 150F (65.6C) for 30 minutes in a closed container. Care should be taken to use containers that will not produce odor. Stainless steel or glass jars with all-metallic lids are recommended.

8.3.1 A panel of five persons with normal odor perception shall examine for odor using the following questions. Response to each shall be noted:

8. METHODS OF TEST

8.3 Odor Emission Test

- 8.3.1 1. Was the odor perceptible?
2. Was the odor objectionable, pleasant or otherwise?
3. Was the odor weak, strong, or very strong?

9. DIMENSIONS AND PERMISSIBLE VARIATIONS:

- 9.1 Standard Sizes - Standard sizes of glass fiber blanket are listed in Table 5.

TABLE 5
STANDARD SIZES

	TYPE I			TYPE II		
	Class	Length - ft. (m)	Width - in. (mm)	Class	Length - ft. (m)	Width - in. (mm)
Grade A	1	100 (30.5)	36 72 (914, 1829)	1	100 (30.5)	36 72 (914, 1829)
	2	100 (30.5)	36 72 (914, 1829)	2	100 (30.5)	36 72 (914, 1829)
	3	100 (30.5)	36 72 (913, 1829)	3	100 (30.5)	36 72 (914, 1829)
	4	100 (30.5)	36 72 (914, 1829)	4	100 (30.5)	36 72 (914, 1829)
	5	50 (15.2)	36 72 (914, 1829)			
	6	50 (15.2)	36 72 (914, 1829)			
	7	100 (30.5)	36 72 (914, 1829)			
	8	100 (30.5)	36 72 (914, 1829)			
	9	100 (30.5)	36 72 (914, 1829)			
	10	100 (30.5)	36 72 (914, 1829)			

TABLE 5 - STANDARD SIZES

		TYPE I				
		Length - ft.		Width - in.		
Grade	Class	(in)		(mm)		
E	1	100	200	36	54	72
		(30.5, 61.0)		(914, 1372, 1829)		
	2	100		36	54	72
		(30.5)		(914, 1372, 1829)		
	3	100		36	54	72
		(30.5)		(914, 1372, 1829)		
	4	100	200	36	54	72
		(30.5, 61.0)		(914, 1372, 1829)		
	5	100		36	54	72
		(30.5)		(914, 1372, 1829)		
	6	100		36	54	72
		(30.5)		(914, 1372, 1829)		
	7	100		36	54	72
		(30.5)		(914, 1372, 1829)		

9.2 The average measured length and width shall not differ from the manufacturer's standard dimensions by more than the following:

Length ± 0.5 ft. (0.152 m)

Width ± 0.5 inch (15 mm)

10. WORKMANSHIP:

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

11. INSPECTION:

11.1 It is recommended that sampling and inspection be performed in accordance with ASTM C 390, Sampling Preformed Thermal Insulation, Plan A.

12. REJECTION:

- 12.1 If inspection of the sample shows failure to conform to the requirements of this specification, a second sample from the same lot shall be tested and the results of this retest averaged with the results of the original test.
- 12.2 Upon retest, as described in 10.1, failure to conform to this specification shall constitute grounds for rejection.
- 12.3 In case of rejection, the manufacturer or supplier shall have the right to reinspect the rejected shipment or resubmit the lot after removal of that portion of the shipment not conforming to the specified requirements.

13. PACKAGING AND MARKING:

- 13.1 Packaging - Unless otherwise agreed or specified between the purchaser and the manufacturer or supplier, the insulation shall be packed in the manufacturer's standard commercial containers.
- 13.2 Marking - Unless otherwise specified, container shall be marked with the supplier's name and designation, type, class, size and thickness and quantity of the material contained.