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Standard Specification for Polyimide Flexible Cellular Thermal and Sound Absorbing Insulation[1]

This standard is issued under the fixed designation C 1482; 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 the composition and physical properties of lightweight, flexible open-cell polyimide foam insulation intended for use as thermal and sound-absorbing insulation for temperatures from -328°F up to +572°F (-200°C and +300°C) in commercial and industrial environments.

1.1.1 Annex A1 includes faced polyimide foam as specified by the U.S. Navy for marine applications.

1.1.2 This standard is designed as a material specification and not a design document. Physical property requirements vary by application and temperature. No single test is adequate for estimating either the minimum or maximum use temperature of polyimide foam under all possible conditions. Consult the manufacturer for specific recommendations and physical properties for specific applications.

1.1.3 The use of an appropriate vapor retarder is required in all applications where condensation could occur and cause a decrease in thermal performance or affect other system properties.

1.2 The values stated in inch-pound units are to be regarded as the standard. The SI units are given in parentheses for information only.[2]

1.3 *This standard does not purport to address all of the safety concerns associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and determine the applicability of regulatory requirements prior to use.*

NOTE 1—The subject matter of this material specification is not covered by any other ASTM specification. There is no known ISO standard covering the subject of this standard.

2. Referenced Documents

2.1 *ASTM Standards:* [3]

C 165 Test Method for Measuring Compressive Properties of Thermal ~~i~~Insulations

C 168 Terminology Relating to Thermal Insulation

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

C 302 Test Method for Density and Dimensions of Preformed Pipe-Covering-Type Thermal Insulation

C 335 Test Method for Steady-State Heat Transfer Properties of ~~Horizontal~~ Pipe Insulation

C 390~~Criteria~~ Practice for Sampling and Acceptance of Thermal Insulation Lots

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

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

C 447 Practice for Estimating the Maximum Use Temperature of Thermal Insulations

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

C 634 Terminology Relating to Building and Environmental Acoustics

C 665 Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing

[1] This specification is under the jurisdiction of ASTM Committee C16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.22 on Organic and Non-homogeneous Inorganic Thermal Insulations.

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~~[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.~~

[2] With the exception of the values given for heat release (Test Method E 1354), where the SI units are regarded as the standard. The inch-pound units are for information only.

~~[3] Federal Aviation Regulations Part 25 (Airworthiness Standards, Transport Category Aircraft, and Section 25.853. Procedure in appendix F, Part I, (a) (1) (i) and (ii). Available from Superintendent of Documents, U.S. Government Printing Office P.O. Box 371954, Pittsburgh, PA 15250-7954.~~

[3] 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.

C 1045 Practice for Calculating Thermal Transmission Properties Under Steady-State Conditions
C 1058 Practice for Selecting Temperatures for Evaluating and Reporting Thermal Properties of Thermal Insulation
C 1114 Test Method for Steady-State Thermal Transmission Properties by Means of the Thin-Heater Apparatus
D 395 ~~Test Method for Rubber Property—Compression Set~~ Test Methods for Rubber PropertyCompression Set
D 543 ~~Test Method~~ Practices for Evaluating the Resistance of Plastics to Chemical Reagents
D 638 Test Method for Tensile Properties of Plastics
D 2126 Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging
D 3574 Test Methods for Flexible Cellular Materials—Slab, Bonded, and Molded Urethane Foams
D 3675 Test Method for Surface Flammability of Flexible Cellular Materials Using ~~A~~a Radiant Heat Energy Source
E 84 Test Method for Surface Burning Characteristics of Building Materials
E 96/E 96M Test Methods for Water Vapor Transmission of Materials
E 176 Terminology of Fire Standards
E 662 Test Method for Specific Optical Density of Smoke Generated by Solid Materials
E 795 Practices for Mounting Test Specimens During Sound Absorption Tests
E 800 Guide for Measurement of Gases Present or Generated During Fires
E 1354 Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter
E 2231 Practice for Specimen Preparation and Mounting of Pipe and Duct Insulation Materials to Assess Surface Burning Characteristics

2.2 *U.S. Federal Standards:*

FAR 25.853(a), Appendix F, Part 1, (a) (1) (i) Test Criteria and Procedures for Showing Compliance with Sec. 25.853, or 25.855[4]
FAR 25.856(a), Appendix F, Part VI, Test Methods to Determine the Flammability and Flame Propagation Characteristics of Thermal/Acoustic Insulation Materials[4]
MIL-C-20079 Cloth, Glass; Tape, Textile Glass; and Thread, Glass[5]
MIL-A-3316 Adhesive, Fire-Resistant, Thermal Insulation[5]
DOD-E-24607 Enamel, Interior, Nonflaming (Dry), Chlorinated Alkyd Resin, Semigloss (Metric)[5]

2.3 *Private Sector Standards:*

Boeing BSS 7239 Test Method for Toxic Gas Generation by Materials on Combustion[6]
TAPPI T 803 Puncture and Stiffness Test of Container Board[7]
TM-232 Vertical Pipe-Chase Test to Determine Flame-Propagation Characteristics of Pipe Covering[8]

3. Terminology

3.1 *Definitions*—Terms used in this specification are defined in Terminology C 168, Terminology C 634, and Terminology E 176. In the case of a conflict, Terminology C 168 shall be the dominant authority.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *flexible cellular product*—a cellular organic polymeric material that will not rupture when a specimen 8 by 1 by 1 in. (200 by 25 by 25 mm) is bent around a 1 in. (25 mm) diameter mandrel at a uniform rate of one lap in 5 sec. at a temperature between 64 and 85°F (18 and 29°C), in accordance with the description of a flexible cellular product (currently Subsection 3.1.3) in Test Methods D 3574.

3.2.2 *slab*—a rectangular section, piece, or sheet of foam that is cut from a bun, or block of foam.

3.2.3 *polyimide foam*—a flexible cellular product in which the bonds formed between monomers during polymerization are imide or amide bonds. The theoretical mole fraction of imide bonds must be greater than the theoretical mole fraction of amide bonds.

4. Classification

4.1 The flexible polyimide cellular insulations of this specification are classified into Types I through VI as listed in Tables 1 and 2 (Note 2). Type I is further subdivided into two grades based on maximum allowable thermal conductivity at 75° F (24° C). The Types II and III are subdivided into classes (Note 3).

~~[4] Available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.~~
[4] Federal Aviation Regulations Part 25 (Airworthiness Standards, Transport Category Aircraft, and Section 25.853. Procedure in appendix F, Part I, (a) (1) (i) and (ii). Available from Superintendent of Documents, U.S. Government Printing Office P.O. Box 371954, Pittsburgh, PA 15250-7954.
~~[5] Available from Boeing Commercial Airplane Group, Material Division, P.O. Box 3707, Seattle, WA 98124-2207.~~
[5] Available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.
~~[6] Available from the Technical Association of the Pulp and Paper Industry, P.O. Box 105113, Atlanta GA 30348.~~
[6] Available from Boeing Commercial Airplane Group, Material Division, P.O. Box 3707, Seattle, WA 98124-2207.
~~[7] Available from Armstrong World Industries, Inc., Research and Development, P.O. Box 3511, Lancaster, PA 17604.~~
[7] Available from Technical Association of the Pulp and Paper Industry (TAPPI), 15 Technology Parkway South, Norcross, GA 30092, http://www.tappi.org.
~~[8] Commander, Naval Sea Systems Command, SEA 55z3, Department of the Navy, Washington, DC 20362-5101.~~
[8] Available from Armstrong World Industries, Inc., Research and Development, P.O. Box 3511, Lancaster, PA 17604.

TABLE 1 Polyimide Foam Classification (inch-pound)

	TYPE I Grade 1	TYPE I Grade 2	TYPE IV	TYPE V	TYPE VI
Density, max, lb/ft^3	0.48	0.48	0.37	0.55	0.50
Maximum Apparent Thermal Conductivity Btu-in./h ft^2–°F					
–238° F	0.14	0.14	0.14	0.14	0.14
–58° F	0.23	0.22	0.23	0.23	0.23
75° F	0.32	0.29	0.34	0.30	0.34
212° F	0.51	0.47	0.54	0.47	0.50
356° F	0.74	0.70	0.81	0.70	0.74
572° F	NA[A]	NA[A]	NA[A]	NA[A]	1.15
Upper Temperature Limit – test temperature for C 411, °F	400	400	400	400	572
High Temperature Stability – % of initial tensile strength retained after 336 hours in air oven at 400° F, min, %	60	60	NA[A]	NA[A]	NA[A]
High Temperature Stability – % of initial tensile strength retained after 336 hours in air oven at 572° F, min, %	NA[A]	NA[A]	NA[A]	NA[A]	70
Tensile Strength, min, lb/in.^{2}	8.5	8.5	2.8	8.5	3.9
Compressive Strength, min, lb/in.^{2} at 25% deflection	0.5	0.5	NA[A]	NA[A]	0.5
50% Compression Deflection, min, lb/in^2	1.2	1.2	NA[A]	NA[A]	NA[A]
Compression Set, max, %	NA[A]	NA[A]	40	40	NA[A]
Steam Aging					
Change in Tensile Strength, max, %	25	25	NA[A]	NA[A]	25
Dimensional and weight changes, max, %	10	10	NA[A]	NA[A]	10
Corrosiveness	pass	pass	pass	pass	pass
Chemical Resistance	pass	pass	pass	pass	pass
Surface Burning Characteristics, 2 in. thickness[B]					
Flame Spread Index, max	10	10	15	15	10
Smoke Development, Index, max	15	15	20	20	15
~~Radiant Panel Surface Flammability, Flame Spread Index, max[B]~~	~~5~~	~~5~~	~~5~~	~~5~~	~~2~~
Radiant Panel Surface Flammability, Radiant Panel Index, max[B]	5	5	5	5	2
Vertical Burn[B,C]					
Burn Length, max, in.	NA[A]	NA[A]	2	2.4	NA[A]
After Flame Time, max, sec	NA[A]	NA[A]	1	1	NA[A]
Flame Propagation[B,C]					
After Flame Time, max, sec	NA[A]	NA[A]	3	3	3
Propagation Length, max, in.	NA[A]	NA[A]	2	2	2
~~Total heat release (2 min), max, Btu/ft^2[B]~~	~~79~~	~~79~~	~~NA[A]~~	~~NA[A]~~	~~NA[A]~~
Total heat release, max, Btu/ft^2[B]	53	53	NA[A]	NA[A]	NA[A]
Maximum heat release rate, max, Btu/min-ft^2[B]	106	106	NA[A]	NA[A]	NA[A]
Specific Optical Smoke Density, D_m, max[B]					
non-flaming mode	5	5	5	5	5
flaming mode	10	10	10	10	5
Total Hydrogen Halide (HCl, HBr, and HF) Gases in Smoke, Flaming Exposure, max, ppm (Above background for empty chamber)[B]	10	10	10	10	10
Toxic Gas Generation: max, ppm[B]					
CO	300	300	300	300	300
HCN	5	5	5	5	5
HF	5	5	5	5	5
HCl	10	10	10	10	10
HBr	5	5	5	5	5
SO2	5	5	5	5	5
NOx	10	10	10	10	10
Acoustical Absorption Coefficient 2 in. thickness, min Noise Reduction Coefficient (NRC)	0.75	0.70	0.75	0.85	0.70

[A] NA = not applicable

[B] This standard should be used to measure and describe the properties of materials, products, or assemblies in response to heat and flame under controlled laboratory conditions and should not be used to describe or appraise the fire hazard or fire risk under actual fire conditions.

[C] The material shall not melt, drip, or flow when tested as required.

NOTE 2—Although all types find application in a wide variety of markets, the current primary market for each type is as follows:

Type I—marine and industrial applications.

Type II—Type II is Type I foam faced and used in specific marine applications, as specified for the U.S. Navy in Annex A1.

Type III—Type III is Type I foam pipe shaped and used in specific marine applications, as specified for the U.S. Navy in Annex A1.

Types IV and V—aerospace applications depending on density.

Type VI—applications requiring improved high temperature and fire performance.

NOTE 3—The Type II and Type III designations as well as the subdivision of Types into Classes is to maintain uniformity with existing U.S. Navy nomenclature (Annex A1).

5. Materials and Manufacture

5.1 Polyimide foam shall be manufactured from the appropriate monomers, and necessary compounding ingredients to conform to 3.2.3. This is not intended to imply that foam products made using different materials are equivalent with respect to all physical properties.

TABLE 2 Polyimide Foam Classification (SI units)

	TYPE I Grade 1	TYPE I Grade 2	TYPE IV	TYPE V	TYPE VI
Density, max, kg/m^3	7.7	7.7	5.9	8.8	8.0
Maximum Apparent Thermal Conductivity W/m-K					
–150° C	0.020	0.020	0.020	0.020	0.020
–50° C	0.033	0.032	0.033	0.033	0.033
24° C	0.046	0.042	0.049	0.043	0.049
100° C	0.074	0.068	0.078	0.068	0.072
180° C	0.107	0.101	0.117	0.101	0.107
300° C	NA[A]	NA[A]	NA[A]	NA[A]	0.166
Upper Temperature Limit – test temperature for C 411, °C	204	204	204	204	300
High Temperature Stability – % of initial tensile strength retained after 336 hours in air oven at 204° C, min, %	60	60	NA[A]	NA[A]	NA[A]
High Temperature Stability – % of initial tensile strength retained after 336 hours in air oven at 300° C, min, %	NA[A]	NA[A]	NA[A]	NA[A]	70
Tensile Strength, kPa	60	60	18	60	27
Compressive Strength, min, kPa at 25% deflection	3.4	3.4	NA[A]	NA[A]	3.4
50% Compression Deflection, min, kPa	8	8	NA[A]	NA[A]	NA[A]
Compression Set, max, %	NA[A]	NA[A]	40	40	NA[A]
Steam Aging,					
Change in Tensile Strength, max, %	25	25	NA[A]	NA[A]	25
Dimensional and weight changes, max, %	10	10	NA[A]	NA[A]	10
Corrosiveness	pass	pass	pass	pass	pass
Chemical Resistance	pass	pass	pass	pass	pass
Surface Burning Characteristics, 50 mm thickness[B]					
Flame Spread Index, max	10	10	15	15	10
Smoke Development, Index, max	15	15	20	20	15
~~Radiant Panel Surface Flammability, Flame Spread Index, max[B]~~	~~5~~	~~5~~	~~5~~	~~5~~	~~2~~
Radiant Panel Surface Flammability, Radiant Panel Index, max[B]	5	5	5	5	2
Vertical Burn[B,C],					
Burn Length, max, mm	NA[A]	NA[A]	50	60	NA[A]
After Flame Time, max, sec	NA[A]	NA[A]	1	1	NA[A]
Flame Propagation[B,C],					
After Flame Time, max sec	NA[A]	NA[A]	3	3	3
Propagation length max, mm	NA[A]	NA[A]	51	51	51
~~Total heat release (2 min), max, kW-min/m^2[B]~~	~~15~~	~~15~~	~~NA[A]~~	~~NA[A]~~	~~NA[A]~~
Total heat release, max, MJ/m^2[B]	10	10	NA[A]	NA[A]	NA[A]
Maximum heat release rate, max, kW/m^2[B]	20	20	NA[A]	NA[A]	NA[A]
Specific Optical Smoke Density, D_m, max[B]					
non-flaming mode	5	5	5	5	5
flaming mode	10	10	10	10	5
Total Hydrogen Halide (HCl, HBr, and HF) Gases in Smoke, Flaming Exposure, max, ppm (Above background for empty chamber)[B]	10	10	10	10	10
Toxic Gas Generation: max, ppm[B]					
CO	300	300	300	300	300
HCN	5	5	5	5	5
HF	5	5	5	5	5
HCl	10	10	10	10	10
HBr	5	5	5	5	5
SO2	5	5	5	5	5
NOx	10	10	10	10	10
Acoustical Absorption Coefficient 50.8 mm thickness, min Noise Reduction Coefficient (NRC)	0.75	0.70	0.75	0.85	0.70

[A] NA = not applicable

[B] This standard should be used to measure and describe the properties of materials, products, or assemblies in response to heat and flame under controlled laboratory conditions and should not be used to describe or appraise the fire hazard or fire risk under actual fire conditions.

[C] The material shall not melt, drip, or flow when tested as required.

6. Physical Properties

6.1 The insulation shall conform to the requirements in Tables 1 and 2 for each type, unless specifically stated otherwise by agreement between the supplier and the purchaser. Tests shall be made in accordance with the methods specified in ~~11.1-11.19~~11.1-11.20.

6.1.1 *Upper Temperature Limit*—Upper temperature limit shall be determined according to 11.4 at the application's intended maximum use temperature or at a temperature determined by agreement between the purchaser and manufacturer.

6.1.2 *Burning Characteristics*—The uncoated and unfaced foam shall conform to the requirements in Tables 1 and 2 for each type, when tested in accordance with ~~11.12-11.18~~11.12-11.19, without the use of flame/smoke or heat suppressant barriers or coatings.

6.1.3 *Sound Absorbing Performance*—Unless specifically otherwise agreed to between the supplier and the purchaser, all tests shall be made in accordance with the methods specified in ~~11.18~~11.19.

6.2 The values stated in Tables 1 and 2 are not to be used as design values. It is the responsibility of the buyer to specify design requirements and obtain supporting documentation from the material supplier.

7. Workmanship and Appearance

7.1 The slab offered as saleable material shall be free of foreign materials and defects that will adversely affect its performance in service.

7.2 *Voids and Surface Damage*—Surface damage due to handling, and voids that are between 0.24 in. (6 mm) and 1.4 in. (35 mm) in diameter, and extend through the entire slab, may be repaired by gluing, plugging, or cutting and splicing. Voids greater than 1.4 in. (35 mm) in diameter shall be cause for rejection of the affected material. Plugging may be achieved using compression fit or by using adhesives. Adhesives used for repair shall not affect the overall smoke, fire, or acoustic performance required for the material in this specification. Material used for repairs shall be of the same composition and quality as undamaged material. The acceptance of type and amount of repair shall be as agreed upon by the supplier and the user.

8. Sampling

8.1 *Sampling*—The insulation shall be sampled in accordance with ~~Criteria~~Practice C 390. Otherwise, specific provisions for sampling shall be as agreed upon between the user and the supplier.

8.2 *Specimen*—For polymide foam insulation, specimens of dimensions 12 in. by 12 in. by 1 in. (300 mm by 300 mm by 25 mm) are sufficient for purposes of acceptance inspection of samples.

9. Qualification Requirements

9.1 The following requirements are generally employed for initial material or product qualification:

~~9.1.1Upper Temperature Limit~~

9.1.1 Upper Temperature Limit,

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9.1.2 Tensile Strength,

9.1.3 Compressive Strength,

9.1.4 Compression Set,

9.1.5 Chemical Resistance,

9.1.6 Apparent Thermal Conductivity at 75° F (24° C),

9.1.7 Specific Optical Smoke Density,

9.1.8 Hydrogen Halide Gases in Smoke,

9.1.9 Surface Burning Characteristics,

9.1.10 Radiant Panel Surface Flammability,

9.1.11 Heat Release Rate, and

9.1.12 Sound Absorption Coefficients.

10. Inspection

10.1 The following requirements are generally employed for acceptance sampling of lots or shipments of qualified polyimide foam insulation:

10.1.1 Density

10.1.2 Apparent Thermal Conductivity at 75° F (24° C)

10.1.3 Vertical burn—Type IV and V only

10.1.4 Workmanship

10.2 As agreed to by the purchaser and the manufacturer, the inspection of the material shall be made at either the point of shipment or point of delivery.

11. Test Methods

11.1 *Sample Preparation*

11.1.1 In cases where the material is cut into pipe insulation and other shapes without further treatment, slab foam test results are generally representative. If other processes are used for specific applications, it is recommended that qualification testing be conducted using slab specimens, and that inspection testing be on the processed material.

11.1.2 Tests for physical and mechanical properties shall be carried out at a temperature of 73.4 ± 3.6° F (23 ± 2° C) and at a relative humidity of 50 ± 5%. Sound absorbing, thermal, and flammability tests shall be carried out at conditions specified in the applicable test methods.

11.1.3 All test specimens for testing of physical and mechanical properties in Tables 1 and 2 shall be preconditioned by twice mechanically reducing (flexing) their thickness to a 25 percent deflection of their original thickness. In cases where a specified test method itself contains this requirement, additional flexing is not to be performed. If required, other preconditioning and physical property test limits shall be determined by agreement between the purchaser and manufacturer (Note 4).

NOTE 4—Because the flexing of polyimide foam has an impact on the measured physical properties, a standard preconditioning procedure is given. If the products performance cannot be adequately discerned using the specified preconditioning method, then a more applicable preconditioning method may be used as determined by agreement between the purchaser and manufacturer with appropriately modified physical property limits.

11.2 *Density*—Test Method D 3574, Test A.

11.3 *Apparent Thermal Conductivity*— Test Methods C 177, C 1114, and C 518 in conjunction with Practice C 1045. Test Method C 518 shall not be used at temperatures or resistances other than those in the range of the calibration. Test temperatures shall be chosen in accordance with Table 3 of Practice C 1058. Use the large temperature difference recommended in Table 3 of Practice C 1058 for temperatures between 25 and 110°F (-4 and 43°C); for mean temperatures under 25° F (-4°C) and over 110F (43°C) use the smaller temperature difference.

11.4 *Upper Temperature Limit*—Test Method C 411 and Practice C 447 shall be used at the insulation's maximum use temperature and at maximum design thickness. No special requirements for heat-up shall be specified by the manufacturer. The foam shall not flame, glow, smolder, smoke, soften, collapse, melt, or drip during hot surface exposure.

11.5 *High Temperature Stability*—Test Method D 2126 incorporating Test Method D 638. Use Test Method D 2126, with a modified test temperature of 400°F (204°C) or 572°F (300°C) as shown in Tables 1 and 2. Test before and after aging using Test Method ASTM D 638, type III specimens.

11.6 *Compressive Strength*—Test Method ASTM C 165, Procedure B.

11.7 *50% Compression Deflection*—Test Method ASTM D 3574, Test C.

11.8 *Compression Set*—Test Method ASTM D 395, test temperature is 158° F (70° C) and aging time is 22 hours.

11.9 *Steam Aging*—Test Method D 3574, Procedure J1 and Test E.

11.10 *Corrosiveness*—Test Method in C 665.

11.11 *Chemical Resistance*—Test Method D 543, practice A, procedure I at room temperature with reagents 6.3.8, 6.3.40, 6.3.46, 6.3.50, aviation turbine fuel grade JP-5 and ethylene glycol antifreeze from Table 1, and SKYDROL hydraulic fluid. Final weight and dimensions are to be determined 24 hours after removal from immersion.

11.12 *Surface Burning Characteristics*— Test Method E 84 and for material used in pipe and duct applications use Test Method E 84 with Practice E 2231.

11.13 *Radiant Panel Surface Flammability*— Test Method D 3675.

11.14 *Vertical Burn*—Test Method FAR 25.853, Appendix F, Part 1, (a) (1) (i) .

11.15 *Flame Propagation*—Test Method FAR 25.856(a), Appendix F, Part VI.

11.16 *Heat Release Rate*—Test Method E 1354 with a heat flux of ~~185 BTU/min-ft~~35 kW/m^2 ~~(35 kW/m~~(185 BTU/min-ft ^{2}) and using external ignition.

~~11.16~~

11.17 *Specific Optical Smoke Density*— Test Method E 662.

~~11.17~~

11.18 *Hydrogen Halides in Smoke*—Test Method E 662, with integrated sampling, and anion detection using ion chromatography, in accordance with Guide E 800.

~~11.18~~

11.19 *Toxic Gas Generation*—Boeing BSS 7239, Flaming mode.

~~11.19~~

11.20 *Sound Absorption Coefficients*— Test Method C 423, using the Type A Mounting described in Practices E 795.

12. Certification

12.1 When specified in the purchase order or contract, the purchaser shall be furnished certification that samples representing each lot have been either tested or inspected as directed in 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. For the purpose of this specification, a lot consists of all material of the same type manufactured in one unchanged production run and offered for delivery at the same time.

13. Packaging and Marking

13.1 *Packaging*—Unless otherwise specified, the insulation shall be supplied in the manufacturer's standard commercial packaging.

13.2 *Marking*—Unless otherwise specified, each container shall be plainly marked with the manufacturer's name, the product name, trademark, and the manufacturer's address, with dimensions or volumes, or both, expressed in units agreed upon by the supplier and customer.

14. Keywords

14.1 flexible cellular insulation; pipe insulation; polyimide; ship insulation; sound absorbing; thermal insulation