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Standard Specification for Flexible Aerogel Insulation[1]

This standard is issued under the fixed designation C1728; 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 classification and performance of flexible aerogel thermal insulation. This will cover the range of continuous exposure operating temperatures from ~~-321°F (-196°C)~~ –321°F (–196°C) up to ~~1200° F~~ 1200°F (649°C).

1.2 For satisfactory performance, properly installed protective vapor retarders or barriers shall be used on below ambient temperature applications to reduce movement of moisture through or around the insulation to the colder surface. Failure to use a vapor retarder or barrier could lead to insulation and system non-performance.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 The following safety hazards caveat pertains only to the test methods described in 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:*[2]

C165 Test Method for Measuring Compressive Properties of Thermal Insulations
C167 Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations
C168 Terminology Relating to Thermal Insulation
C177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
C303 Test Method for Dimensions and Density of Preformed Block and Board–Type Thermal Insulation
C335 Test Method for Steady-State Heat Transfer Properties of Pipe Insulation
C356 Test Method for Linear Shrinkage of Preformed High-Temperature Thermal Insulation Subjected to Soaking Heat
C390 Practice for Sampling and Acceptance of Thermal Insulation Lots
C411 Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation
C447 Practice for Estimating the Maximum Use Temperature of Thermal Insulations
C518 Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
C795 Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel
C1045 Practice for Calculating Thermal Transmission Properties Under Steady-State Conditions
C1058 Practice for Selecting Temperatures for Evaluating and Reporting Thermal Properties of Thermal Insulation
C1101/C1101M Test Methods for Classifying the Flexibility or Rigidity of Mineral Fiber Blanket and Board Insulation
C1104/C1104M Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation
C1114 Test Method for Steady-State Thermal Transmission Properties by Means of the Thin-Heater Apparatus
C1338 Test Method for Determining Fungi Resistance of Insulation Materials and Facings
~~C1511 Test Method for Determining the Water Retention (Repellency) Characteristics of Fibrous Glass Insulation (Aircraft Type)~~
C1617 Practice for Quantitative Accelerated Laboratory Evaluation of Extraction Solutions Containing Ions Leached from Thermal Insulation on Aqueous Corrosion of Metals

[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] 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.

C1763 Test Method for Water Absorption by Immersion of Thermal Insulation Materials
E84 Test Method for Surface Burning Characteristics of Building Materials
E2231 Practice for Specimen Preparation and Mounting of Pipe and Duct Insulation Materials to Assess Surface Burning Characteristics

2.2 *Other Standards:*[3]
CAN/ULC-S102 Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

3. Terminology

3.1 *Definitions:*For definitions used in this specification, see Terminology A3.

3.1.1 *flexible aerogel insulation, n*—a flexible insulation containing a composite of aerogel, fibrous carrying media, or reinforcements, or a combination thereof.

[3] Available from Underwriters Laboratories (UL), 2600 N.W. Lake Rd., Camas, WA 98607-8542, http://www.ul.com.

3.1.1.1 *Discussion*—

Opacifiers are sometimes added as either fibers or powders.

~~3.2 *flexible aerogel insulation, n*—a flexible insulation containing a composite of aerogel, fibrous carrying media, or reinforcements, or a combination thereof.~~

~~3.2.1 *Discussion*—~~

~~Opacifiers are sometimes added as either fibers or powders.~~

3.2 *Abbreviations:*
3.2.1 *N/A*—Not applicable.

4. Classification

4.1 Flexible ~~½~~aerogel insulation shall be classified into three Types based on the maximum use temperature:
4.1.1 Type I — 257°F (125°C)
4.1.2 Type II — 390°F (200°C)
4.1.3 Type III — ~~1200° F~~ 1200°F (649°C)

4.2 ~~Types I and II are~~ Type I is subdivided as Grade 1 (tested in flat configuration) and Categories A or B by thermal conductivity.

4.3 Type II comprises a Grade 1 (tested in flat configuration) and Category A.

4.4 Type III is subdivided into two Grades 1 and 2 whereby Grade 1 is tested in a flat configuration using Test Method C177 and Grade 2 is tested only in a pipe configuration using Test Method C335.

5. Ordering Information

5.1 The Type, Grade, Category, dimensions, and thickness shall be specified by the purchaser. A product certification (if required) shall be specified in the purchase order.

6. Materials and Manufacture

6.1 *Composition*—Flexible aerogel insulation is a composite of an amorphous silica-based aerogel, a fibrous carrying media, or reinforcements, or a combination thereof, that allow the construct to be flexible.

6.1.1 A fibrous carrying media or reinforcement, or both, consists of the following: fibers, batts, strips, sheets, or some combination thereof.

6.1.1.1 This fibrous carrying media or reinforcement material, or both, is either organic, such as polyester, or inorganic, such as glass fibers. Additionally, some flexible aerogel insulation contains additives such as a water resistant treatment or opacifiers, or both.

7. Physical, Mechanical and Chemical Property Requirements

NOTE 1—Performance requirements for flexible aerogel insulation (Type I Grade 1 Category A, Type I Grade 1 Category B, Type II Grade 1 Category A, Type ~~II Grade 1 Category B, and Type~~ III Grade 1 Category A, and Type III Grade 2 Category A) are given in Table 1.

7.1 *Maximum Use Temperature*—When tested in accordance with Test Method C411 in a flat configuration and the hot surface performance of Practice C447 in a flat configuration at the insulation's maximum use temperature at a thickness of 80 mm or

TABLE 1 Performance Requirements for Types I, II, and III Flexible Aerogel Insulation

Type	I	I	II	II	III	III
Type	I	I	II	III	III	
Grade	1	1	1	1	1	2
Grade	1	1	1	1	2	
Catergory	A	B	A	B	A	A
Catergory	A	B	A	A	A	
Maximum use temperature, °F (°C)	257 (125)	257 (125)	390 (199)	390 (199)	1200 (649)	1200 (649)
Maximum use temperature, °F (°C)	257 (125)	257 (125)	390 (199)	1200 (649)	1200 (649)	
Minimum use temperature, °F (°C)	-321 (-196)	-321 (-196)	-321 (-196)	-321 (-196)	75 (24)	75 (24)
Minimum use temperature, °F (°C)	-321 (-196)	-321 (-196)	-321 (-196)	75 (24)	75 (24)	
Minimum / Maximum Composite Density, lbs/ft^3 (kg/m^3)	1.9 to 6.3 (30 to 100)	5.0 to 11.2 (80 to 180)	4.7 to 9.4 (75 to 150)	5.0 to 11.2 (80 to 180)	10.0 to 15.0 (160 to 240)	10.0 to 15.0 (160 to 240)
Minimum / Maximum Composite Density, lbs/ft^3 (kg/m^3)	1.9 to 6.3 (30 to 100)	5.0 to 11.2 (80 to 180)	4.7 to 9.4 (75 to 150)	10.0 to 15.0 (160 to 240)	10.0 to 15.0 (160 to 240)	
Apparent thermal conductivity, max, Btu●in/h●ft^2●°F (W/m●K) Mean Temperature, °F (°C)						
-200 (-129)	0.098 (0.014)	0.096 (0.014)	0.073 (0.011)	0.093 (0.013)	N/A	N/A
-200 (-129)	0.098 (0.014)	0.096 (0.014)	0.073 (0.011)	N/A	N/A	
-100 (-73.3)	0.12 (0.017)	0.10 (0.015)	0.091 (0.013)	0.10 (0.015)	N/A	N/A
-100 (-73.3)	0.12 (0.017)	0.10 (0.015)	0.091 (0.013)	N/A	N/A	
0 (-17.8)	0.14 (0.021)	0.11 (0.016)	0.11 (0.016)	0.11 (0.016)	N/A	N/A
0 (-17.8)	0.14 (0.021)	0.11 (0.016)	0.11 (0.016)	N/A	N/A	
75 (23.9)	0.17 (0.024)	0.12 (0.017)	0.13 (0.019)	0.12 (0.017)	0.14 (0.021)	0.16 (0.023)
75 (23.9)	0.17 (0.024)	0.12 (0.017)	0.13 (0.019)	0.14 (0.021)	0.16 (0.023)	
100 (37.8)	0.17 (0.025)	0.12 (0.017)	0.14 (0.020)	0.12 (0.018)	0.15 (0.022)	0.17 (0.024)
100 (37.8)	0.17 (0.025)	0.12 (0.017)	0.14 (0.020)	0.15 (0.022)	0.17 (0.024)	
200 (93.3)	0.21 (0.030)	0.13 (0.019)	0.18 (0.025)	0.14 (0.021)	0.16 (0.023)	0.18 (0.024)
200 (93.3)	0.21 (0.030)	0.13 (0.019)	0.18 (0.025)	0.16 (0.023)	0.18 (0.024)	
300 (149)	NA	NA	0.22 (0.032)	0.19 (0.027)	0.18 (0.025)	0.21 (0.028)
300 (149)	NA	NA	0.22 (0.032)	0.18 (0.025)	0.21 (0.028)	
400 (204)	NA	NA	NA	NA	0.20 (0.029)	0.24 (0.033)
400 (204)	NA	NA	NA	0.20 (0.029)	0.24 (0.033)	
500 (260)	NA	NA	NA	NA	0.22 (0.032)	0.28 (0.035)
500 (260)	NA	NA	NA	0.22 (0.032)	0.28 (0.035)	
600 (316)	NA	NA	NA	NA	0.25 (0.036)	0.33 (0.040)
600 (316)	NA	NA	NA	0.25 (0.036)	0.33 (0.040)	
700 (371)	NA	NA	NA	NA	0.30 (0.043)	0.39 (0.048)
700 (371)	NA	NA	NA	0.30 (0.043)	0.39 (0.048)	