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Standard Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation for Pipes and Tanks[1]

This standard is issued under the fixed designation C1393; 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, dimensions, and physical properties of compression-resistant, perpendicularly oriented mineral fiber (rock, slag, or glass) roll and sheet insulation intended for use on flat, curved, or round surfaces operating at temperatures between 0°F (–18°C) and 1000°F (538°C). This product (pipe and tank insulation) is typically used on nominal 24 in. (610 mm) or greater diameter surfaces. For specific applications, the actual use temperatures and diameters shall be agreed upon between the manufacturer and the purchaser.

1.2 The orientation of the fibers within the roll or sheet insulation is essentially perpendicular to the heated/cooled surface (parallel to heat flow). This specification does not apply to flat block, board, duct wrap, or preformed pipe mineral fiber insulation where the insulation fiber orientation is generally parallel to the heated/cooled surface (across the heat flow).

1.3 For satisfactory performance, properly installed protective vapor retarders must be used in below ambient temperature applications to reduce movement of moisture/water vapor through or around the insulation towards the colder surface. Failure to use a vapor retarder can lead to insulation and system damage. Refer to Practice C921 to aid material selection. Although vapor retarders properties are not part of this specification, properties required in Specification C1136 are pertinent to application or performance.

1.4 When the installation or use of thermal materials, accessories, and systems may pose safety or health problems, the manufacturer shall provide the user-appropriate current information regarding any known problems associated with the recommended use for the products of the company and shall also recommend protective measures to be employed in their safe utilization. The user shall establish appropriate safety and health practices and determine the applicability of regulatory requirements prior to use.

1.5 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.

1.6 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C165 Test Method for Measuring Compressive Properties of 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

[1] This specification is under the jurisdiction of ASTM Committee C16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.20 on 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.

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
C665 Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
C680 Practice for Estimate of the Heat Gain or Loss and the Surface Temperatures of Insulated Flat, Cylindrical, and Spherical Systems by Use of Computer Programs
C795 Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel
C921 Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
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
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
C1136 Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
C1335 Test Method for Measuring Non-Fibrous Content of Man-Made Rock and Slag Mineral Fiber Insulation
C1338 Test Method for Determining Fungi Resistance of Insulation Materials and Facings
C1617 Practice for Quantitative Accelerated Laboratory Evaluation of Extraction Solutions Containing Ions Leached from Thermal Insulation on Aqueous Corrosion of Metals
E84 Test Method for Surface Burning Characteristics of Building Materials

2.2 *Other Referenced Documents:*

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

3. Terminology

3.1 *Definitions*—Definitions pertaining to insulation are in accordance with Terminology C168.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *delivered density*—the actual density, calculated by shipped weight divided by volume, of the product transported by the manufacturer or the seller and received by the purchaser.

3.2.2 *facing*—a layer or foundation of thin material which is adhered to the insulation to form a continuous roll or sheet of insulation.

3.2.3 *mean temperature*—the sum of the cold surface temperature and the hot surface temperature divided by two.

4. Classification

4.1 Mineral fiber roll or sheet insulation covered by this specification is classified into the six types and two categories shown in Table 1. This classification is based upon the maximum use temperature, maximum apparent thermal conductivity, and compressive resistance properties.

4.1.1 *Types:*

4.1.1.1 *Type I*—Maximum use temperature up to 450°F (232°C).
4.1.1.2 *Type II*—Maximum use temperature up to 650°F (343°C).
4.1.1.3 *Type IIIA*—Maximum use temperature up to 850°F (454°C).
4.1.1.4 *Type IIIB*—Maximum use temperature up to 850°F (454°C).
4.1.1.5 *Type IVA*—Maximum use temperature up to 1000°F (538°C).
4.1.1.6 *Type IVB*—Maximum use temperature up to 1000°F (538°C).

4.1.2 *Categories:*

4.1.2.1 *Category 1*—Greater minimum compressive resistance properties are required.
4.1.2.2 *Category 2*—Lesser minimum compressive resistance properties are required.

5. Ordering Information

5.1 The type, category, dimensions, and facing shall be specified by the purchaser. Shot content and delivered density certification only if specified by the purchaser.

6. Materials and Manufacture

6.1 *Composition*—Mineral fiber roll or sheet shall be composed of rock, slag, or glass processed from the molten state into fibrous form, bonded with an organic binder, and the orientation of the fibers within the roll or sheet insulation is essentially perpendicular to the heated or cooled surface (parallel to heat flow).

6.2 *Facings:*

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

TABLE 1 Physical Property Requirements[A]

Properties	Type I	Type II	Type IIIA	Type IIIB	Type IVA	Type IVB
Maximum Use Temperature,° F (°C) See Note 1 in 6.2.1	Up to 450 (232)	650 (343)	850 (454)	850 (454)	1000 (538)	1000 (538)
Apparent thermal conductivity Maximum Btu in./h·ft^2 °F (W/m·K) Mean temperature,° F (°C)						
25 (-4)	0.26(0.038)	0.26(0.038)	0.26(0.038)	0.26(0.038)	0.26(0.038)	0.27(0.039)
75 (24)	0.27(0.039)	0.27(0.039)	0.27(0.039)	0.27(0.039)	0.27(0.039)	0.28(0.040)
100 (38)	0.29(0.042)	0.29(0.042)	0.29(0.042)	0.29(0.042)	0.29(0.042)	0.30(0.043)
200 (93)	0.38(0.055)	0.38(0.055)	0.38(0.055)	0.36(0.052)	0.36(0.052)	0.36(0.052)
300 (149)	0.48(0.069)	0.48(0.069)	0.48(0.069)	0.45(0.065)	0.45(0.065)	0.43(0.062)
400 (204)	0.61(0.088)	0.61(0.088)	0.61(0.088)	0.54(0.078)	0.54(0.078)	0.50(0.072)
500 (260)		0.81(0.117)	0.81(0.117)	0.66(0.095)	0.66(0.095)	0.58(0.084)
600 (316)					0.82(0.118)	0.67(0.097)
Category 1—Greater compressive resistance, minimum load required to produce a 10 % reduction in thickness, lb/ft^2 (kPa)	120 (5.7)	120 (5.7)	120 (5.7)	120 (5.7)	120 (5.7)	200 (9.6)
Category 2—Lesser compressive resistance, minimum load required to produce a 10 % reduction in thickness, lb/ft^2 (kPa)	25 (1.2)	25 (1.2)	25 (1.2)	25 (1.2)	25 (1.2)	25 (1.2)
Category 3—Least compressive resistance, minimum load required to produce a 10 % reduction in thickness, lb/ft^2 (kPa)	10 (0.48)	10 (0.48)	10 (0.48)	10 (0.48)	10 (0.48)	10 (0.48)
Water vapor sorption, max % by weight	5.0	5.0	5.0	5.0	5.0	5.0
Density, maximum lb/ft^3 (kg/m^3)[B]	6 (96)	6 (96)	6 (96)	6 (96)	6 (96)	8 (128)
Surface burning characteristics:						
Maximum flame spread index	25	25	25	25	25	25
Maximum smoke developed index	50	50	50	50	50	50

[A]Refer to Section 7 for additional physical property requirements.
[B]The maximum density specified is for weight design purposes only. It is acceptable for additional density requirements to be specified as agreed upon between the purchaser and the manufacturer.

6.2.1 The purchaser must specify the insulation facing and type required.

NOTE 1—The user is advised that the maximum use temperature of the facings and adhesives may be lower than the maximum use temperature of the insulation. The specifier shall ensure that sufficient insulation thickness is installed so none of the accessory items (facing and adhesive) are exposed to temperatures above their maximum use temperature. Practice C680 can be used to predict surface temperatures.

6.2.2 *Typical Facings:*

6.2.2.1 Fiber glass nonreinforced mat.

6.2.2.2 Laminated aluminum foil, reinforced fiber glass scrim, and natural Kraft paper generally known as FRK or FSK.

6.2.2.3 Laminated white Kraft paper, reinforced fiber glass scrim, and aluminum foil generally known as ASJ (All Service Jacket).

6.2.2.4 All vapor retarder facings shall comply with Specification C1136.

6.2.2.5 It is acceptable to specify other kinds of compositions or facings..

6.3 *Manufacturing/Fabrication*—Mineral (rock, slag, or glass) fiberboard is normally manufactured with the fiber essentially oriented parallel with the face or a facing. Fiber direction described in this specification is substantially perpendicular to a facing. This construction aligns mineral fiberboard in a way that one end of the cut fiber is adhered to a facing. The finished product is wound into rolls or cut into sheets.

7. Physical Properties

7.1 The perpendicularly oriented mineral fiber roll and sheet thermal insulation shall conform to the following requirements in Table 1:

7.1.1 *Maximum Use Temperature*—Test in accordance with 11.1.

7.1.2 *Density*—Test in accordance with 11.2.

7.1.3 *Apparent Thermal Conductivity*—Test in accordance with 11.4.

7.1.4 *Surface Burning Characteristics*—Test in accordance with 11.5.

7.1.5 *Water Vapor Sorption*—Test in accordance with 11.7.

7.1.6 *Compressive Resistance*—Test in accordance with 11.8.