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Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form[1]

This standard is issued under the fixed designation C 534/C 534M; 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.

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

1. Scope

~~1.1This specification covers preformed flexible elastomeric cellular thermal insulation in sheet and tubular form. Grade 1 covers materials to be used on commercial or industrial systems with operating temperatures from -183 to 104°C (-297 to 220°F), Grade 2 covers material used on industrial systems with operating temperatures from -183 to 175°C (-297 to 350°F), and Grade 3 covers material used on industrial systems with operating temperatures from -183 to 120°C (-297 to 250°F) where halogens are not permitted.~~

~~1.2The values stated in SI units are to be regarded as the standard. The inch-pound equivalents of SI units, given in parentheses, are approximate.~~

1.1 This specification covers preformed flexible elastomeric cellular thermal insulation in sheet and tubular form. Grade 1 covers materials to be used on commercial or industrial systems with operating temperatures from -183 to 104°C [-297 to 220°F], Grade 2 covers material used on industrial systems with operating temperatures from -183 to 175°C [-297 to 350°F], and Grade 3 covers material used on industrial systems with operating temperatures from -183 to 120°C [-297 to 250°F] where halogens are not permitted.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

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:* [2]

C 168 Terminology Relating to Thermal Insulation
C 177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
C 209 Test Methods for Cellulosic Fiber Insulating Board
C 390 Practice for Sampling and Acceptance of Thermal Insulation Lots
C 335 Test Method for Steady-State Heat Transfer Properties of Pipe Insulation
C 411 Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation
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 534 Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
C 585 Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System)
C 692 Test Method for Evaluating the Influence of Thermal Insulations on External Stress Corrosion Cracking Tendency of Austenitic Stainless Steel
C 795 Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel

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[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 Nonhomogeneous 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.

C 871 Test Methods for Chemical Analysis of Thermal Insulation Materials for Leachable Chloride, Fluoride, Silicate, and Sodium Ions
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
C 1304 Test Method for Assessing the Odor Emission of Thermal Insulation Materials
C 1427 Specification for Extruded Preformed Flexible Cellular Polyolefin Thermal Insulation in Sheet and Tubular Form
D 883 Terminology Relating to Plastics
D 1622 Test Method for Apparent Density of Rigid Cellular Plastics
D 1667 Specification for Flexible Cellular MaterialsPoly (Vinyl Chloride) Foam (Closed-Cell)
E 84 Test Method for Surface Burning Characteristics of Building Materials
E 96/E 96M Test Methods for Water Vapor Transmission of Materials
E 177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods
E 456 Terminology Relating to Quality and Statistics
E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method
E 2231 Practice for Specimen Preparation and Mounting of Pipe and Duct Insulation Materials to Assess Surface Burning Characteristics

2.2 *Other Standards:*[3]

CAN/ULC-S102–03 Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

3. Terminology

3.1 *Definitions*— Terms used in this specification are defined in Terminology C 168 and in Terminology D 883.

3.2 *Definition of Term Specific to This Standard:*

3.2.1 *cellular elastomeric foam*—a closed-cell foam made of natural or synthetic rubber, or a mixture of the two, and containing other polymers, other chemicals, or both, which is permitted to be modified by organic or inorganic additives. These foams have properties similar to those of vulcanized rubber, namely, (*1*) the ability to be converted from a thermoplastic to a thermosetting state by cross-linking (vulcanization) and (*2*) the ability to recover substantially its original shape when strained or elongated.

3.2.2 *flexible cellular*—a flexible cellular organic polymeric material shall not rupture within 60 s when a specimen 200 by 25 by 25 mm ~~(8~~[8 by 1 by 1 ~~in.)~~in.] is bent around a 25-mm ~~(1-in.)~~[1-in.] diameter mandrel at a uniform rate of one lap in 5 s in the form of a helix at a temperature between 18 and 29°C ~~(65~~[65 and ~~85°F).~~ 85°F].

NOTE 1—The flexibility of these materials may decrease at lower temperatures.

4. Classification

4.1 The types are designated below:

4.1.1 *Type I*—Tubular.

~~Grade 1 Use temperature -183 to 104°C (-297 to 220°F).~~
Grade 1 Use temperature -183 to 104°C [-297 to 220°F].
~~Grade 2 Use temperature -183 to 175°C (-297 to 350°F).~~
Grade 2 Use temperature -183 to 175°C [-297 to 350°F].
~~Grade 3 Use temperature -183 to 120°C (-297 to 250°F).~~
Grade 3 Use temperature -183 to 120°C [-297 to 250°F].

4.1.2 *Type II*—Sheet.

~~Grade 1 Use temperature -183 to 104°C (-297 to 220°F).~~
Grade 1 Use temperature -183 to 104°C [-297 to 220°F].
~~Grade 2 Use temperature -183 to 175°C (-297 to 350°F).~~
Grade 2 Use temperature -183 to 175°C [-297 to 350°F].
~~Grade 3 Use temperature -183 to 104°C (-297 to 220°F).~~
Grade 3 Use temperature -183 to 104°C [-297 to 220°F].

4.2 Grade 1 is flexible elastomeric material for use on typical commercial systems.

4.3 Grade 2 is a high temperature flexible elastomeric material.

4.4 Grade 3 is an elastomeric material that does not contain any leachable chlorides, fluorides or polyvinyl chloride.

NOTE 2—Continuous long-term exposure at or above the upper use temperature may cause degradation in the form of loss of flexibility

5. Materials

5.1 These products shall be made of a homogeneous blend of natural or synthetic rubber that is permitted to be modified with various thermoplastic or thermosetting resins, plasticizers, modifiers, antioxidants, curatives, blowing agents and other additives. These products are thermoset and are not thermoplastic in nature.

[3] Available from, Underwriters Laboratories of Canada, 7 Crouse Road, Scarborough, Ontario MIR3A9

5.2 These products are expanded with chemical blowing agents that decompose with the application of heat. The gases produced by these blowing agents are similar to those found in the atmosphere and thus the diffusion rate is not significant. These gases do not change over time and the thermal conductivity of the insulation is stable over time.

5.3 Flexible, elastomeric, cellular thermal insulations shall be of uniform core density and have closed cells. Even though these insulation materials are permitted to have a smooth skin surface on one or both sides, they are to be considered homogeneous for the purposes of determining thermal performance.

6. Physical Requirements

6.1 *Qualification Requirements* —Thermal conductivity, water vapor permeability and dimensional stability physical properties listed in Table 1, are defined as qualification requirements (refer to Practice C 390, Section 5, Classification of Requirements and Section 6, Acceptance for Qualification Requirements).

6.2 *Inspection Requirements*:

6.2.1 The requirements for water absorption listed in Table 1 is defined as an inspection requirement (refer to Practice C 390, Section 5, Classification of Requirements, and Section 7, Acceptance for Inspection Requirements).

6.2.2 All dimensional requirements shall be as described in Section 6 and Table 2.

6.2.3 All workmanship, finish and appearance requirements shall be as described in Section 9.

6.2.4 Compliance with inspection requirements shall be in accordance with Practice C 390.

6.3 Both Type I and Type II insulations shall conform to the physical property requirements listed in Table 1.

6.4 The material shall be free of objectionable odors at all temperatures within the recommended use range when tested according to Test Method C 1304.

6.5 *Surface Burning Characteristics* —The material shall be tested to assess its surface burning characteristics, at the thickness supplied, in accordance with Test Method E 84 with mounting according to Practice E 2231. The results shall be reported. In Canada, use Test Method CAN/ULC-S102-03 and report the results.

6.5.1 This test method does not always define the hazard potentially presented by preformed flexible elastomeric cellular thermal insulation under actual fire conditions. It is retained for reference in this standard as test data are required by some codes.

6.5.2 Preformed flexible cellular elastomeric thermal insulation is an organic material and is combustible. Do not exposed it to flames or other ignition sources. In some applications, the fire test response characteristics of the material are addressed through requirements established by the appropriate governing documents.

6.6 *Leachable Chloride/Fluoride Content*—Grade 3 shall be below the detectable limit of the test procedure used for leachable chlorides or fluorides when tested according to Test Method C 871.

7. Standard Shapes, Sizes and Dimensions

7.1 *Type I*—Tubular materials are manufactured in 1.83 m ~~([~~ 72 ~~in.)~~in.] standard lengths, as well as in continuous lengths.

TABLE 1 Physical Requirements for Type I (Tubular) and Type II (Sheet)[A]

Property	Unit	Grade 1	Grade 2 (higher temperature)	Grade 3 (non-chloride/non-fluoride containing)
~~Apparent thermal conductivity, max., at a mean temperature of:~~	~~W/m·K (Btu·in./h·ft²·°F)~~			
Apparent thermal conductivity, max., at a mean temperature of:	W/m·K [Btu·in./h·ft²·°F)			
~~-150°C(-238°F)~~		~~0.023(0.16)~~	~~0.023 (0.16)~~	~~0.023 (0.16)~~
-150°C(-238°F)		0.023[0.16]	0.023 [0.16]	0.023 [0.16]
~~-100°C (-148°F)~~		~~0.028 (0.18)~~	~~0.028 (0.18)~~	~~0.028 (0.18)~~
-100°C (-148°F)		0.028 [0.18]	0.028 [0.18]	0.028 [0.18]
~~-29°C (-20°F)~~		~~0.036 (0.25)~~	~~0.036 (0.25)~~	~~0.036 (0.25)~~
-29°C (-20°F)		0.036 [0.25]	0.036 [0.25]	0.036 [0.25]
~~-18°C (0°F)~~		~~0.038 (0.26)~~	~~0.038 (0.26)~~	~~0.038 (0.26)~~
-18°C (0°F)		0.038 [0.26]	0.038 [0.26]	0.038 [0.26]
~~24°C (75°F)~~		~~0.040 (0.28)~~	~~0.043 (0.30)~~	~~0.040 (0.28)~~
24°C (75°F)		0.040 [0.28]	0.043 [0.30]	0.040 [0.28]
~~50°C (120°F)~~		~~0.043 (0.30)~~	~~0.047 (0.32)~~	~~0.043 (0.30)~~
50°C (120°F)		0.043 [0.30]	0.047 [0.32]	0.043 [0.30]
~~86°C (150°F)~~		~~0.045 (0.31)~~	~~0.049 (0.34)~~	~~0.045 (0.31)~~
86°C (150°F)		0.045 [0.31]	0.049 [0.34]	0.045 [0.31]
~~150°C (300°F)~~		~~NA~~	~~0.061 (0.42)~~	~~NA~~
150°C (300°F)		NA	0.061 [0.42]	NA
Water absorption, max.	% by volume	0.20	0.20	0.20
~~Water-vapor permeability, max.~~	~~g/Pa·s·m (perm-in.)~~	~~1.44×10^{-10}(0.10)~~	~~1.44×10^{-10}(0.10)~~	~~1.44×10^{-10}(0.10)~~
Water-vapor permeability, max.	g/Pa·s·m [perm-in.]	1.44×10^{-10}[0.10]	1.44×10^{-10}[0.10]	1.44×10^{-10}[0.10]
Linear shrinkage, max after soak at maximum use temperature	% linear change	7.0 %	7.0 %	7.0 %

[A] Table 1 describes two types of flexible elastomeric cellular thermal insulation. The values stated in Table 1 may not always be appropriate as design values. For specific design recommendations using a particular product and for supporting documentation, consult the manufacturer.