



Designation: ~~C1427–16~~ C1427 – 21

Standard Specification for Extruded Preformed Flexible Cellular Polyolefin Thermal Insulation in Sheet and Tubular Form¹

This standard is issued under the fixed designation C1427; 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 extruded preformed flexible cellular polyolefin thermal insulation operating temperatures from -150°F to 200°F (-101°C to 93°C). For specific applications, the actual temperature limit shall be agreed upon between the manufacturer and the purchaser.

1.2 The use of thermal insulation materials covered by this specification are governed by codes and standards that address fire performance. Contact manufacturer for specific performance of product at the intended use thickness.

1.3 This specification covers the physical properties of preformed flexible cellular polyolefin thermal insulation, which have been deemed mandatory for thermal design. Physical properties such as density and coefficient of thermal expansion (CTE) have been deemed nonmandatory for thermal design. Nonmandatory physical properties have been included in **Appendix X1** for information purposes only.

1.4 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.

1.5 *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.*

1.6 *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

[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](#)

[C335 Test Method for Steady-State Heat Transfer Properties of Pipe Insulation](#)

[C390 Practice for Sampling and Acceptance of Thermal Insulation Lots](#)

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.

Current edition approved Dec. 1, 2016 March 1, 2021. Published January 2017 March 2021. Originally approved in 1999. Last previous edition approved in 2013 2016 as ~~C1427–13~~ C1427 – 16. DOI: 40.1520/C1427-16.10.1520/C1427-21.

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.

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
 C534 Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
 C585 Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing
 C670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials
 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
 C1114 Test Method for Steady-State Thermal Transmission Properties by Means of the Thin-Heater Apparatus
 C1303 Test Method for Predicting Long-Term Thermal Resistance of Closed-Cell Foam Insulation
 C1304 Test Method for Assessing the Odor Emission of Thermal Insulation Materials
 C1763 Test Method for Water Absorption by Immersion of Thermal Insulation Materials
 D883 Terminology Relating to Plastics
 D1622 Test Method for Apparent Density of Rigid Cellular Plastics
 D1667 Specification for Flexible Cellular Materials—Poly (Vinyl Chloride) Foam (Closed-Cell)
 D3575 Test Methods for Flexible Cellular Materials Made from Olefin Polymers
 E84 Test Method for Surface Burning Characteristics of Building Materials
 E96/E96M Test Methods for Water Vapor Transmission of Materials
 E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods
 E228 Test Method for Linear Thermal Expansion of Solid Materials With a Push-Rod Dilatometer
 E456 Terminology Relating to Quality and Statistics
 E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method
 E2231 Practice for Specimen Preparation and Mounting of Pipe and Duct Insulation Materials to Assess Surface Burning Characteristics

2.2 Other Standards:

CAN/ULC-S102.2 Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies.

3. Terminology

3.1 *Definitions*—Terms used in this specification are defined in Terminology C168 and in Terminology D883.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *polyolefin*—polymers made by the polymerization of olefins, such as ethylene or propylene or copolymerization of olefins with other monomers.

3.2.2 *cellular polyolefin*—a cellular plastic composed primarily of olefin material, processed to form a flexible foam with a closed cell construction.

3.2.2.1 *Discussion*—

These materials are considered foam plastics.

3.2.3 *natural skin*—continuous polymer surface or skin naturally occurring as a result of the extrusion or production process, also referred to as “integral skin.”

3.2.4 *flexible cellular*—a flexible cellular organic polymeric material will not rupture within 60 s 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 s in the form of a helix at a temperature between 65 and 85°F (18 and 29°C).

4. Classification

4.1 The preformed flexible cellular polyolefin thermal insulation shall be of the following types:

4.1.1 *Type I*—tubular.

4.1.2 *Type II*—sheet.

5. Material

5.1 These products shall be extruded flexible cellular polyolefin materials.

5.2 These products are expanded with hydrochlorofluorocarbon gases, hydrofluorocarbon gases, hydrocarbon gases, chemical blowing agents, atmospheric gases, or combinations thereof. These gases will diffuse from the insulation with time after production.

5.3 Extruded flexible cellular polyolefin materials shall be of uniform density. Even though these materials will 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:

6.1.1 Thermal conductivity, water vapor permeability, and linear shrinkage, physical properties listed in **Table 1** are defined as qualification requirements (refer to Practice **C390**, Section 5).

6.2 Inspection Requirements:

6.2.1 The requirements for water absorption listed in **Table 1** is defined as inspection requirements (refer to Practice **C390**, Sections 5 Classification of Requirements and Section 7, Acceptance for Inspection Requirements.)

6.2.2 All dimensional requirements shall be as described in Section 7 and **Table 2**.

6.2.3 All workmanship, finish and appearance requirements shall be as described in Section 8.

6.2.4 Compliance with inspection requirements shall be in accordance with Practice **C390**.

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

6.3 The material shall be free of objectionable odors at all temperatures within the recommended use range when tested according to **Test Method C1304**.

TABLE 1 Physical Property Requirements (Type I—Tubular and Type II—Sheet)

NOTE 1—The values stated in **Table 1** are not always appropriate as design values. For specific design recommendations using a particular product and for supporting documentation, consult the manufacturer.

Property	Unit	Requirement
Use temperature, max	°F (°C)	200 (93)
Use temperature, min	°F (°C)	−150 (−101)
Thermal conductivity, max.		
At a mean temperature of:		
−120°F (−84°C)	Btu-in./hr-ft ² -°F	0.29 (0.042)
0°F (−18°C)	(W/m K)	0.33 (0.048)
75°F (24°C)		0.35 (0.050)
120°F (49°C)		0.37 (0.053)
Water-vapor permeability, max.	perm-in (g/Pa s m)	0.05 (7.29 × 10 ^{−9})
Water absorption, max.,	% by volume	0.2
linear shrinkage, at maximum use temperature.	% linear change	7.0

TABLE 2 Dimensional Tolerances, in. (mm)

<i>Type I</i>		
Inside diameter:		
Up to 5/8 (16) incl.	+1/8 (+ 3)	-0 (-0)
3/4 (19) to 1-1/2 (38) incl.	+3/16 (+ 5)	-0 (-0)
1-3/8 (41) to 2-3/8 (60) incl.	+1/4 (+ 6)	-0 (-0)
Over 2-3/8 (60)	+3/8 (+ 10)	-0 (-0)
Wall thicknesses:		
Up to 3/4 (19)	+1/8 (+ 3)	-0 (-0)
3/4 and over (19)	+3/16 (+ 5)	-0 (-0)
Length:	+3 (+ 75)	-1 (-25)
<i>Type II</i>		
Thickness:		
Up to 1/2 (13) incl.		± 1/16 (2)
Over 1/2 (13)		± 3/32 (3)
Length and width:		± 3 %

6.4 Surface Burning Characteristics:

6.4.1 Surface burning characteristics shall be tested for the thickness supplied in accordance with Test Method E84. For applications in Canada test to CAN/ULC-S102.2. When the referenced Canadian document in this specification is referred to in applicable Canadian building codes, the editions, referenced by those building codes shall govern. The results shall be reported. See Section 1 of Test Method E84 for information regarding the applicability of this test method for use with cellular plastics and Practice E2231 for specimen mounting methods. This test does not always define the hazard potentially resulting from burning of preformed flexible cellular polyolefin thermal insulation under actual fire conditions. It is retained for reference in this specification as laboratory test data required by applicable codes and regulations.

6.4.2 Preformed flexible cellular polyolefin thermal insulation is an organic material and is combustible. Do not expose it to flames or other ignition sources. The fire performance of the material shall be addressed through fire test requirements established by the appropriate governing documents.

6.4.3 It is possible the surface burning characteristics of the materials are different in the vertical orientation from those in the horizontal orientation.

7. Standard Shapes, Sizes and Dimensions

7.1 *Type I*—Tubular materials are manufactured in 36, 60 or 72-in. (0.91, 1.52 or 1.83-m) standard lengths, as well as, continuous lengths. Tubular insulation is manufactured for pipe sizes up to 4-in. (100-mm) nominal pipe size (NPS) with wall thickness up to 1-in. (25.4-mm).

7.2 *Type II*—Sheet and roll material are manufactured in thickness up to 1 in. (25 mm). Sheet insulation is manufactured in the following sizes: 36 by 48 in. (0.91 by 1.22 m) and 48-in. (1.22-m) wide continuous lengths.

7.3 Actual dimensions and tolerances shall be agreed upon between the manufacturer and the purchaser. The Procedure Section and Pipe and Tubing Diameter Section of Practice C585 is beneficial in some cases in determining the actual dimensions required.

7.4 The insulation dimensions shall conform to Table 2 unless otherwise agreed upon between the supplier and the purchaser.

8. Surface

8.1 *Type I*—All surfaces (except ends and slits that are mechanically cut) shall have natural skins.

8.2 *Type II*—Sheet material is manufactured either without skins, with skin on one side or with skin on two sides. The surface shall be at the manufacturer's option, unless otherwise specified.

9. Workmanship, Finish, and Appearance

9.1 The insulation shall be free of visual defects that will adversely affect the service performance.

10. Sampling

10.1 The insulation shall be sampled in accordance with Practice C390. Details shall be agreed upon between the purchaser and the supplier.

10.2 When possible, the insulation shall be tested in the form supplied. However, when Type I does not lend itself to testing or to making of test specimens because of its shape, standard test specimen sheets shall be prepared from material having equivalent physical characteristics to Type I (see 11.1.1).

11. Test Methods

11.1 The physical requirements enumerated in this specification shall be determined in accordance with the following methods:

11.1.1 When standard test specimen sheets are required for tubular material, they shall be prepared from tubular specimen having a minimum inner diameter of 3 in. by longitudinally slitting the tubular specimens along one wall thickness, opening and laying the specimen flat.

11.1.2 These products are manufactured with either skin on one side or skin on both sides. Testing shall be done in the as sold form.

11.2 *Apparent Thermal Conductivity:*

11.2.1 *Type I*—Use in accordance with Test Method C177, C518, C1114 or C335 in conjunction with Practice C1045. Use standard test sheet for Test Methods C177, C518, or C1114.

11.2.1.1 Test Method C1114 shall not be used at temperatures or resistance ranges other than those with comparable results to Test Method C177. In case of dispute, Test Method C177 is recognized as the final authority.

NOTE 1—Test Method C335 may be used to determine the apparent thermal conductivity values for Type 1 tubular material operating at or above ambient temperature. Normally, Test Method C335 is not used to determine the apparent thermal conductivity values for Type 1 tubular material operating at or below ambient temperature.

11.2.2 *Type II*—Use in accordance with Test Methods C177, C518 or C1114 in conjunction with Practice C1045.

11.2.2.1 Test Method C1114 shall not be used at temperatures or resistance ranges other than those with comparable results to Test Method C177. In case of dispute, Test Method C177 is recognized as the final authority.

11.2.3 Tests shall be conducted with a temperature differential of $50 \pm 10^{\circ}\text{F}$ ($25 \pm 5^{\circ}\text{C}$) between the hot and cold plates of the testing apparatus in accordance with Practice C1058, Table 3.

11.2.4 All materials shall be aged a minimum of 180 days at $73 \pm 4^{\circ}\text{F}$ ($23 \pm 2^{\circ}\text{C}$) and at relative humidity of $50 \pm 5\%$ in atmospheric air before measuring the thermal conductivity. Test Method C1303 shall be used in estimating the long-term change in the thermal resistance of unfaced closed cell plastic foams by slicing and scaling under controlled laboratory conditions, providing the material meets the requirements for homogeneity as defined in Test Method C1303.

11.3 *Water Vapor Permeability:*

11.3.1 *Type I and Type II*—Use standard test specimen sheets for Type I. Use Test Method E96/E96M—desiccant method, with the following conditions:

11.3.2 Use Test Method E96/E96M, Method A, desiccant method with the environmental conditions set at $50 \pm 2\%$ relative humidity, $73 \pm 2^{\circ}\text{F}$ ($23 \pm 1^{\circ}\text{C}$).