Designation: C1029 – 15

Standard Specification for Spray-Applied Rigid Cellular Polyurethane Thermal Insulation[1]

This standard is issued under the fixed designation C1029; 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 U.S. Department of Defense.

1. Scope

1.1 This specification covers the types and physical properties of spray applied rigid cellular polyurethane intended for use as thermal insulation. The operating temperatures of the surfaces to which the insulation is applied shall not be lower than −22°F (−30°C) or greater than +225°F (+107°C). For specific applications, the actual temperature limits shall be as agreed upon between the manufacturer and the purchaser.

1.2 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.

1.3 *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]

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

C518 Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

C1303/C1303M Test Method for Predicting Long-Term Thermal Resistance of Closed-Cell Foam Insulation

C1363 Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus

D883 Terminology Relating to Plastics

D1621 Test Method for Compressive Properties of Rigid Cellular Plastics

D1622/D1622M Test Method for Apparent Density of Rigid Cellular Plastics

D1623 Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics

D2126 Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging

D2842 Test Method for Water Absorption of Rigid Cellular Plastics

D6226 Test Method for Open Cell Content of Rigid Cellular Plastics

E84 Test Method for Surface Burning Characteristics of Building Materials

E96/E96M Test Methods for Water Vapor Transmission of Materials

3. Terminology

3.1 *Definitions:*For definitions of terms used in this specification, refer to Terminologies C168 and D883.

4. Classification

4.1 Spray-applied rigid-cellular polyurethane thermal insulation covered by this specification is classified into four types as follows:

4.1.1 *Type I*—Compressive strength 15 psi (104 kPa) minimum.

4.1.2 *Type II*—Compressive strength 25 psi (173 kPa) minimum.

4.1.3 *Type III*—Compressive strength 40 psi (276 kPa) minimum.

4.1.4 *Type IV*—Compressive strength 60 psi (414 kPa) minimum.

5. Ordering Information

5.1 Orders for materials purchased under this specification shall include the following:

[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.

5.1.1 ASTM designation, year of issue, and title.
5.1.2 Type (see 4.1).
5.1.3 *R* value or thickness required (see 10.1).
5.1.4 Sampling, if different (see Section 8).
5.1.5 If a certificate of compliance is required (see 13.1).
5.1.6 If packaging is other than specified (see 14.1).
5.1.7 If marking is other than specified (see 14.4).

6. Materials and Manufacture

6.1 Spray-applied rigid-cellular polyurethane thermal insulation is produced by the catalyzed chemical reaction of polyisocyanates with polyhydroxyl compounds, with the addition of other compounds such as stabilizers and blowing agents.

6.2 The materials shall be capable of being mixed and applied using commercial polyurethane spray equipment.

NOTE 1—The thermal insulation shall be formed directly on the surface to be sprayed, unless agreed upon by the purchaser and the manufacturer.

7. Physical Requirements

7.1 Polyurethane thermal insulation shall have the limiting property values as shown in Table 1.

7.2 Other physical properties shall be required, as agreed upon by the purchaser and the manufacturer

NOTE 2—Density is not a requirement of this specification, but if agreed upon by the purchaser and the manufacturer shall be determined in accordance with Test Method D1622/D1622M for point-of-manufacture quality control.

8. Sampling

8.1 *Lot*—For purposes of sampling, the lot shall consist of all the polyurethane liquid components purchased at one time.

8.2 *Unit Sample*—The unit sample shall consist of approximately 50 lb (23 kg) of each of the two liquid components as required to prepare the foam test specimens specified in Section 9. Samples may be drawn from representative bulk storage or from one or more shipping containers.

8.3 Sampling for qualification tests, if required, shall be in accordance with statistically sound practice. Qualification tests will be conducted on the physical properties in Table 1.

8.4 Sampling for inspection tests, if required, shall be for properties agreed upon between the manufacturer and the purchaser.

9. Test Specimen Preparation

9.1 Finished polyurethane foam insulation test panels shall be made by spray application consistent with the manufacturer's recommendations including: temperatures of the liquid components, ambient temperature, temperature and type of substrate, type and operation of spray equipment, and thickness of foam per pass. Unless otherwise specified and reported, the ambient and substrate temperature shall be 75 ± 5°F (24 ± 3°C). The relative humidity must not exceed 80%. The test panels shall be of a sufficient quantity and size to satisfy test requirements.

NOTE 3—Specific panel sizes and thicknesses shall be based on the requirements of the individual tests.

9.2 The test panels shall be allowed to cure for at least 72 h at 73 ± 2°F (23 ± 1°C) and 50 ± 5% relative humidity prior to cutting or testing for physical properties.

9.3 Core specimens, when required, shall be obtained by removing both the external skin and the boundary skin found at the substrate/foam interface. A trim cut on each face to a depth of ⅛ to ¼ in. (3 to 6 mm) is generally sufficient. Core specimens may contain one or more internal skins at spray pass boundaries.

9.4 *Sample preparation for Test Method D2126:* For Type I, II, III, and IV products the sample foams are spray applied to 2 ft. by 2 ft. (610 by 610- mm) exterior CDX Grade ¾ in. (19-mm) plywood (unfinished on both sides). The preparation of these samples will begin with a control lift of foam with a thickness of approximately ½ in. (13-mm) ±15%. One but no more than two additional lifts are then applied to develop a total foam thickness between 1.5 in. to 2.0 in. (38 to 50-mm). The first pass shall be a control lift approximately ½ (13 mm) thickness (±15 %) A 12 in. × 12 in. (305 × 305-mm) sample is cut from the center of the plywood/foam as the test specimen. The specimen and plywood will be cut in such a manner that it will have at least one knit line. The cut foam height (including the control lift) will be 1.5 in. (38 mm) from the plywood. The test specimen will be cut from the field sample so as to have smooth edges free of cracks. All faces will be smooth and shall be dust free. Two specimens shall be used for test exposure per test. In addition, 2 samples of the plywood will also be cut 12 in. × 12 in. (305 × 305-mm) as a control.

TABLE 1 Physical Properties

Property	Requirements			
	Type I	Type II	Type III	Type IV
Thermal resistance of 1.0 in. (25 mm) thickness, min, °F·ft²·h/Btu (K·m²/W) at mean temperature 75°F (24°C)	6.2	6.2	6.2	6.2
Compressive strength, at yield or 10 % deformation, whichever comes first, min, psi (kPa)	15 (104)	25 (173)	40 (276)	60 (414)
Water vapor permeability, max, perm-inches (ng/Pa·s·m)	3.0 (4.4)	3.0 (4.4)	3.0 (4.4)	3.0 (4.4)
Water absorption, max, volume %	5	5	5	5
Tensile strength, min, psi (kPa)	20 (138)	32 (221)	42 (290)	56 (386)
Response to thermal and humid aging, max, linear change %	12	9	6	5
Closed cell content, min, %	90	90	90	90
Surface burning characteristics, report value	...	...	...	...

10. Test Methods

10.1 Determine thermal resistance in accordance with Test Method C177, Test Method C1363, or Test Method C518 at a mean temperature of 75 ± 2°F (24 ± 1°C) and 40°F (22°C) minimum temperature gradient on 1 ± ⅛-in. (25 ± 3-mm) thick core specimens. These core specimens shall be conditioned at 73 ± 2°F (23 ± 1°C) and 50 ± 5% relative humidity for 180 ± 5 days from time of manufacture (see X1.2) or 90 + 2 days at 140 °F (60 °C) dry heat + 2 °F (1°C). Where other thermal resistance testing requirements are mandated by governmental energy conservation rules and regulations, those procedures shall be required.

NOTE 4—Although Test Method C1303/C1303M can be used to predict long term thermal resistance value, predicted values for current materials covered in Specification C1029 are not available. The industry has started a test program to address this need.

10.2 Determine compressive strength in accordance with Method C165, Procedure A, at a crosshead speed of 0.1 in./min per inch of thickness, at yield or 10% deformation, whichever comes first, or in accordance with Test Method D1621, Procedure A. The loading force shall be applied parallel to the normal thickness dimension of the insulation panel.

10.3 Determine water vapor permeability in accordance with Test Methods E96/E96M, Desiccant Method, at 73 ± 2°F (23 ± 1°C).

10.4 Determine water absorption in accordance with Test Method D2842.

10.5 Determine tensile strength in accordance with Test Method D1623.

10.6 Determine response to thermal and humid aging in accordance with Test Method D2126. Expose the specimens to 158 ± 4 °F (70 ± 2 °C) and 97 ± 3% relative humidity for 168 ± 2 h. Determine the dimensions of the three principal axes to the nearest 0.1%. Measure the percent change in the length, width, and thickness directions of the sample at 24 ± ½ h and 168 ± 2h. Make three measurements of length and width at the center point and two quarter points at the edge of the top surface, and five measurements of thickness at the center and four quarter points of the top surface. If specimens distort, report them as distorting under the specified aging conditions. The maximum of the length, width, and thickness shall be compared to the limits in Table 1.

10.7 Determine the closed cell content in accordance with Test Method D6226.

10.8 Determine the surface burning characteristics in accordance with Test Method E84 at end use thicknesses and report the results. See Section 1 of Test Method E84 for information regarding the applicability of this test method for testing rigid cellular plastics.

11. Inspection

11.1 Inspection of the material shall be as agreed upon between the manufacturer and the purchaser as part of the purchase agreement.

12. Rejection and Rehearing

12.1 Material that fails to conform to the requirements of the specification shall be rejected. Rejection shall be reported to the manufacturer promptly and in writing. The manufacturer shall have the right in case of disagreement of the results to make a claim for a rehearing.

13. Certification

13.1 When specified in the purchase order or contract, a manufacturer's certification shall be furnished to the purchaser that the material was manufactured, sampled, tested, and inspected in accordance with this specification and has been found to meet the requirements. When specified in the purchase order or contract, a report of the test results shall be furnished.

13.2 Upon the request of the purchaser in the contract or order, the certification of an independent third party indicating conformance to the requirements of this specification may be considered.

14. Packaging and Package Marking

14.1 Unless otherwise specified or agreed upon between the manufacturer and the purchaser, the liquid components shall be packaged in the manufacturer's standard commercial containers.

14.2 Each container shall be blanketed with dry air or nitrogen and tightly sealed.

14.3 Each container shall be clearly identified as either polyisocyanate ("A" component) or resin ("B" component).

14.4 Each container shall also be marked with the following information:

14.4.1 Name of the manufacturer.

14.4.2 Manufacturer's product designation.

14.4.3 Manufacturer's lot number or the date of production, or both.

14.4.4 Net weight of the contents and gross weight of the container and contents.

14.4.5 Instructions for safe handling and recommended storage temperatures.

14.4.6 Mixing instructions.

14.4.7 Listing agency label if applicable.

15. Keywords

15.1 air seal; monolithic; SPF; thermal insulation

APPENDIX

(Nonmandatory Information)

X1. General Information

X1.1 The properties of spray-applied polyurethane thermal insulation may vary depending on such factors as the thickness of the foam sprayed, the temperature and type of substrate, the ambient temperature and humidity, the number of spray passes, and the output of the equipment. The properties may also vary depending on different manufacturer's liquid components.

X1.2 Spray-applied polyurethane thermal insulation generally exhibits its highest thermal resistance at the time of manufacture. The thermal resistance may be significantly influenced by installation and service-related variables such as age, foam thickness, type of coating, environmental conditions and mechanical abuse. These variables may cause the thermal resistance to be reduced from measured initial values.

X1.3 The application of a suitable vapor retarder may be required in conjunction with this insulation. In exterior installations, coatings or coverings are necessary for protection from the elements and should be applied on the same day.

X1.4 Rigid-cellular polyurethane thermal insulation is combustible to varying degrees when exposed to an ignition source or high temperatures, or both. In interior installations, the polyurethane thermal insulation shall be covered by an approved thermal barrier the same day it is spray applied.[3]

X1.5 Consult local building and fire code regulations, insurance requirements, and the manufacturer's specifications and application instructions for each specific installation. Detailed information concerning the application of spray-applied rigid cellular polyurethane foam thermal insulation and fire safety can be obtained from the Spray Polyurethane Foam Contractors Division of The Society of the Plastics Industry.

[3] Available from SPFA, Spray Polyurethane Foam Alliance, 4400 Fair Lakes Court, Suite 105 Fairfax, VA 22033.