Designation: C 1029 – 96

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

This standard is issued under the fixed designation C 1029; 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

1.1 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 the standard. The values given in parentheses are for information only.

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:*

C 165 Test Method for Measuring Compressive Properties of Thermal Insulations[2]

C 168 Terminology Relating to Thermal Insulating Materials[2]

C 177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus[2]

C 236 Test Method for Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box[2]

C 518 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus[2]

D 883 Terminology Relating to Plastics[3]

D 1621 Test Method for Compressive Properties of Rigid Cellular Plastics[3]

D 1622 Test Method for Apparent Density of Rigid Cellular Plastics[3]

D 1623 Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics[3]

D 2126 Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging[3]

D 2842 Test Method for Water Absorption of Rigid Cellular Plastics[4]

D 2856 Test Method for Open Cell Content of Rigid Cellular Plastics by the Air Pycnometer[4]

E 84 Test Method for Surface Burning Characteristics of Building Materials[5]

E 96 Test Methods for Water Vapor Transmission of Materials[2]

3. Terminology

3.1 Definitions—For definitions of terms used in this specification, refer to Terminologies C 168 and D 883.

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:

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).

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[1] This specification is under the jurisdiction of ASTM Committee C-16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.22 on Organic and Nonhomogeneous Inorganic Thermal Insulations.

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[2] *Annual Book of ASTM Standards*, Vol 04.06.

[3] *Annual Book of ASTM Standards*, Vol 08.01.

[4] *Annual Book of ASTM Standards*, Vol 08.02.

[5] *Annual Book of ASTM Standards*, Vol 04.07.

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

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

6.4 In most cases the thermal insulation is formed directly on the surface to be insulated.

7. Physical Requirements

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

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

NOTE 1—Density is not a requirement of this specification, but may be determined in accordance with Test Method D 1622-93 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 2—About 150 ft^2(15 m^2) of finished polyurethane foam should be sufficient. Specific panel sizes and thicknesses should be selected based on the requirement 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.

10. Test Methods

10.1 Determine thermal resistance in accordance with Test Method C 177, Test Method C 236, or Test Method C 518 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). Where thermal resistance testing requirements are mandated by governmental energy conservation rules and regulations, other procedures may be required, for example, conditioning at 140 ± 2°F (60 ± 1°C) for 90 ± 3 days.

10.2 Determine compressive strength in accordance with Method C 165, 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 D 1621, 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 E 96, Desiccant Method, at 73± 2°F (23 ± 1°C).

10.4 Determine water absorption in accordance with Test Method D 2842.

10.5 Determine tensile strength in accordance with Test Method D 1623.

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·ft^2·h/Btu (K·m^2/W) at mean temperature 75°F (24°C)	6.2 (1.1)	6.2 (1.1)	6.2 (1.1)	6.2 (1.1)
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, volume change %	12	9	6	5
Closed cell content, min,%	90	90	90	90
Surface burning characteristics, report value	...	...	...	...

10.6 Determine the response to thermal and humid aging in accordance with Test Method D 2126. Expose 12 by 12 by 1-in. (305 by 305 by 25-mm) specimens to 158 ± 4°F (70± 2°C) and 97 ± 3% relative humidity for 168 ± 2 h. Measure after 24 ± ½h and 168 ± 2 h.

10.7 Determine the closed cell content in accordance with Test Method D 2856.

10.8 Determine the surface burning characteristics in accordance with Test Method E 84 at end use thicknesses and report the results. See Section 1 of Test Method E 84 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 this specification may be rejected. Rejection should be reported to the manufacturer promptly and in writing. In case of disagreement with the results of any test, the manufacturer may make a claim for a rehearing. In case of rejection, the manufacturer shall have the right to reinspect the rejected shipment and resubmit the lot after removal of that portion not conforming to requirements.

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.[6]

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

[6] Available from the Spray Polyurethane Foam Contractors Division (SPFD) of The Society of the Plastics Industry, Inc., 1275 "K" St., N.W., Suite 400, Washington, DC 20005.

fire safety can be obtained from the Spray Polyurethane Foam Contractors Division of The Society of the Plastics Industry.