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Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board¹

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

1. Scope

1.1 This specification covers the general requirements for faced thermal insulation boards composed of rigid cellular polyisocyanurate surfaced with other materials. The insulation boards are intended for use at temperatures between -40 and 200°F (-40 and 93°C). This specification does not cover cryogenic applications. Consult the manufacturer for specific recommendations and properties in cryogenic conditions. For specific applications, the actual temperature limits shall be agreed upon by the manufacturer and the purchaser.

1.2 This standard is intended to apply to rigid cellular polyurethane-modified polyisocyanurate thermal insulation board products that are commercially acceptable as non-structural panels useful in building construction. The term polyisocyanurate encompasses the term polyurethane. For engineering and design purposes, users should follow specific product information provided by board manufacturers regarding physical properties, system design considerations and installation recommendations.

NOTE 1—See [Appendix X1](#) for guidance on determining wind pressure resistance of panels when required for wall sheathing applications.

1.3 The use of thermal insulation materials covered by this specification is typically regulated by building codes, or other agencies that address fire performance. Where required, the fire performance of the material shall be addressed through standard fire test methods established by the appropriate governing documents.

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.

NOTE 2—For conversion to metric units other than those contained in this standard, refer to [IEEE/ASTM SI 10](#).

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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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 The following documents, of the issue in effect on the date of material purchase, form a part of this specification to the extent specified herein:

2.2 *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
- C203 Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation
- C208 Specification for Cellulosic Fiber Insulating Board
- C209 Test Methods for Cellulosic Fiber Insulating Board
- C303 Test Method for Dimensions and Density of Preformed Block and Board-Type Thermal Insulation
- C390 Practice for Sampling and Acceptance of Thermal Insulation Lots
- C518 Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
- C550 Test Method for Measuring Trueness and Squareness of Rigid Block and Board Thermal Insulation
- C728 Specification for Perlite Thermal Insulation Board
- C1045 Practice for Calculating Thermal Transmission Properties Under Steady-State Conditions

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.

C1058/C1058M 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

C1177/C1177M Specification for Glass Mat Gypsum Substrate for Use as Sheathing

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

C1763 Test Method for Water Absorption by Immersion of Thermal Insulation Materials

D1621 Test Method for Compressive Properties 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

E84 Test Method for Surface Burning Characteristics of Building Materials

E96/E96M Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials

IEEE/ASTM SI 10 Standard for Use of the International System of Units (SI): (The Modernized Metric System)

2.3 *Voluntary Product Standard:*³

Voluntary Product Standard PS 1–09 Structural Plywood
Voluntary Product Standard PS 2–10 Performance Standard for Wood Based Structural Use Panels

2.4 *CAN/ULC Standard:*⁴

CAN/ULC-S770-09 Standard Test Method for Determination of Long-Term Thermal Resistance of Closed-Cell Thermal Insulating Foams

2.5 *CAN/CSA and CSA Standards:*⁵

CAN/CSA O325-07 (R2012) – Construction Sheathing
CSA O121-08 (R2013) Douglas Fir Plywood
CSA O151-09 Canadian Softwood Plywood

2.6 *ASHRAE Standards:*⁶

ASHRAE Handbook Fundamentals

3. Terminology

3.1 For complete descriptions of terms used in this specification, refer to Terminology **C168**.

3.2 The term polyisocyanurate encompasses the term polyurethane (see 1.2).

4. Classification

4.1 The faced thermal insulation boards composed of rigid cellular polyisocyanurate covered by this specification are classified as follows:

4.1.1 *Type I*—Faced with aluminum foil on both major surfaces of the core foam.

4.1.1.1 *Class 1*—Non-reinforced core foam.

4.1.1.2 *Class 2*—Glass fiber reinforced or non-reinforced core foam.

4.1.2 *Type II*—Faced with either cellulosic facers or glass fiber mat facers on both major surfaces of the core foam.

4.1.2.1 *Class 1*—Faced with glass fiber reinforced cellulosic facers on both major surfaces of the core foam.

(1) *Grade 1*—16 psi (110 kPa), min, compressive strength.

(2) *Grade 2*—20 psi (138 kPa), min, compressive strength.

(3) *Grade 3*—25 psi (172 kPa), min, compressive strength.

4.1.2.2 *Class 2*—Faced with coated glass fiber mat facers on both major surfaces of the core foam.

(1) *Grade 1*—16 psi (110 kPa), min, compressive strength.

(2) *Grade 2*—20 psi (138 kPa), min, compressive strength.

(3) *Grade 3*—25 psi (172 kPa), min, compressive strength.

4.1.2.3 *Class 3*—Faced with uncoated glass fiber mat facers on both major surfaces of the core foam.

(1) *Grade 1*—16 psi (110 kPa), min, compressive strength.

(2) *Grade 2*—20 psi (138 kPa), min, compressive strength.

(3) *Grade 3*—25 psi (172 kPa), min, compressive strength.

4.1.2.4 *Class 4*—Faced with coated or uncoated glass fiber mat facers on both major surfaces of the core foam. This product is used at a maximum thickness of ½ in. (12.7 mm).

(1) *Grade 1*—80 psi (551 kPa), min, compressive strength

(2) *Grade 2*—110 psi (758 kPa), min, compressive strength

(3) *Grade 3*—140 psi (965 kPa), min, compressive strength

4.1.3 *Type III*—Faced with a perlite insulation board on one major surface of the core foam and faced on the other major surface with any facer described in this specification.

4.1.4 *Type IV*—Faced with a cellulosic fiber insulating board on one major surface of the core foam and faced on the other major surface with any facer described in this specification.

4.1.5 *Type V*—Faced with oriented strand board (OSB) or plywood on one major surface of the core foam and faced on the other major surface with any facer described in this specification.

4.1.6 *Type VII*—Faced with glass mat faced gypsum board on one major surface of the core foam and faced on the other major surface with any facer described in this specification.

NOTE 3—These general statements refer to generic composition descriptions of facer materials that are currently commercially accepted in the marketplace for these products, using terms common to these competing products.

5. Ordering Information

5.1 Orders shall include the following information:

5.1.1 Title, designation, and year of issue of C1289,

5.1.2 Quantity of material being ordered,

5.1.3 Product name and manufacturer’s name, address, and telephone number,

5.1.4 Type or Class, or both, if Type I; type, class, and grade or type and class, if Type II, (see Section 4),

³ United States Department of Commerce, National Institute of Standards and Technology, Available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

⁴ Available from Underwriters Laboratories (UL), 2600 N.W. Lake Rd., Camas, WA 98607-8542, <http://www.ul.com>.

⁵ CSA Group, 178 Rexdale Blvd., Toronto, ON, Canada M9W 1R3, <http://www.csagroup.org/ca>.

⁶ Available from American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE), 1791 Tullie Circle, NE, Atlanta, GA 30329, <http://www.ashrae.org>.

- 5.1.5 R-value and specific thickness, as required (see 7.2),
- 5.1.6 Tolerance if other than specified (see 8.1),
- 5.1.7 Size(s) required (see 8.6),
- 5.1.8 Type of edge (see 8.3 and 8.4),
- 5.1.9 Sampling, if different (see 10.1),
- 5.1.10 If a certificate of compliance is required (see 10.2, 10.3, 10.4, Table 1 and Table 2),
- 5.1.11 If packaging is other than specified (see 13.1), and
- 5.1.12 If marking is other than specified (see 13.2).

nate with a polyol, or the reaction of an isocyanate with itself, or both, using a catalyst and blowing agents to form a rigid closed-cell-structured polyisocyanurate foam. The insulation foam core shall be homogeneous and of uniform density.

6.2 *Facer Materials*—The facers incorporated into the faced thermal insulation board for this specification shall be applied in the manufacturing process (on-line in the foaming process or off-line adhered to the facer) and shall be as follows:

6.2.1 *Aluminum Foil*—Aluminum foil is plain or coated aluminum foil, or foil laminated to a supporting membrane.

6.2.2 *Glass Fiber Reinforced Cellulosic Facer*—This facer shall consist of cellulosic fibers containing glass fibers.

6. Materials and Manufacture

6.1 *Cellular Material*—Rigid polyisocyanurate thermal insulation boards shall be based upon the reaction of an isocya-

TABLE 1 Physical Properties^A

Product Type	Type I Class 1	Type I Class 2	Type II Class 1	Type II Class 2	Type II Class 3	Type II Class 4 ^B
Facers (on both major surfaces)	Aluminum foil	Aluminum foil	Glass fiber reinforced cellulosic	Coated glass fiber mat	Uncoated glass fiber mat	Coated or uncoated glass fiber mat
Core Foam	Non-reinforced	Glass fiber reinforced or non-reinforced				
Compressive Strength, psi (kPa), min	16 (110)	16 (110)	16 (110)	16 (110)	16 (110)	80 (551)
	Grade 1		20 (138)	20 (138)	20 (138)	110 (758)
	Grade 2		25 (172)	25 (172)	25 (172)	140 (965)
	Grade 3					
Dimensional Stability, Percent Linear Change, Thickness, max	−40°F (−40°C)/ amb, RH	4.0	4.0	4.0	4.0	4.0
	158°F (70°C)/ 97 % RH	4.0	4.0	4.0	4.0	4.5
	200°F (93°C)/ amb RH	4.0	4.0	4.0	4.0	4.0
Dimensional Stability, Percent Linear Change, length and width, max	−40°F (−40°C) / amb RH	2.0	1.5	2.0	2.0	2.0
	158°F (70°C)/ 97 % RH	2.0	1.5	2.0	2.0	2.0
	200°F (93°C)/ amb, RH	4.0	1.5	2.0	2.0	2.0
		40 (275)	40 (275)	40 (275)	40 (275)	40 (275)
Flexural Strength (modulus of rupture) or Yield Strength, psi (kPa), min	½ in. (12 mm) product					400 (2750)
	¼ in. (6 mm) product					800 (5500)
		8 (35)	8 (35)	17 (75)	17 (75)	17 (75)
Flexural Strength (Break Load or Load at Yield), lbf (N), min	½ in. (12 mm) product					20 (89)
	¼ in. (6 mm) product					14 (62)
Tensile strength, psf (kPa), min		500 (24)	500 (24)	500 (24)	500 (24)	2000 (95)
Water absorption 2h percent by volume, max		1.0	1.0	1.5	1.5	2.0
Water vapor permeance, perm (ng/Pa·s·m ²), max		0.3 (17.2)	0.3 (17.2)	1.5 (85.8)	4.0 (228.8)	8.0 (457.6)
						1.5 (85.8)

^ASee 7.1 about the product thicknesses covered by this table. Consult manufacturers for other thicknesses. When appropriate, physical property values as agreed between buyer and seller shall replace those listed in Table 1 as qualification requirements described in 10.3.

^BProducts made at a maximum thickness of 0.5 in. (12.7 mm).

TABLE 2 Thermal Resistance Properties^{A,B,C}

Product Type	Type I Class 1	Type I Class 2	Type II Class 1 Grades 1, 2, 3	Type II Class 2	Type II Class 3	Type II Class 4 ^D
Facers (on both major surfaces)	Aluminum foil	Aluminum foil	Glass fiber reinforced cellulosic	Coated glass fiber mat	Uncoated glass fiber mat	Coated or uncoated glass fiber mat
Core Foam	Non- reinforced	Glass fiber reinforced or non- reinforced				
						1.0 (0.18)
						2.0 (0.35)
Minimum Thermal Resistance @ 75 ± 2°F (24 ± 1°C) Mean temp. °F ft ² h/Btu (Km ² /W)	1 in. (25.4 mm) product	6.0 (1.06)	6.0 (1.06)	5.6 (0.97)	5.3 (0.93)	5.0 (0.88)
	1.5 in. (38.1 mm) product	9.0 (1.59)	9.0 (1.59)	8.4 (1.48)	8.0 (1.41)	7.5 (1.32)
	2 in. (50.8 mm) product	12.0 (2.11)	12.0 (2.11)	11.2 (1.97)	10.6 (1.87)	10.0 (1.76)

^A Because core foam thickness and facer type, thickness, and permeance can all influence product R-values, three faced product thicknesses have been described for referee purposes (except for Type II, Class 4). Consult manufacturers regarding other thicknesses. When appropriate, thermal resistance values as agreed between buyer and seller shall replace those listed in Table 2 as qualification requirements described in 10.3.

^B Determined in accordance with conditioning procedures in 11.1.2.

^C Non-mandatory minimum thermal resistance values at 40°F (4°C) and 110°F (43°C) are included in Appendix X2.

^D Products made at a maximum thickness of 0.5 in. (12.7 mm).

6.2.3 *Coated Glass Fiber Mat*—The polymer-bonded glass fiber mat shall consist of fibrous glass mats bonded with organic polymer binders and coated with organic polymer, clay, or other inorganic substances.

6.2.4 *Uncoated Glass Fiber Mat*—The polymer-bonded glass fiber mat shall consist of fibrous glass mats bonded with organic polymer bonded binders.

6.2.5 *Perlite Insulation Board*—The perlite insulation board shall conform to the material and physical property requirements specified in Specification C728, either type 1 or type 2 may be used. The perlite insulation board may be either the ½-in. board listed in Specification C728, which has a *higher* core density and *modified* formulation (as agreed upon between buyer and seller) than the thicker products, or may be a ½-in. thickness (available only to manufacturers of laminated rigid foam products) of the ¾ to 3 in. formulation perlite board listed in Specification C728.

6.2.6 *Cellulosic Fiber Insulation Board*—The cellulosic fiber insulating board shall conform to the material and physical properties requirements specified in Specification C208.

6.2.7 *Oriented Strand Board*—The oriented strand board (OSB) shall conform to the material and physical properties requirements specified in U.S. Voluntary Product Standard PS 2–10 or Canadian Standard CAN/CSA O325–07.

6.2.8 *Plywood*—The plywood shall conform to the material and physical properties requirements specified in U.S. Voluntary Product Standard PS 1–09 or PS 2–10 or Canadian Standard CSA O121–08 or CSA O151–09.

6.2.9 *Glass Mat Faced Gypsum Board*—The glass mat faced gypsum board shall be ¼ in. (6.4 mm) thickness and

shall conform to the material and physical properties requirements in Specification C1177/C1177M.

7. Physical Properties

7.1 The thermal insulation board shall conform to the properties stated in Table 1. Foam thickness and facer type, thickness and permeance can all influence the magnitude of values measured for physical properties listed in Table 1. For Type I and II (except Type II, Class 4), a 1 in. (25.4 mm) product with the facers on has been described in Table 1 to establish compliance with this specification. For Types III, IV, V and VII, compliance with the properties stated in Table 1 is established through the foam product (Type I or II) used to manufacture the composite product. The average value of the tested specimens shall be used to determine compliance with the requirements. For information about the number of specimens, consult Section 11 or the specified standard test method used. For information about the precision of the results, consult the specified standard test method used.

7.1.1 The physical properties stated in Table 1 shall not be used as design or engineering values unless this recommendation is made in writing by the product manufacturer. It remains the buyer's responsibility to specify design requirements and obtain supporting physical properties documentation from each product manufacturer and supplier.

7.2 *Thermal Resistance (R-value)*—When ordering, specify the R-value; thickness shall be specified if there is a specific thickness requirement and R-value is not specified. The values specified shall be for the faced insulation product only, and