Designation: ~~C1289 – 22a~~ C1289 – 23

Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board[1]

This standard is issued under the fixed designation C1289; 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 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.

1.5 *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.*

---

[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 ~~Oct. 1, 2022~~May 1, 2023. Published ~~October 2022~~May 2023. Originally approved in 1995. Last previous edition approved in 2022 as ~~C1289 – 22.~~C1289 – 22a. DOI: ~~10.1520/C1289-22A.~~10.1520/C1289-23.

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
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).

---

[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.

[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.

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 1; type, class, and grade or type and class, if Type II, (see Section 4),

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).

6. Materials and Manufacture

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

6.2.3 *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.

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)				
	Grade 1			16 (110)	16 (110)	16 (110)	80 (551)
	Grade 2			20 (138)	20 (138)	20 (138)	110 (758)
	Grade 3			25 (172)	25 (172)	25 (172)	140 (965)
Dimensional Stability, Percent Linear Change, Thickness, max	–40°F (–40°C)/ amb, RH	4.0	4.0	4.0	4.0	4.0	4.0
	158°F (70°C)/ 97 % RH	4.0	4.0	4.0	4.0	4.0	4.5
	200°F (93°C)/ amb RH	4.0	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	1.0
	158°F (70°C)/ 97 % RH	2.0	1.5	2.0	2.0	2.0	1.0
	200°F (93°C)/ amb, RH	4.0	1.5	2.0	2.0	2.0	1.0
Flexural Strength (modulus of rupture) or Yield Strength, psi (kPa), min		40 (275)	40 (275)	40 (275)	40 (275)	40 (275)	
	½ in. (12 mm) product						400 (2750)
	¼ in. (6 mm) product						800 (5500)
Flexural Strength (Break Load or Load at Yield), lbf (N), min		8 (35)	8 (35)	17 (75)	17 (75)	17 (75)	
	½ in. (12 mm) product						20 (89)
	¼ in. (6 mm) product						14 (62)
Tensile strength, psf (kPa), min Perpendicular to board surface		500 (24)	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	4.0
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)

[A]See 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.
[B]Products made at a maximum thickness of 0.5 in. (12.7 mm).

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

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				
Minimum Thermal Resistance @ 75 ± 2°F (24 ± 1°C) Mean temp. °F ft^2 h/Btu (Km^2/W)	¼ in. (6.4 mm) product						1.0 (0.18)
	½ in. (12.7 mm) product						2.0 (0.35)
	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).

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 shall not include any additional thermal resistances from reflective facer surfaces and adjacent air spaces or from other components of the building system. The mean thermal resistance of the material tested shall not be less than the minimum relevant value prescribed in Table 2. The thermal resistances of individual specimens tested shall not be less than 90 % of the minimum value identified in Table 2. Values in Table 2 shall be determined in accordance with Section 11. Table 2 contains the mandatory performance requirements for thermal resistance values at 75°F (24°C) mean temperature. Appendix X2 contains minimum thermal resistance values at 40°F (4°C) and 110°F (43°C) that are not required to establish compliance with this material specification but shall be provided at the buyer's request, see 11.2.

NOTE 4—Thermal resistance of cellular plastics may be significantly influenced by installation and service-related variables such as age, encapsulation within gas barrier materials, environmental conditions, mechanical abuse, etc. and may be reduced from measured values after exposure to conditions of use. For specific design recommendations, consult the manufacturer or qualified professionals, such as architects or engineers.

7.2.1 For Type III, IV, V and VII, the thermal resistance value to establish compliance with this specification is based on the minimum R-value of the foam product (Type I or II, according to Table 2) used to manufacture the composite product, added to the thermal resistance of the specific perlite, cellulosic fibers, OSB, plywood or gypsum board used. For the R-value of the boards used for Type III, IV, V and VII, refer to: Specification C728 for perlite; Specification C208 for cellulosic fiber insulation; and ASHRAE Handbook of Fundamentals for OSB, plywood, and gypsum.

7.2.2 *Long-Term Thermal Resistance ~~(LTTR)~~ (LTTR):* ~~Determine, and report values, in accordance with practice and details in CAN/ULC-S770-09[7] or Test Method C1303/C1303M. For Test Method C1303/C1303M, use the prescriptive test method and core slices only. If the core slices are prepared from 1.75 in. (45 mm) to 2.25 in. (55 mm) material to predict 0.9 in. (22 mm) to 4.1 in. (103 mm) thick products, the homogeneity qualification test and the alternate product thickness qualification tests are not~~

~~required. If the slices are prepared from other material thickness, follow the instructions for stack composition in Test Method C1303/C1303M. LTTR shall apply to Type II through Type VII, inclusive.~~

7.2.2.1 Determine, and report values, in accordance with practice and details in CAN/ULC-S770-09[7] or Test Method C1303/C1303M.

~~NOTE 5—The results of a ruggedness test program for Test Method C1303/C1303M completed in 2011[8] has established good agreement between full-thickness aged values and the accelerated aging predictions for polyiso foam when a product with an original thickness between 1.75 and 2.25 in. (45 and 55 mm) is used to predict the long term aged value for products between 0.9 and 4.1 in. (22 and 103 mm), using stack of core slices with a thickness of 8 to 12 mm.~~

7.2.2.2 For Test Method C1303/C1303M, use the prescriptive test method and core slices only. If the core slices are prepared from 1.75 in. (45 mm) to 2.25 in. (55 mm) material to predict 0.9 in. (22 mm) to 4.1 in. (103 mm) thick products, the homogeneity qualification test and the alternate product thickness qualification tests are not required. If the slices are prepared from other material thickness, follow the instructions for stack composition in Test Method C1303/C1303M.

7.2.2.3 LTTR shall apply to Type II through Type VII, inclusive.

NOTE 5—The results of a ruggedness test program for Test Method C1303/C1303M completed in 2011[8] has established good agreement between full-thickness aged values and the accelerated aging predictions for polyiso foam when a product with an original thickness between 1.75 and 2.25 in. (45 and 55 mm) is used to predict the long term aged value for products between 0.9 and 4.1 in. (22 and 103 mm), using stack of core slices with a thickness of 8 to 12 mm.

7.3 *Fire Characteristics*—Polyisocyanurate thermal insulation boards are combustible. They shall not be exposed to open flames or other ignition sources. The fire performance of the material shall be addressed through fire test requirements established by the appropriate governing authority, which are specific to the end use and occupancy.

7.3.1 *Surface Burning Characteristics*—Determine, if required, in accordance with Test Method E84.

8. Dimensions

8.1 *Dimensional Tolerances*—Measure in accordance with Test Method C303. The length and width tolerances shall not exceed ± ¼ in. (6.4 mm); the thickness tolerance shall not exceed 1⁄16 in. (1.6 mm) for ¼ in. (6.4 mm) product and ⅛ in. (3.2 mm) for all other thicknesses; and the thickness of any two boards shall not differ more than 1⁄16 in. (1.6 mm) for ¼ in. (6.4 mm) product and ⅛ in. (3.2 mm) for all other thicknesses.

8.2 *Edge Squareness*—The thermal insulation boards shall not be out of square more than 1⁄16 in./ft (5.2 mm/m) of width or length, when examined in accordance with Practice C550.

8.3 *Edge Trueness in the x/y Direction*—Unless otherwise specified, the thermal insulation board shall be furnished with straight edges and edges shall not deviate more than 1⁄32 in./ft (2.6 mm/m) when examined in accordance with Practice C550.

8.4 *Shiplap Edges*—When specified, the insulation board shall be fabricated with shiplap edges along its longest dimensions.

8.4.1 The nominal depth of each shiplap shall be the sum of its thickest facer dimension plus one half the thickness of its core foam dimension.

8.4.2 For boards 2 in. (50.8 mm) or greater in nominal thickness, the width of the shiplap shall be 1 in. (25.4 mm). For boards less than 2 in. (50.8 mm) in thickness, the nominal width of the shiplap shall be one half the thickness of the faced board product.

8.4.3 All fabrication tolerances shall provide for a dimensionally stable, smooth, and uniform shiplap joint in installation and in service.

[7] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:C16-1035.

[8] Supporting data can be found in Oak Ridge National Lab Report number ORNL/TM-2012/214, Evaluation of Experimental Parameters in the Accelerated Aging of Closed-Cell Foam Insulation, December 2012.