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Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation¹

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1. Scope

1.1 This specification covers faced or unfaced, rigid cellular phenolic thermal insulation. Boards shall be faced or unfaced. Tubular forms covered by this standard shall be unfaced. It does not apply to field expanded cellular phenolic materials.

NOTE 1—If a facer or vapor retarder is to be used for the tubular form, then refer to Practice C921

1.2 Materials covered by this specification are used as roof insulation; sheathing or rigid board for non-load bearing, building material applications; and pipe insulation for use between -40 and 257°F (-40 and 125°C). Type II Grade 1 and Type III Grade 1 materials with an appropriate vapor retarder covering on the warm surface can be used to a lower temperature limit of -290°F (-180°C). (See 7.2.)

1.3 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.

1.4 The main body of this specification covers Chlorofluorocarbons and Hydrochlorofluorocarbons free (ODP 0) closed cell rigid cellular phenolic thermal insulation.

1.5 The table in Annex A1 addresses requirements of faced and unfaced rigid cellular phenolic thermal insulation manufactured with Hydrochlorofluorocarbons blowing agent.

1.6 *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.* For specific precautionary statements, see Section 16.

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. 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
- C209 Test Methods for Cellulosic Fiber Insulating Board
- C335 Test Method for Steady-State Heat Transfer Properties of Pipe 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
- C585 Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing
- C921 Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
- 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
- C1303 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
- D1621 Test Method for Compressive Properties of Rigid Cellular Plastics
- D1622 Test Method for Apparent Density of Rigid Cellular Plastics

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.

- [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 Water Vapor Transmission of Materials](#)

3. Terminology

3.1 The definitions and terms in Terminology [C168](#) shall apply to this specification.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *foam core*—rigid cellular thermal insulation without any facers or barriers on the surface of the insulation.

3.2.2 *closed cell material*—foam where more than 90 % of the cells are totally enclosed by cell walls, and not interconnected with other cells.

3.2.3 *open cell material*—foam whose cells are not totally enclosed by its walls and therefore exhibits a predominance of interconnecting cells.

4. Classification

4.1 The thermal insulation shall be of the following types and grades:

4.1.1 *Type I*—For use as roof insulation board. Produced without integral vapor retarder facers.

4.1.2 *Type II*—For use as sheathing or rigid panel for non-load bearing applications. Produced with integral vapor retarder facers.

4.1.3 *Type III*—For use as pipe insulation. Produced without integral vapor retarder facers.

4.1.4 *Grade 1—Closed cell material.* Foam for Type I of this grade will have an apparent thermal conductivity of 0.16 Btu·in./h·ft²·°F (0.023 W/mK) or less and foam for Types II and III of this grade will have an apparent thermal conductivity of 0.15 Btu·in./h·ft²·°F (0.022 W/mK) or less at a mean temperature of 75°F (24°C) when aged in accordance with [13.6.1](#).

4.1.5 *Grade 2—Open cell material.* Foam of this grade will have an apparent thermal conductivity of 0.23 Btu·in./h·ft²·°F (0.033 W/mK) or less at a mean temperature of 75°F (24°C).

NOTE 2—The average thermal conductivities shown in this section are for classification only, not for qualification purposes as indicated by Section [10.1](#).

5. Ordering Information

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

- 5.1.1 Designation of this specification.
- 5.1.2 Product name, type, and/or grade.
- 5.1.3 Size and dimensions.
- 5.1.4 Quantity of material.
- 5.1.5 Special requirements for inspection and/or testing.
- 5.1.6 Pipe insulation jacketing (optional).

6. Materials and Manufacture

6.1 *Foam Core Chemical Composition*—The foam shall be produced by a chemical reaction of a phenolic resin, surfactant, blowing agent, and other additives as needed.

6.2 *Facings*—Facing on Type II material shall be adhered to the core stock and suitable for the service intended. They shall be supplied as agreed upon between manufacturer and purchaser.

7. Physical Properties

7.1 The material shall conform to the requirements as shown in [Table 1](#).

7.2 Not all physical properties at temperatures below –40°F (–40°C) have been fully tested, and the user should consult the manufacturer for properties and performance at these lower temperatures.

8. Dimensions and Tolerances

8.1 *Dimensions*—The dimensions shall be as agreed upon between the purchaser and the supplier, but commonly shall be as follows:

8.1.1 *Type I*—Width, 24 in., 36 in., or 48 in. (610 mm, 915 mm, or 1220 mm). Length, 48 in. or larger (1220 mm or larger).

8.1.2 *Type II*—Width, 48 in. (1220 mm). Length, 96 in. or larger (2440 mm or larger).

8.1.3 *Type III*—Pipe insulation with dimensions that are in accordance with Practice [C585](#).

8.2 *Tolerances*—Unless otherwise agreed upon between the purchaser and the supplier, the tolerances shall be as follows:

8.2.1 *Types I and II*—When measured at 73.4 ± 3.6°F (23 ± 2°C) and 50 ± 5 % relative humidity, these types shall conform to the following:

8.2.1.1 *Length*—Not to exceed ±¼ in. (±6.4 mm).

8.2.1.2 *Width*—Not to exceed ±¼ in. (±6.4 mm).

8.2.1.3 *Thickness*—Not to exceed ±⅛ in. (±3.1 mm).

8.2.2 *Type III*—Thicknesses available for various pipe and tube sizes should be in accordance with Practice [C585](#). The average measured length shall not differ from the manufacturer's standard dimension by more than ±¼ in. (6.4 mm).

8.3 *Other Parameters for Types I and II:*

8.3.1 *Squareness*—Board squareness shall be within required tolerance if the two diagonal measurements of the board differ by no more than ¼ in. (6.4 mm).

8.3.2 *Straightness*—Unless otherwise specified, the boards shall be furnished with straight edges which shall not deviate by more than ⅓ in./ft (2.6 mm/m).

8.3.3 *Flatness*—The boards shall not depart from absolute flatness by more than ⅓ in./ft of width or length (5.2 mm/m).

8.3.4 The straightness and flatness shall be determined in accordance with Practice [C550](#), except that a straight edge longer than the dimension being determined shall be used.

9. Workmanship, Finish, and Appearance

9.1 The insulation shall have no defects that adversely affect its service qualities.

TABLE 1 Physical Properties

NOTE—As Type II insulation is produced with integral vapor retarder facers, the orientation of the facer is important in preventing moisture penetration into the insulation and the water vapor permeance of the Type II faced insulation is valid as long as the facer does not fail.

Property	Unit	Type I	Type II	Type III ^A
Density, min	lb/ft ³ (kg/m ³)	N/A ^B	2 (32)	2 (32)
Compressive resistance, min (faced or unfaced)	psi (kPa)	16 (108)	18 (124)	18 (124)
Tensile strength, min (faced)	psf (Pa)	150 (7180)	N/A ^B	N/A ^B
Apparent Thermal Conductivity, max ^C (foam core):	Btu-in./h-ft ² ·°F (W/mK)			
Grade 1				
–250°F (–157°C) mean temp.		N/A ^B	0.12 (0.017)	0.12 (0.017)
–200°F (–129°C) mean temp.		N/A ^B	0.13 (0.018)	0.13 (0.018)
–150°F (–101°C) mean temp.		N/A ^B	0.14 (0.019)	0.14 (0.019)
–100°F (–73°C) mean temp.		N/A ^B	0.15 (0.021)	0.15 (0.021)
–50°F (–46°C) mean temp.		N/A ^B	0.15 (0.021)	0.15 (0.021)
–0°F (–17°C) mean temp.		N/A ^B	0.15 (0.021)	0.15 (0.021)
40°F (4°C) mean temp.		0.16 (0.022)	0.15 (0.021)	0.15 (0.021)
75°F (24°C) mean temp.		0.17 (0.025)	0.15 (0.021)	0.15 (0.021)
110°F (43°C) mean temp.		0.19 (0.028)	0.15 (0.021)	0.17 (0.024)
150°F (65°C) mean temp.		N/A ^B	N/A ^B	0.20 (0.029)
Grade 2				
40°F (4°C) mean temp.		0.21 (0.030)	0.21 (0.030)	0.21 (0.030)
75°F (24°C) mean temp.		0.23 (0.033)	0.23 (0.033)	0.23 (0.033)
110°F (43°C) mean temp.		0.25 (0.036)	0.25 (0.036)	0.25 (0.036)
150°F (65°C) mean temp.		N/A ^B	N/A ^B	0.28 (0.040)
Dimensional stability, 1 week ^D	% lin chg, max			
Exposure (foam core):				
257 ± 4°F (125 ± 2°C), ambient RH		N/A ^B	N/A ^B	2
–40 ± 6°F (–40 ± 3°C), ambient RH		2	2	2
158 ± 4°F (70 ± 2°C), 97 ± 3 % RH		2	2	2
Water absorption, max, (foam core):	% by volume			
Grade 1		3.0	3.0	3.0
Grade 2		8.0	8.0	8.0
Water vapor permeance, perms, (facer only)	grains/h-ft ² ·in.·Hg (ng/s·m ² ·Pa)			
Grade 1		E	≤1.0 (57) ^F	
Grade 2		E	>3.0 (170)	
Water vapor permeability, max, perm-in. (foam core)	Perm-inch (ng/s·m·Pa)			
Grade 1		0.9 (1.3)	0.9 (1.3)	0.9 (1.3)
Grade 2		>4.0 (5.8)	N/A ^B	>4.0 (5.8)
Flame spread index, max ^{G,H} (foam core)		25	25	25
Smoke developed index, max ^{G,H} (foam core)		50	50	50

^A Type III test samples shall be obtained from a free-rise block of foam, except where otherwise specified.

^B N/A = not applicable.

^C Thermal Conductivity tests shall be used for classification purposes only. The thermal conductivity values shown in this table were obtained using Test Method C177 or C518.

^D Dimensional stability data at lower temperature will be added when testing program is complete.

^E No minimum or maximum values are required for Type I material. It is expected roof design will reflect actual building and environmental conditions. Under certain circumstances a vapor retarder is required.

^F Consult manufacturer for certain application in cold climates where greater permeance values are desirable.

^G This standard is used to measure and describe the response of materials, products, or assemblies to heat and flame under controlled conditions, but does not by itself incorporate all factors required for fire-hazard or fire-risk assessment of the materials, products, or assemblies under actual fire conditions.

^H Facings used on composite products may cause the flame spread index and smoke developed index of the composite to be significantly different than the foam core indexes.

10. Qualification Requirements

10.1 For the purpose of initial material or product qualification, each type and grade of insulation shall meet the test results of Table 1.

10.2 Acceptance qualification for lots and shipments of qualified product should be agreed upon by purchaser and supplier.

10.3 When it is anticipated that phenolic foam will be in direct contact with metal, the foam supplier shall provide the proper installation procedure. Type I phenolic foams may contain some compounds which may promote corrosion in the presence of liquid water. As far as can be ascertained, there are currently no directly applicable ASTM corrosion tests for phenolic foams. An attempt will be made to develop a

meaningful corrosion test and it will be incorporated into the standard when it becomes available.

11. Sampling

11.1 Unless otherwise specified in the purchase order or contract, sampling shall be in accordance with Practice C390.

12. Specimen Preparation

12.1 Unless otherwise specified in the test procedure, all tests shall be made on specimens conditioned at least 24 h at 73.4 ± 3.6°F (23 ± 2°C) and 50 ± 5 % relative humidity.

12.2 All Type II test specimen have facers present and Type I and Type III test specimens are foam core samples except where otherwise indicated.