



# Standard Specification for Flexible Polymeric Foam Sheet Insulation Used as a Thermal and Sound Absorbing Liner for Duct Systems<sup>1</sup>

This standard is issued under the fixed designation C 1534; 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.

## 1. Scope

1.1 This specification covers the composition, dimensions, and physical properties of flexible unfaced foam sheet, used to insulate interior surfaces of HVAC ducts, plenums and equipment used for the distribution of conditioned air with a temperature of up to 250°F (121°C).

1.2 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are in SI, and 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 requirements prior to use.*

## 2. Referenced Documents

### 2.1 ASTM Standards:

- C 168 Terminology Relating to Thermal Insulating Material<sup>2</sup>
- C 177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus<sup>2</sup>
- C 209 Test Methods for Cellulosic Fiber Insulating Board<sup>2</sup>
- C 390 Criteria for Sampling and Acceptance of Preformed Thermal Insulation Lots<sup>2</sup>
- C 411 Test Method for Hot-Surfaced Performance of High Temperature Thermal Insulation<sup>2</sup>
- C 423 Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method<sup>2</sup>
- C 518 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus<sup>2</sup>
- C 634 Terminology Relating to Environmental Acoustics<sup>2</sup>
- C 665 Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing<sup>2</sup>
- C 1045 Practice for Calculating Thermal Transmission Properties from Steady-State Heat Flux Measurements<sup>2</sup>

- C 1071 Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)<sup>2</sup>
- C 1104 Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation<sup>2</sup>
- C 1114 Test Method for Steady-State Thermal Transmission Properties by Means of the Thin-Heater Apparatus<sup>2</sup>
- C 1304 Test Method for Assessing the Odor Emission of Thermal Insulation Materials<sup>2</sup>
- C 1338 Test Method for Determining the Fungi Resistance of Insulation Materials and Facings<sup>2</sup>
- E 84 Test Method for Surface Burning Characteristics of Building Materials<sup>3</sup>
- E 176 Terminology of Fire Standards<sup>3</sup>
- G 21 Practice for Determining Resistance of Synthetic Polymer Materials to Fungi<sup>4</sup>
- G 22 Practice for Determining Resistance of Plastics to Bacteria<sup>4</sup>

## 3. Terminology

3.1 The definitions of terms used in this specification shall be in accordance with Terminologies C 168, C 634, and E 176. In case of any conflicts, Terminology C 168 shall be the authority.

### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *closed cell foam*—a foam comprised of predominately individual non interconnecting cells.

3.2.2 *flexible cellular*—a cellular material that will not rupture within 60 s when a specimen 1 × 1 × 8 in. in length (25 × 25 × 200 mm) is bent around a 1 in. (25 mm) diameter mandrel at a uniform rate of one lap in 5 s in the form of a helix at a temperature between 65 and 85°F (18 and 29°C).

3.2.3 *open cell foam*—a foam made porous by interconnecting cells.

## 4. Classification

4.1 The flexible polymeric insulations of this specification are classified into Types I and II. Type I is a closed flexible foam. Type II is an open cell flexible foam.

NOTE 1—The primary difference between Type I and Type II materials are: Type I materials exhibit lower water absorption properties and Type

<sup>1</sup> 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 Non-Homogenous Inorganic Thermal Insulations.

Current edition approved July 10, 2002. Published September 2002.

<sup>2</sup> *Annual Book of ASTM Standards*, Vol 04.06.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 04.07.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 14.04.

II materials have greater acoustical properties as noted in Tables 1 and 2.

## 5. Materials

5.1 These products shall be made of a homogeneous blend of natural or synthetic polymeric materials that may be modified with various thermoplastic or thermosetting resins, plasticizers, modifiers, antioxidants, curatives, blowing agents and other additives.

5.2 Flexible, polymeric cellular thermal insulations shall be of uniform core density. Even though these insulation materials may have a smooth skin surface or coating on one or both sides, they are to be considered homogeneous for the purposes of determining thermal performance.

## 6. Ordering Information

6.1 Specific installation, insulation type, thickness, length, and width suited for the intended use shall be agreed upon by the purchaser and supplier.

## 7. Physical Properties—See Tables 1 and 2 for Summary of Requirements

7.1 *Apparent Thermal Conductivity*—The material shall be tested for apparent thermal conductivity at 75°F (24°C) mean temperature in accordance with 12.1. The thermal conductivity for the average of any four randomly selected samples, shall not be more than 0.30 Btu-in./h-sq ft°F (0.043 W/m-K) when tested in accordance with 12.1. See Table 1.

NOTE 2—Consult the local or state building codes for the minimum installed thermal resistance, R-value, required to be installed.

7.2 *Surface Burning Characteristics*—Shall be in accordance with 12.2. See Table 1 and Note 1 for requirements.

7.3 *Hot Surface Performance*—The insulation shall have no evidence of flaming, glowing, smoldering, visible smoke, delamination, cracking, warpage, melting, dripping or reduction in thickness when tested in accordance with 12.3 at the temperature specified in Table 1.

7.4 *Water Vapor Sorption*—Shall be tested in accordance with 12.4. See Table 1.

7.5 *Water Absorption*—Shall be tested in accordance with 12.5. See Table 1.

7.6 *Dimensional Stability*—Shall be tested in accordance with 12.6.

7.7 *Odor Emission*—There shall be no detectable odor of objectionable nature when tested in accordance with 12.7.

7.8 *Corrosiveness*—No corrosion shall be noted when tested in accordance with 12.8.

7.9 *Fungi Resistance*—When tested in accordance with 12.9, the test specimens shall show no fungal growth.

7.10 *Bacteria Resistance*—When tested in accordance with 12.10 the test specimens shall show no bacteria growth.

7.11 *Erosion Resistance*—The product shall show no evidence of delamination or continued erosion when air is passed through typical duct sections when tested in accordance with 12.11.

7.12 *Sound Absorption Coefficient*—When tested in accordance with Test Method C 423 using an “A” mounting, the insulation shall have sound absorption coefficient and NRC not less than that indicated in Table 2.

## 8. Qualification and Inspection Requirements

8.1 *Qualification Requirements*—The following requirements shall be used for purposes of initial material qualification:

- 8.1.1 Apparent thermal conductivity,
- 8.1.2 Surface burning characteristics,
- 8.1.3 Hot surface performance,
- 8.1.4 Water vapor sorption,
- 8.1.5 Water absorption,
- 8.1.6 Odor emission,
- 8.1.7 Corrosiveness,
- 8.1.8 Fungi resistance,
- 8.1.9 Bacterial resistance,
- 8.1.10 Sound absorption coefficient, and
- 8.1.11 Erosion resistance.

8.2 *Inspection*—The following requirements shall be used for purposes of acceptance sampling of lots or shipments of qualified thermal insulation:

- 8.2.1 Dimensional tolerances, and
- 8.2.2 Workmanship.

**TABLE 1 Physical Properties**

NOTE 1—Consult manufacturer regarding maximum thickness approved for surface burning characteristics.

NOTE 2— Actual product properties may be better, consult manufacturers for specific applications.

	Type I	Type II
Maximum Apparent Thermal Conductivity Btu-in./h-ft sq-°F) max. (W/m-K) max.	0.30 (0.043)	0.30 (0.043)
Surface Burning Characteristics ( at maximum total installed thickness):	(See Note 1)	(See Note 2)
Flame Spread Index, (max) ≤ 25	Pass	Pass
Smoke Development Index, (max) ≤ 50	Pass	Pass
Water Vapor Sorption wt % gain by vol. (max.)	0.00	0.1
Water Absorption, wt % gain by vol. (max.)	0.2	4.0
Dimensional Stability % change (max.) length, width or thickness	7.0	1.0
Odor Emission	Pass	Pass
Corrosiveness	Pass	Pass
Fungi/Bacteria Resistance	No Growth	No Growth
Erosion Resistance	Pass	Pass
Hot Surface Performance at not less than 250°F (125°C) (See 7.3 for requirements)	Pass	Pass

**TABLE 2 Sound Absorption Coefficients (min) Using a Type “A” Mounting<sup>A</sup>**

Frequency, Hz	125	250	500	1000	2000	4000	NRC <sup>B</sup>
Type I							
½ in. (13 mm)	0.03	0.04	0.06	0.20	0.40	0.15	0.20
1 in. (25 mm)	0.15	0.10	0.30	0.30	0.20	0.20	0.25
Type II							
½ in. (13 mm)	0.07	0.10	0.25	0.60	0.98	0.85	0.50
1 in. (25 mm)	0.14	0.20	0.45	0.80	0.98	0.85	0.60
2 in. (50 mm)	0.25	0.58	1.00	0.98	1.00	0.90	0.90

<sup>A</sup> Using Type A mounting. Data on Type “A” mounting is for comparison only and is not intended to indicate characteristics in duct devices.

<sup>B</sup>NRC—Noise Reduction Coefficient

## 9. Dimensional Tolerances

9.1 After conditioning for a minimum of 24 h at  $70 \pm 3^\circ\text{F}$  ( $21 \pm 1.6^\circ\text{C}$ ) and  $50 \pm 5\%$  relative humidity, the insulation shall conform to the dimensional tolerances listed in Table 3. All dimensions shall be measured at the conditioning temperature.

## 10. Workmanship and Finish

10.1 The insulation shall indicate good workmanship in fabrication and shall not have visible defects that adversely affect their service qualities.

## 11. Sampling

11.1 Sampling of the insulation shall be in accordance with Criteria C 390. Specific provisions for sampling shall be agreed upon between the purchaser and the supplier.

## 12. Test Methods

12.1 *Apparent Thermal Conductivity*—Test in accordance with Test Method C 177 or Test Method C 518 or Test Method C 1114 at  $75^\circ\text{F}$  ( $24^\circ\text{C}$ ) mean temperature (see also Practice C 1045).

12.2 *Surface Burning Characteristics*—Determine the surface burning characteristic for the material in accordance with Test Method E 84.

12.3 *Hot Service Performance*—The maximum hot surface temperature of the material shall be tested in accordance with Test Method C 411.

12.4 *Water Vapor Sorption*—Test the water sorption of the material in accordance with the Test Method C 1104.

12.5 *Water Absorption*—Determine the amount of water absorption of the test specimen in accordance with Test Method C 209 (24 h immersion time).

12.6 *Dimensional Stability*—Determine length, width and thickness change when tested in accordance with C 356 after aging 24 h at the maximum use temperature as noted in Table 1.

12.7 *Odor Emission*—Determine the odor emission in accordance with Test Method C 1304 except test at  $200^\circ\text{F}$  ( $92^\circ\text{C}$ ).

12.8 *Corrosiveness*—The corrosiveness of the material shall be determined in accordance with the corrosiveness test

method defined in Specification C 665.

12.9 *Fungi/Resistance*—The fungi resistance of the material shall be determined in accordance with Practice G 21 and Test Method C 1338.

12.10 *Bacterial Resistance*—The bacteria resistance of the material shall be determined in accordance with Practice G 22.

12.11 *Erosion Resistance*—The air erosion properties of the material shall be as determined in accordance with the erosion resistance test methods and requirements defined in Specification C 1071. The air velocity for the test is dependent upon the use of the product. The air velocity for the test should be 2.5 times the maximum rated velocity of the product.

## 13. Inspection

13.1 Inspection of the insulation shall be as agreed upon by the purchaser and the manufacturer as part of the purchase agreement.

## 14. Rejection

14.1 Material that fails to conform to the requirements agreed upon in the purchasing agreement is subject to rejection. Rejection should be reported to the producer or supplier promptly and in writing.

## 15. Certification

15.1 When specified in the purchase order or contract, a producer’s, supplier’s, or independent third party’s certification shall be furnished to the purchaser indicating 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 test results shall be furnished.

## 16. Product Marking

16.1 To meet building code requirements, the air stream surface of the liner should be marked with the following: product name, thickness, manufacturer, surface burning characteristics and nominal R-value.

## 17. Packaging and Package Marking

17.1 *Packaging*—Unless otherwise specified, the insulation shall be packaged in the manufacturer’s standard containers.

17.2 *Package Marking*—The markings shall be clear and legible. Unless otherwise specified, each container shall be marked with the manufacturer’s name, address, and telephone number; product name; production location and lot number; material width; length; thickness; nominal R-value.

**TABLE 3 Dimensional Tolerance, in. (mm)**

Dimension	Tolerance
Width	+0.250 in./-0 in. (+6 mm/-0 mm)
Length	-0/excess permitted
Thickness	$\pm 10\%$



## 18. Keywords

open cell; sound absorbing; thermal insulation

18.1 closed cell; ducts; flexible; foam; HVAC; insulation;

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