



Standard Specification for Discrete Non-Asbestos Fiber-Cement Interior Substrate Sheets¹

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1. Scope

1.1 This specification covers discrete non-asbestos fiber-cement sheets manufactured to be dimensionally stable and suitable for decoration as paint, wallpaper, natural stone, tile, or resilient flooring in internal wet and dry areas.

1.2 This specification is not applicable to asbestos-cement flat sheets (Specification C 220), non-asbestos fiber cement flat sheets for exterior applications such as claddings, facades, curtain walls, and soffits (Specification C 1186), gypsum backing board and coreboard (Specification C 442), water-resistant gypsum backing board (Specification C 630), glass mat gypsum backing board (Specification C 1178), particle boards (Definitions D 1554), fiber mat cement boards (Specification C 1325 and ANSI A118.9), or cement-bonded particleboards (Specification BS 5669: Part 4) and (ISO 8335).

1.3 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

2. Referenced Documents

2.1 ASTM Standards:

- C 220 Specification for Flat Asbestos-Cement Sheets²
- C 442 Specification for Gypsum Backing Board and Coreboard³
- C 630 Specification for Water-Resistant Gypsum Backing Board³
- C 1154 Terminology for Non-Asbestos Fiber-Reinforced Cement Products²
- C 1178 Specification for Glass Mat Water-Resistant Gypsum Backing Panel³
- C 1185 Test Methods of Sampling and Testing Non-Asbestos Fiber-Cement Flat Sheet, Roofing and Siding Shingles, and Clapboards²
- C 1186 Specification for Flat Non-Asbestos Fiber-Cement Sheets²

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² *Annual Book of ASTM Standards*, Vol 04.05.

³ *Annual Book of ASTM Standards*, Vol 04.01.

C 1325 Specification for Fiber-Mat Reinforced Non-Asbestos Cement Interior Substrate Sheets²

D 1037 Test Methods of Evaluating the Properties of Wood-Base Fiber and Particle Panel Materials⁴

D 1554 Definitions of Terms Relating to Wood-Base Fiber and Particle Panel Materials⁴

E 84 Test Method for Surface Burning Characteristics of Building Materials⁵

G 21 Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi⁶

2.2 ANSI Standards:⁷

A118.1 Specification for Dry-Set Portland Cement Mortar

A118.4 Specification for Latex-Portland Cement Mortar

A118.9 Test Methods and Specifications for Cementitious Backer Units

A136.1 Standard for Organic Adhesives for Installation of Ceramic Tile

2.3 British Standards:⁷

BS 5669: Part 4 Specification for cement bonded particle-board

2.4 International Standards:⁷

ISO 8335 Cement-bonded particleboards—Boards of Portland or equivalent cement reinforced with fibrous wood particles

3. Terminology

3.1 *Definitions:* Refer to Terminology C 1154.

4. Classification

4.1 Flat sheets covered by this specification are intended for interior dry or wet area applications as a desired unfinished substrate or an unfinished substrate for decoration such as paint, wallpaper, natural stone, tile, or resilient flooring where dimensional stability is required.

4.2 They may be supplied coated or uncoated.

4.3 The sheets are further classified into four grades according to their flexural strengths. The manufacturer shall declare

⁴ *Annual Book of ASTM Standards*, Vol 04.10.

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

⁶ *Annual Book of ASTM Standards*, Vol 14.04.

⁷ Available from American National Standards Institute, 11 West 42nd St., 13th Floor, New York, NY 10036.

the grade of a given product in the literature for that product.

5. Composition and Manufacture

5.1 *Composition*—This specification is applicable to discrete non-asbestos fiber-reinforced cement flat sheets consisting essentially of an inorganic hydraulic binder or a calcium silicate binder formed by the chemical reaction of a siliceous material and a calcareous material reinforced by organic fibers, inorganic non-asbestos fibers, or both. Process aids, fillers, and pigments that are compatible with the fiber-reinforced cement may be added.

5.2 *Manufacture*—These products may be formed either with or without pressure and cured, under either natural or accelerated conditions, to meet the property requirements of this specification.

6. Mechanical and Physical Properties

6.1 Mechanical and physical properties shall be determined on uncoated product wherever practical. This material shall also be tested, with the results identified as applying to coated material, where the products are supplied coated.

6.1.1 Sampling and inspection for mechanical and physical properties shall be conducted in accordance with Test Methods C 1185.

6.2 Mechanical Properties:

6.2.1 *Flexural Strength*—When tested in accordance with Test Methods C 1185, flexural strength shall be not less than the corresponding value for the appropriate grade listed in Table 1. Where manufacturers state the minimum product strength, this shall be at the 4 % acceptable quality level (AQL) as are the values of Table 1.

6.2.2 Sheets shall be tested and specified in both the wet and equilibrium conditions, and they shall meet the minimum wet and minimum equilibrium flexural strength requirements for the appropriate grade specified in Table 1. In addition, the average wet flexural strength of the sample shall not be less than 50 % of the mean equilibrium strength of the sample.

NOTE 1—When sampling from continuous production, these tests may be conducted on dry, equilibrium, or saturated specimens, provided that a relationship can be established between this testing and the specified values.

6.3 Physical Properties:

6.3.1 *Density*—Nominal values and tolerances for density shall be stated by the manufacturer for each product. When tested in accordance with the method specified in Test Methods C 1185, the value for the density shall comply with the value stated by the manufacturer.

TABLE 1 Flexural Strength Requirements

NOTE 1—The values of Table 1 are lower limit values based on an AQL of 4 %.

Grade	Minimum Wet Strength, psi (MPa)	Minimum Equilibrium Strength, psi (MPa)
I	580 (4)	580 (4)
II	1015 (7)	1450 (10)
III	1885 (13)	2320 (16)
IV	2610 (18)	3190 (22)

6.3.2 *Modulus of Elasticity*—Nominal values for modulus of elasticity shall be stated by the manufacturer for each product. When tested in accordance with the method specified in Test Methods C 1185, the nominal value for the modulus of elasticity shall comply with the value stated by the manufacturer.

7. Dimensions and Permissible Variations

7.1 *Method of Measurement*—The method of measurement shall be in accordance with Test Methods C 1185.

7.2 *Nominal Length and Width*—Fiber-cement sheets are typically supplied in nominal lengths of 96 in. (2438 mm) and 120 in. (3048 mm) and nominal widths of 48 in. (1219 mm). Greater or lesser nominal lengths and widths may be supplied.

7.3 *Nominal Thickness*—Fiber-cement sheets are normally available in thicknesses of 1/8 in. (3.5 mm) to 1 in. (25 mm), although thicknesses outside of this range may be supplied.

7.4 *Length and Width Tolerance*—The permissible variation from the nominal width shall be $\pm 0.5\%$, with a maximum variation of $\pm 1/4$ in. (6 mm). A maximum variation of $\pm 1/8$ in. (3 mm) is acceptable for dimensions less than 24 in. (609 mm).

7.5 *Thickness Tolerance*—The maximum difference between extreme values of the thickness measurement within a sheet shall not exceed 15 % of the maximum measured value. The thickness variation from sheet to sheet shall not exceed the tolerances given in Table 2.

7.6 *Squareness Tolerance*—The length of the diagonals shall not vary by more than 1/32 in./ft. (2.6 mm/m) of the length of the sheet. Opposite sides of the sheet shall not vary in length by more than 1/32 in./ft. (2.6 mm/m).

7.7 *Edge Straightness Tolerance*—The sheet edges shall be straight within 1/32 in./ft. (2.6 mm/m) of length or width.

8. Workmanship, Finish, and Appearance

8.1 *Workmanship*—Sheets shall have a commercially uniformly smooth surface on one side, and they shall be free of major defects that will impair appearance, erection, use, or serviceability.

8.2 *Finish*—The surface of the sheet to be exposed shall be smooth, granular, or otherwise textured.

8.3 *Appearance*—The surface of the sheet shall be the natural color of the product or may be colored by the addition of mineral pigments, chemical impregnation, pigmented coating, veneer, or embedded mineral granules.

9. Inspection and Acceptance

9.1 If required, inspection of material shall be at the point of shipment. The inspector representing the purchaser shall have authorized access to the carriers being loaded for shipment to the purchaser. The purchaser shall be afforded all reasonable

TABLE 2 Thickness Requirements

Nominal Thickness, in. (mm)	Tolerance, in. (mm)
1/8 to 3/16 (3.5–5)	± 0.02 (0.5)
>3/16 to 3/8 (>5–10)	± 0.04 (1.0)
>3/8 to 5/8 (>10 to 16)	± 0.05 (1.3)
>5/8 to 3/4 (>16 to 20)	± 0.06 (1.5)
>3/4 (>20)	$\pm 10\%$ thickness

and available facilities at the point of shipment for sampling and inspection of the material, which shall be conducted so as not to interfere with the loading of the carriers unnecessarily.

9.2 Third party certification, either continuous or at regular intervals, shall be recognized as an alternative to lot inspection.

9.3 Failure to conform to any one of the requirements of this specification shall constitute grounds for nonacceptance.

10. Product Marking

10.1 *Identification*—Product marking shall include a trademark or other means of identification that ensures that the manufacturer and product category can be identified. The method of marking shall be stated in the manufacturer's catalog.

11. Packaging and Storage

11.1 *Commercial Packaging*—Flat sheets shall be packaged so as to ensure acceptance by common carrier. There is no standard package. The material is usually shipped in bulk, but it may be crated when so specified by the purchaser.

11.2 *Storage*—Flat sheets should be piled on sufficient firm supports that will keep the sheets level and flat. The sheets

should be piled with the edges square and flush and covered to provide protection from the weather until used.

12. Keywords

12.1 acceptance; air cured; appearance; autoclaved cured; cellulose fiber; polyvinyl alcohol fiber; density; edge straightness; exterior applications sheet grading; finish; flex-ural strength; frost resistance; heat/rain resistance; inspection; interior wet area application; length and width tolerance; mechanical properties; minimum equilibrium strength; minimum wet strength; moisture content; moisture movement; nominal length; nominal thickness; nominal width; non-asbestos fiber; packaging; physical properties; polyethylene fiber; polypropylene fiber; coated glass fiber; polyacrylonitrile fiber; surface burning characteristics; pressure cured; sampling; shipping; squareness tolerance; storage; supplementary tests; thickness requirements; thickness tolerance; third party certification; tolerance; type tests; warm water resistance; water tightness; workmanship

SUPPLEMENTARY REQUIREMENTS

The following supplementary requirements shall apply only when specified by the purchaser in the contract or order.

S1. Supplementary Tests

S1.1 Supplementary tests for these sheets shall consist of once-only supplementary tests, with the manufacturer's statement of results provided upon the customer's request. Fundamental changes in formulation or methods of manufacture, or both, shall require the subsequent re-testing of the supplementary tests.

S1.2 Supplementary tests shall be determined on uncoated product whenever practical. When fiber-cement sheets are supplied coated, this material shall also be tested, with the results identified as applying to coated material.

S1.3 The following supplementary tests shall be required:

S1.3.1 Moisture movement,

S1.3.2 Moisture content,

S1.3.3 Water tightness,

S1.3.4 Warm water resistance,

S1.3.5 Surface burning characteristics,

S1.3.6 Shear bond strength (dry-set portland cement mortar),

S1.3.7 Shear bond strength (latex-portland cement mortar),

S1.3.8 Shear bond strength (organic adhesive type 1),

S1.3.9 Nail-head pull-through (roofing nail), and

S1.3.10 Mold resistance.

S2. Moisture Movement

S2.1 The linear variation with change in moisture content shall be stated as the percentage change in length based on a relative humidity change from 30 to 90 % in accordance with

Test Methods C 1185. The linear variation with change shall be ≤ 0.07 %.

S3. Moisture Content

S3.1 State the percentage of moisture content of the fiber-cement sheet when conditioned at 50 ± 5 % relative humidity and a temperature of $73 \pm 4^\circ\text{F}$ ($23 \pm 2^\circ\text{C}$) in accordance with Test Methods C 1185.

S4. Water Tightness

S4.1 When tested in accordance with the Test Methods C 1185, the specimens may show traces of moisture on the underside of the sheet, but in no instance shall there be any formation of water drops.

S5. Warm Water Resistance

S5.1 When tested in accordance with Test Methods C 1185, the specimens shall not show visible cracks or structural alteration such as to affect their performance in use. The ratio of the average strengths as calculated from test results shall not be less than 80 %.

S6. Surface Burning Characteristics

S6.1 When used as a finished substrate without decoration, fiber-cement sheets of $\frac{1}{4}$ -in. (6-mm) thickness shall have a reported flame spread index of 0 and a smoke developed index of not more than 5, when tested in accordance with Test Method E 84. Sheets of thicknesses greater than $\frac{1}{4}$ in. (6 mm) shall meet this specification or shall be formed at $\frac{1}{4}$ -in. (6-mm) thickness with the same formulation for test purposes.

S7. Shear Bond Strength (Dry-Set Portland Cement Mortar)

S7.1 Fiber-cement substrate sheets tested in accordance with ANSI A118.1 (fiber-cement substrate sheet to fiber-cement substrate sheet) shall demonstrate a minimum shear bond strength at 7-day curing of 50 psi (344 kPa).

S8. Shear Bond Strength (Latex-Portland Cement Mortar)

S8.1 Fiber-cement substrate sheets tested in accordance with ANSI A118.4 (fiber-cement substrate sheet to fiber-cement substrate sheet) shall demonstrate a minimum shear bond strength at 7-day curing of 50 psi (344 kPa).

S9. Shear Bond Strength (Organic Adhesives Type 1)

S9.1 Fiber-cement substrate sheets tested in accordance with ANSI A136.1 (fiber-cement substrate sheet to fiber-

cement substrate sheet) shall demonstrate a minimum shear bond strength at 7-day curing of 50 psi (344 kPa).

S10. Nail-Head Pull-Through

S10.1 Fiber-cement sheets of 1/4-in. (6-mm) thickness shall have a minimum saturated nail-head pull-through resistance of 90 lb (400 N) when tested in accordance with Test Methods D 1037 using a roofing nail with a 0.375-in. (10-mm) diameter head and a shank diameter of 0.121 in. (3 mm). Sheets of thicknesses greater than 1/4 in. (6 mm) shall meet this specification or shall be formed in 1/4-in. (6-mm) thickness with the same formulation for test purposes.

S11. Mold Resistance

S11.1 When used as a finished substrate without decoration, fiber-cement sheets shall not support mold growth greater than one when tested in accordance with Practice G 21.

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