DIRITEC
THE ANSWER TO YOUR CONSULTING NEEDS

Los Angeles, February 24, 2006

DCA06-DEC-072

Florida Building Commission
Florida Department of Community Affairs
22555 Shumard Oak Boulevard
Tallahassee, Florida 32399-2100

RE: Request for declaratory statement for Rule 9b-72

To how it may concern

My name is Diego Rivera; I am working with a fibercement manufacture who is trying to sell a 4/4 and 5/4 exterior trim in Florida market. We are being questioned by our customers about a Florida Product Approval for this type of product in your state.

Plycem Trim is used as an accessory or complement to any siding application adding a distinctive curb appeal. It's ideal for use in non-structural trim applications, such us corner boards, fascia, door and window trim.

See Exhibit B for product information

After researching the 2003 and 2006 International Building Code, 2003 International Residential Building Code, 2004 Florida Building Code, and Rule 9B-72 of the Department of Community Affairs- Florida Building Commission; I was not able to obtain any information or requirements needed for this type of application.

As a security to our customer we have tested our product in a certified laboratory in California following the requirements stated for fibercement by ASTM C-1185 and ASTM C-1186 (Exhibit A). These requirements are also used in chapter 14 (numeral 1404.10 attached) of the 2003 and 2006 International Building Code for fibercement siding.

> **1404.10 Fiber cement siding.** Fiber cement siding shall conform to the requirements of ASTM C 1186 and shall be so identified on labeling listing an approved quality control agency.

Based on this information can you please help me with the following question:

Does a non structural accessory for siding applications such us our Plycem Trim follows with in the scope of Rule 9B-72?

Sincerely,

D. Rivera

Diego Rivera
1230 Oakridge Drive
Glendale, CA 91205
818-422-6925

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EXHIBIT A

ASTM C -1186 TEST RESULTS

DIRITEC CORP. P.O. Box 251138, Glendale, CA 91225 (818) 649-7009 phone (818) 649-7119 fax w.w.w.diritec.com

TEST REPORT 10427-95 AND 10516A-95 FOR COMPLIANCE WITH ASTM 1186-99

C 1186-99 Section	Required Test	Condition of Acceptance	Test Report 10427-95 10516A-95 Result
5.2.1	Flexure Strength	Grade 1 (Type A) Wet 580 psi min Equilibrium 580 psi min Wet/Dry > 50 %	Grade 1 (Type A) Wet 589 psi Equilibrium 1171 psi Wet/Dry > 50.3 %
5.3.1	Density	Shall comply w/manufacture's stated values	71.5 lbs/ft^3
7.2	Nominal Length	96 inches +/- 0.5%	96 inches +/- 0.13%
7.2	Nominal Width	48 inches +/- 0.5%	48 inches +/- 0.09%
7.3	Nominal Thickness	0.44 +/- 0..5 in.	0.432 +/- 0.027 in
7.6	Squareness	0.031 in./ft	0.014 in/ft
7.7	Edge Straightness	0.031 in./ft	0.005 in/ft
S 1.1	Moisture Movement	Shall be Stated	0.153 in/ft (MD) 0.118 in/ft (CD)
S 1.1	Water Absorption	Shall be Stated	31%
S 1.1	Water Tightness	No Moisture on underside	No Moisture on underside
S 1.1	Frost Resistance	No visible cracks No visible structural alterations Retained strength > 80%	No visible cracks No visible structural alterations Retained strength > 112%
S 1.1	Warm Water	No visible cracks No visible structural alterations Retained strength reported	No visible cracks No visible structural alterations Retained strength = 99%
S 1.1	Surface Burning	Flame spread index = 0 Smoke developed < 5	Flame spread index = 0 Smoke developed = 0
S 1.1	Heat Rain	No visible cracks No visible structural alterations	No visible cracks No visible structural alterations

Designation: C 1185 – 03

Standard Test Methods for Sampling and Testing Non-Asbestos Fiber-Cement Flat Sheet, Roofing and Siding Shingles, and Clapboards[1]

This standard is issued under the fixed designation C 1185; 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 These test methods cover sampling and testing of non-asbestos fiber-cement flat sheets, roofing shingles, siding shingles, and clapboards. These products may be smooth or surface textured. These test methods are utilized in evaluating products cited in Specifications C 1186, C 1225, C 1288, and C 1325.

1.2 *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.*

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 20 Test Methods for Apparent Porosity, Water Absorption, Apparent Specific Gravity, and Bulk Density of Burned Refractory Brick and Shapes by Boiling Water[2]

C 1154 Terminology for Non-Asbestos Fiber-Reinforced Cement Products[3]

C 1186 Specification for Flat Non-Asbestos Fiber-Cement Sheets[3]

C 1225 Specification for Non-Asbestos Fiber-Cement Roofing Shingles, Shakes, and Slates[3]

C 1288 Specification for Discrete Non-Abestos Fiber-Cement Interior Substrate Sheets[3]

C 1325 Specification for Fiber-Mat Reinforced Non-Abestos Cement Interior Substrate Sheets[3]

2.2 *ISO Standards:*

ISO 390 Product in Fiber Reinforced Cement Sampling and Inspection[4]

ISO 2859-0 Sampling Procedures for Inspection by Attributes—Part 0: Introduction to the ISO 2859 Attribute Sampling System[4]

ISO 2859-1 Sampling Procedures for Inspection by Attributes—Part 1: Sampling Schemes Indexed by Acceptance Quality Limit (AQL) for Lot-by-Lot Inspection[4]

ISO 3951 Sampling Procedures and Charts for Inspection by Variables for Percent Nonconforming[4]

3. Terminology

3.1 *Definitions:* Refer to Terminology C 1154.

3.1.1 *density*—the mass per unit volume expressed in pounds per cubic foot (lb/ft^3) or kilograms per cubic metre (kg/m^3).

3.1.2 *flexural strength*—the average flexural strength is the average of two perpendicular breaks expressed in pound-force per square inch (megapascals) as calculated from the average breaking load of wet or equilibrium test specimens, loaded as simple beams, with the load applied at the center.

3.1.3 *heat-rain sheets*—fixed to a building frame in accordance with the manufacturer's recommended installation practices. The sheeted frame is then subjected to alternate wetting and heating cycles and any structural alteration of the sheet caused by the test is reported.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *dimensions*—for the purpose of these test methods, the length, width and thickness of fiber-cement flat sheets, roofing shingles, siding shingles, and clapboard are measured under specified conditions.

3.2.2 *moisture content*—for the purpose of these test methods, the percentage of moisture content of the fiber-cement product when conditioned at 50 ± 5 % relative humidity and a temperature of 73 ± 4°F (23 ± 2°C).

3.2.3 *moisture movement*—in these test methods, the linear variation in length and width of test specimen, with change in moisture content.

3.2.4 *water absorption*—for the purpose of these test methods, the increase in mass of the test specimen expressed as a percentage of its dry mass after immersion in water for a specified period of time as prescribed.

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[1] These test methods are under the jurisdiction of ASTM Committee C17 on Fiber-Reinforced Cement Products and are the direct responsibility of Subcommittee C17.02 on Non-Asbestos Fiber Cement Products.

Current edition approved July 10, 2003. Published August 2003. Originally approved in 1991. Last previous edition approved in 1999 as C 1185 – 99.

[2] *Annual Book of ASTM Standards*, Vol 15.01.

[3] *Annual Book of ASTM Standards*, Vol 04.05.

[4] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

4. Sampling and Inspection

4.1 Employ sampling procedures providing an acceptable quality level (AQL) of 4 % at a 90 % confidence level with a sample size given by special inspection level S3, except where specific sampling is required by particular test procedures.

4.2 *Acceptable Quality Level (AQL)*—The acceptable quality level (AQL) may be defined as follows:

4.2.1 The maximum percent nonconforming that, for purposes of sampling inspection, can be considered satisfactory as a process or long-term average, and

4.2.2 A quality level which corresponds to relatively high probability (commonly 90 %) of acceptance.

4.3 *Sample Size*—The sample size is determined according to the inspection lot size by the special inspection level S3 of ISO 2589-1 where the inspection is by attributes or special inspection level S3 of ISO 3951 where the inspection is by variables.

NOTE 1—When a manufacturer's process satisfies a sampling scheme with an AQL of 4 % then this indicates that better than 96 % of the inspected production exceeds the specifications. Under this type of specification the consumer is provided the protection and confidence of a clearly defined lower boundary. This would not be true if acceptance were based solely on the average value of the measured property. Examples of sampling schemes which may be used can be found in documents such as ISO 390, ISO 2859-1, or ISO 3951. Other sampling schemes may be used. Inspection by attributes is a method which consists of determining, for every item of a sample, the presence or absence of a certain qualitative characteristic (attribute) with respect to the applicable specification. It is, in essence, a pass-fail inspection which determines the number of items in a sample that do conform to the specification and the number of those that do not conform. An attribute could be a dimensional measurement, or a flexural strength value, or others that are described in these test methods. Inspection by variable is a method which consists of measuring a quantitative characteristic for each item in a sample. Conformance with the applicable specification is determined from the mean values of the measured properties and the statistical variations of these values above and below the mean. These procedures detail sampling plans to suit all common sampling situations. The sampling plans specify the number of specimens to be taken from each batch and the acceptance/rejection criteria. The specified inspection levels have been selected to suit fiber-cement products, to balance the cost of assessment against confidence in results commensurate with this industry.

5. Flexural Strength (Modulus of Rupture)

5.1 *Significance and Use*—This is a routine test measuring a primary product characteristic used for product grading.

5.2 *Procedure*:

5.2.1 *Preparation of Test Specimens, (Flat Sheets)*—Cut a pair of specimens, each 6 ± 1/16 in. (152 ± 1.6 mm) in width and 12 ± 1/16 in. (305 ± 1.6 mm) in length, from the interior area of each sample sheet in such a manner that no edge of specimen is less that 3 in. (76 mm) from the original edges of the sheet. The longer dimension of one of the specimens of each pair shall be parallel to the length of the sheet (that is, parallel with the fiber lay), and the other shall be at right angles to it.

5.2.2 *Preparation of Test Specimens, (Roofing Shingles, Siding Shingles, and Clapboards)*—Cut a single specimen 6 ± 1/16 in. (152± 1.6 mm) in width and 12 ± 1/16 in. (305 ± 1.6 mm) in length from each unit. Cut one half of the specimens in such a manner that the 12-in. (305-mm) dimension of each specimen is parallel to one edge of the shingle or clapboard unit; cut one half of the specimens at right angles thereto.

NOTE 2—Alternate test specimen dimensions and span may be used provided that the ratio of the test span to specimen thickness is not less than 18, and that the actual span used be reported.

5.2.3 *Conditioning*:

5.2.3.1 *Equilibrium Conditioning*—Place the test specimens, for at least four days [thickness< ½ in. (12 mm)] or at least seven days [thickness ≥ ½ in. (12 mm)] in a controlled atmosphere of 73 ± 4°F (23 ± 2°C) and 50 ± 5 % relative humidity and in such a manner that all faces are adequately ventilated.

5.2.3.2 *Wet Conditioning*— Immerse specimens to be tested in wet condition in water at a temperature of 73 ± 7°F (23 ± 4°C) for a period of 48 h minimum. Test the specimens immediately upon removal from the water.

5.2.4 *Test Procedure*— Determine the flexural strength of each specimen by placing the underside of the specimen on supports that cannot exert longitudinal constraints [rocker-type bearing edges, rollers, etc. with a 1/8-in. (3.2-mm) minimum radius and a ½-in. (12.7-mm) maximum radius] and apply the load at mid-span through a similar edge bearing against the finished surface of the specimen. The test span shall be 10 ± 1/16 in. (254 ± 1.6 mm) and the load line and support shall be parallel. Mount a dial micrometer reading to 0.01 in. (0.25 mm) or an equally sensitive apparatus, to bear on the loading member or on the specimen at mid-span to determine the deflection of the specimen at the center of the test span. Measure and record the deflection when the maximum load is reached. Increase the load at a uniform deflection rate, such as will result in failure of the specimen between five and thirty seconds. The error in the load reading shall not exceed 1 % of the maximum load.

NOTE 3—Alternate test specimen dimensions and span may be used provided that the ratio of the test span to specimen thickness is not less than 18, and that the actual span used be reported.

5.2.4.1 Measure the specimen thickness, for the flexural test, at four points along the line of break for an average result. This measurement may be completed either before or after load testing. The thickness gage shall have flat parallel anvils of between 0.4-in. (10-mm) and 0.6-in. (15-mm) diameter with an accuracy of ±0.002-in. (±0.05-mm). Determine face-textured product thickness from volume measurement by water displacement using the formula:

$$t = \frac{V}{L \times W} \tag{1}$$

where:

t = specimen thickness, in.,
V = volume, determined by water displacement, in.^{3},
L = length, in., and
W = width, in.

NOTE 4—Alternative methods for determination of average thickness of textured product may be used provided that they can be proven, on average, to yield a thickness measurement within ±2 % of that determined from volume measurement by water displacement.

5.3 *Calculation and Report*:

5.3.1 Calculate the flexural strength for each specimen by the following equation:

$$R = \frac{3\,PL}{2\,bd^2} \tag{2}$$

where:
R = flexural strength, psi (MPa),
P = maximum load, lb (N),
L = length of span, in. (mm),
b = width of specimen, in. (mm), and
d = average thickness, in. (mm).

The average flexural strength of the specimen pair shall be the arithmetic mean value obtained in the two directions. Report the arithmetic mean value of each pair.

5.3.2 It shall be the option of the manufacturer to report the handleability index of his product. Handleability index values are relative and are used to determine the capability of the material to be handled without breaking. An increase in handleability index means increased ease of handling. For each sheet direction, calculate handleability index using the formula:

$$U = \frac{0.5\,P\Delta}{t} \tag{3}$$

where:
U = handleability index, in., lb/in. (mm, N/mm),
P = breaking load, lb (N), in each direction at a span of 10 in. (254 mm),
Δ = ultimate deflection, in. (mm), under center loading at a span of 10 in. (254 mm), and
t = thickness of the test specimen, in. (mm).

5.3.3 Calculate the breaking moment (roofing products only) for each sample specimen by the following equation:

$$M = \frac{P\,L}{4\,b} \tag{4}$$

where:
M = breaking moment, ft, lbf/ft (Nm/m),
P = maximum load, lbf (N),
L = length of span, ft (m), and
b = width of specimen, ft (m).

Report the arithmetic mean value for the sample specimen group.

5.4 Calculate the modulus of elasticity (interior substrate sheets only) for each sample specimen by the following equation:

$$E = (P_2 - P_1) \times L^3/4bd^3\,(y_2 - y_1) \tag{5}$$

where:
E = modulus of elasticity, psi (kg/mm^2),
P_2 and P_1 = loads, lb (kg), taken from two points within the linear section of the plot,
y_2 and y_1 = deflections, in. (mm) corresponding to the loads selected,
b = width of specimen, in. (mm),
d = thickness of specimen, in. (mm), and
L = length of span, in. (mm).

5.5 *Precision and Bias*:

5.5.1 *Precision*—The precision of the procedure in Test Methods C 1185 for measuring flexural strength is being determined.

5.5.2 *Bias*—Since there is no accepted reference material suitable for determining the bias for the procedure in Test Methods C 1185 for measuring flexural strength, no statement on bias is being made.

6. Density

6.1 *Significance and Use*—The uniformity of density results are used for quality control assurance.

6.2 *Procedure*:

6.2.1 *Preparation of Test Specimen*—Use a test specimen from the flexural test or a specimen of equivalent dimension.

6.2.2 *Testing Procedure*—Determine the volume of the specimen by any method capable of giving a result accurate to within 2 % of the results obtained by the water displacement method. Determine the mass by drying out the test specimen in an oven at 194 ± 4°F (90 ± 2°C) until the difference between two consecutive weighings, at intervals not less than two hours, is less than 0.1 % by mass.

NOTE 5—Water displacement can be obtained per Test Methods C 20, in which volume (V) of the test specimen is obtained in cubic centimetres by subtracting the suspended weight (W) from the saturated weight (S), both in grams as follows:

$$V = W - S \tag{6}$$

where:
V = volume, cm^3,
W = saturated weight, g, and
S = suspended weight, g.

This assumes that 1 cm^3 of water weighs 1 g. This is true within about three parts in 1000 for water at room temperature. Suspended weight (S) is obtained for each test specimen by suspending the specimen in a loop or halter of AWG gage No. 22 (0.644 mm) copper wire hung from one arm of the balance. The balance shall be previously counter balanced with the wire in place and immersed in water to the same depth as is determining the suspended weight, blot each specimen lightly with a moistened smooth linen or cotton cloth to remove all drops of water from the surface, and determine the saturated weight (W) in grams by weighing in air to the nearest 0.1 g.

6.3 *Calculation and Report*—Calculate and report the density of the specimen in pounds per cubic foot (lb/ft^3) using the equations:

$$\text{density} = \frac{W}{V} \times \frac{1}{454} \times \frac{1728}{1} \tag{7}$$

where:
W = dry mass of specimen, g, and
V = volume, in.^{3},

or in kilograms per cubic metre (kg/m^3) using the equation:

$$\text{Density} = \frac{W}{V} \times 1\,000\,000 \tag{8}$$

where:
W = dry mass of specimen, g, and
V = volume, mm^3.

6.4 *Precision and Bias*:

6.4.1 *Precision*—The precision of the procedure in Test Methods C 1185 for measuring density is being determined.

6.4.2 *Bias*—Since there is no accepted reference material suitable for determining the bias for the procedure in Test Methods C 1185 for measuring density, no statement on bias is being made.

7. Dimensional Measurements

7.1 *Significance and Use*:

7.1.1 These are routine measurements for determining whether the length and width of the individual units are as ordered, to ensure that they fit together properly in application, and to determine the uniformity of the specified thickness.

7.1.2 In determining the thickness of a sheet having a textured or granulated surface, a metal plate is placed adjacent to the textured surface, and the micrometer readings are taken on the combined thickness of the sheet and the metal plate. The purpose is to obtain a more accurate overall thickness measurement of the textured or granulated sheet. This would be rather difficult to do, in many cases, because of surface irregularities when the plate is not used.

7.2 *Conditioning*— Condition the specimens to be tested in an environment of 73 ± 4°F (23 ± 2°C) temperature and 50 ± 5 % relative humidity for 48 h. Condition specimens for all dimensional measurement tests.

7.3 *Measurement or Thickness*:

7.3.1 *Flat Sheets Measurement of Thickness*—Take thickness measurements at the midpoint along each edge dimension with a gage capable of reading to an accuracy of 0.002 in. (0.05 mm).

7.3.2 *Textured or Granulated Sheets*—Measure the thickness of each test specimen by placing a smooth metal plate of uniform thickness with dimensions approximately 1/64 by 4 by 4 in. (0.4 by 102 by 102 mm) against the finished, textured, or weather-exposed surface of the specimen. Using a gage capable of reading to 0.002 in. (0.05 mm), measure the overall thickness of the metal plate and specimen at the approximate midpoint of each edge of the specimen and at least ½ in. (12.7 mm) from the edge of the specimen.

7.3.2.1 *Flat Sheets*— Average the four measurements and record as the specimen thickness.

7.3.2.2 *Textured or Granulated Sheets*—Subtract the measured thickness of the metal plate from each measurement and average four measurements to give the specimen thickness. This method shall not be used for calculation of flexural strength and density.

7.4 *Flat Sheets Measurement of Squareness*—Measure the length of the diagonals, as well as the edge lengths of the sheets, with a steel tape capable of reading to an accuracy of 1/32 in. (0.7 mm).

7.5 *Flat Sheets Measurement of Edge Straightness*—Measure the greatest distance between the edge of the sheet and a string or wire stretched from one corner of the panel to the adjacent corner with a steel rule capable of reading to an accuracy of 1/32 in. (0.7 mm).

7.6 *Flat Sheets Measurement of Length and Width*—Take three measurements of each dimension with a steel tape capable of reading to an accuracy of 1/32 in. (0.7 mm).

7.7 *Precision and Bias*:

7.7.1 *Precision*—The precision of the procedure in Test Methods C 1185 for dimensional measurements is being determined.

7.7.2 *Bias*—Since there is no accepted reference material suitable for determining the bias for the procedure in Test Methods C 1185 for dimensional measurements, no statement on bias is being made.

8. Moisture Movement

8.1 *Significance and Use: Moisture Movement*—This test is used to determine the serviceability of product in areas of high humidity and exposure to moisture.

8.2 *Test Specimen*— The test specimens shall be 3 in. (76 mm) in width and at least 12 in. (305 mm) in length. Provide two specimens, one cut parallel with the long dimension of each sheet and one from the same sheet cut at right angles to the long dimension.

8.3 *Conditioning*— Condition each specimen to practical equilibrium at a relative humidity of 30 ± 2 % and a temperature of 73 ± 4°F (23 ± 2°C). Practical equilibrium is defined as the state of time change in weight where, for practical purposes, the specimen is neither gaining nor losing moisture content more than 0.1 wt. % in a 24-h period.

8.4 *Procedure*—Measure the length of each specimen in a dial gage comparator using a standard bar of the same nominal length as the specimen for reference, or any other method capable of measuring each specimen to the nearest 0.001 in. (0.02 mm). Then condition the specimens to practical equilibrium at a relative humidity of 90 ± 5 % and a temperature of 73 ± 6°F (23 ± 3°C). Measure the length of each specimen in a dial gage comparator or any other method capable of measuring each specimen to the nearest 0.001 in. (0.02 mm). If bowing is evident, choose a method that will record measurements on both sides of the test specimen and average the results.

8.5 *Calculation and Report*—Report the linear change in moisture content as the percentage change in length based on the length at relative humidity change of 30 to 90:

$$\text{linear change, \%} = \frac{(L) \text{ at } 90\ \% - (L) \text{ at } 30\ \% \times 100}{(L) \text{ at } 30\ \%} \qquad (9)$$

8.6 *Precision and Bias*:

8.6.1 *Precision*—The precision of the procedure in Test Methods C 1185 for moisture movement is being determined.

8.6.2 *Bias*—Since there is no accepted reference material suitable for determining the bias for the procedure in Test Methods C 1185 for moisture movement, no statement on bias is being made.

9. Water Absorption

9.1 *Significance and Use*—This is a routine test. The values are relative. The test is made to determine the tendency of a product to absorb water and sometimes determine uniformity of the product.

9.2 *Procedure*:

9.2.1 Dry each specimen of minimum size of 4 by 4 in. (100 by 100 mm) to constant weight in a ventilated oven at a temperature of 194 ± 4°F (90 ± 2°C) and cool to room temperature in a desiccator or desiccator-type cabinet. Weigh

each cooled specimen separately on a scale of an accuracy of 0.5 % of specimen mass. Record the dry weight of each cooled specimen. Submerge the specimen for 48 ± 8 h in clean water at 73 ± 7°F (23 ± 4°C).

9.2.2 Remove each specimen from the water, wipe with a damp cloth, and weigh each specimen separately on a scale of an accuracy of 0.5 % of specimen mass.

9.3 *Calculation and Report*:

9.3.1 Calculate the water absorption value for each specimen as follows:

$$\text{water absorption, mass } \% = [(W_s - W_d)/W_d] \times 100 \quad (10)$$

where:
W_s = saturated mass, lb (g) of specimen, and
W_d = dry mass, lb (g) of specimen.

9.3.2 Report the water absorption as the average value for all specimens tested.

9.4 *Precision and Bias*:

9.4.1 *Precision*—The precision of the procedure in Test Methods C 1185 for water absorption is being determined.

9.4.2 *Bias*—Since there is no accepted reference material suitable for determining the bias for the procedure in Test Methods C 1185 for water absorption, no statement on bias is being made.

10. Moisture Content

10.1 *Significance and Use*—This is a routine test. Nominal values and tolerances for moisture content shall be declared by the manufacturer for his products.

10.2 *Procedure*:

10.2.1 *Preparation of Test Specimen*—Use a test specimen from the flexural test. When for any reason additional determination of moisture content are required, prepare separate samples. These moisture content specimens shall be the full thickness of the material and 3 in. (76 mm) wide and 6 in. (152 mm) long.

10.2.2 *Conditioning*— Condition as stated in 5.2.3.1.

10.2.3 *Testing Procedure*—After equilibrium conditioning, weigh each sample separately on a scale to an accuracy of 0.5 %. Note this mass as initial mass (w). Dry each specimen to constant mass in a circulated oven at a temperature of 194 ± 4°F (90 ± 2°C) and cool to room temperature in a desiccator-type cabinet. Record the dry mass of each cooled specimen and note as final mass when oven-dry (F).

10.3 *Calculation and Report*—Calculate the moisture content as follows:

$$M = 100\,[(W - F)/F] \quad (11)$$

where:
M = moisture content, %,
W = initial mass, lb (kg), and
F = final mass when oven-dry, lb (kg).

10.4 *Precision and Bias*:

10.4.1 *Precision*—The precision of the procedure in Test Methods C 1185 for moisture content is being determined.

10.4.2 *Bias*—Since there is no accepted reference material suitable for determining the bias for the procedure in Test Methods C 1185 for moisture content, no statement on bias is being made.

11. Water Tightness

11.1 *Significance and Use*—This test is used to determine the serviceability (water tightness) of product when subjected to a determined water head for a protracted period.

11.2 *Test Specimens*— Cut the test specimens to 24 by 20 in. (610 by 508 mm) minimum, from at least three sampled sheets. Cut one specimen from each sheet with a total of three specimens for each test. Where product size is less than 24 by 20 in. (610 by 508 mm) use the largest size product as the test specimen.

11.3 *Procedure*—Keep the 24 by 20-in. (610 by 508-mm) test specimens in a controlled environment for at least five days at an ambient temperature [exceeding 41°F (5°C)]. Place and seal a suitable frame 22 by 18 in. (559 by 457 mm) minimum on top of the face of the specimen and fill with water to a height of 2 in. (50 mm) above the face of the sheet. Place the specimen in a controlled environment at 73 ± 4°F (23 ± 2°C) and 50 ± 5 % relative humidity for a period of 24 h.

11.4 *Calculation and Report*—Examine the specimen with the unaided eye and report any formation of drops of water on the underside of the sheet. Report the thickness of the product tested.

11.5 *Precision and Bias*—No statement is made about either the precision or bias of Test Methods C 1185 for measuring water tightness since the result merely states whether there is conformance to the criteria for success specified in the procedure.

12. Freeze/Thaw—Cladding Products

12.1 *Significance and Use*—This test investigates the possible degradation of the product due to exposure to repeated freeze or thaw cycles, or both. This test is a comparative one and is only significant for as-received products.

12.2 *Test Specimens*— The test specimens shall be 6 by 12 in. (152 by 305 mm) cut from at least five sampled sheets as delivered by the manufacturer. Cut two pairs of two specimens from each sheet with a total of ten pairs of specimens for this test.

12.3 *Procedure*:

12.3.1 Divide the paired specimens to form two sets of paired specimens each.

12.3.2 Submit the first set of ten specimens to the saturated flexural strength test according to Section 5.

12.3.3 Saturate the remaining set of ten specimens by immersing in water of a temperature greater than 41°F (5°C) for a minimum of 48 h. Then seal each specimen separately in a plastic bag. The plastic bag shall have a thickness between 8 mils (0.2 mm) and 12 mils (0.3 mm). The length and width of the plastic bag shall not exceed the length and width of the sample by more than 20 %, respectively. Subject the specimens to freeze/thaw cycles consisting of:

12.3.3.1 Cool to − 4 ± 4°F (−20 ± 2°C) over a period of not less than one hour nor more than two hours. Hold the specimens at − 4± 4°F (−20 ± 2°C) for one hour.

12.3.3.2 Thaw to 68 ± 4°F (20 ± 2°C) over a period of not less than one hour and a maximum of two hours. After thawing, maintain the specimens at 68 ± 4°F (20 ± 2°C) for one hour before proceeding with freezing.

(*1*) Each freeze/thaw cycle shall have a minimum cycle time of four hours and a maximum of six hours.

(*2*) The freezer unit shall have a forced-air circulation capable of being regulated to the prescribed freezing condition with a full load of test specimens.

(*3*) The total number of freeze/thaw cycles shall be as specified in the applicable standard specification.

(*4*) Freeze/thaw cycles may be controlled automatically or manually.

(*5*) An interval between cycles, maximum 48 h, is permissible. During this interval, store specimens in warm condition at 68 ± 4°F (20 ± 2°C).

(*6*) During both freezing and thawing, position the specimens to enable free circulation of the conducting medium (air or water) around each bag.

12.4 *Calculation and Report*:

12.4.1 Examine the specimens with the unaided eye in order to detect possible cracks, delamination, and other defects, and record any observations.

12.4.2 Saturate the specimens and test the flexural strength (*Ff*) according to Section 5.

12.4.3 Calculate and report the ratio (*R*) of the strength averaged for the set undergoing freeze/thaw cycles (*Ff*) to the strength averaged for the control of reference set (*Fr*).

$$R = F_f/F_r \tag{12}$$

12.5 *Precision and Bias*:

12.5.1 *Precision*—The precision of the procedure in Test Methods C 1185 for freeze/thaw is being determined.

12.5.2 *Bias*—Since there is no accepted reference material suitable for determining the bias for the procedure in Test Methods C 1185 for freeze/thaw, no statement on bias is being made.

13. Warm Water

13.1 *Significance and Use*—This test investigates the long-term chemical interaction of constituent materials. Wet and elevated temperature conditions are used to accelerate the results. This test is a comparative one and is only significant for products as delivered.

13.2 *Sampling*:

13.2.1 Sample five or more sheets as delivered by the producer. Cut ten sets of paired specimens to suit the flexural strength test, in accordance with 5.2.1.

13.2.2 Cut each specimen pair from the same sheet and uniquely number for later comparison of results. Two pairs of specimens may be cut from the sheet.

13.3 *Procedure*:

13.3.1 Divide the paired specimens to form two sets of ten specimens each.

13.3.2 Submit the first lot of ten specimens to the saturated flexural strength test, as specified in Section 5, and at the same time immerse the ten specimens of the second lot in water saturated with an excess of lime and maintained at 140 ± 4°F (60 ± 2°C) for 56 ± 2 days. At the end of this period, place the specimens in a conditioning chamber at 73 ± 4°F (23 ± 2°C) and 50± 5 % relative humidity for 48 ± 2 h.

13.3.3 Examine the specimens with the unaided eye in order to detect possible cracks, delamination, or other defects, and record any observations.

13.3.4 Carry out the flexural strength test as specified in Section 5, after preliminary conditioning for wet strength.

13.4 *Calculation, Interpretation of Results, and Report*:

13.4.1 For each pair of specimens ($i = 1$ to 10), calculate the individual ratio (ri) as follows:

$$r_i = t_i/c_i \tag{13}$$

where:

t = flexural strength after warm water immersion, and
c = control flexural strength.

13.4.2 Calculate and report the average ($\bar{x}$) and the standard deviation (*S*) of the individual ratios (*ri*). The standard deviation (estimated) shall be calculated as follows:

$$s = \sqrt{\frac{n\Sigma(x)^2 - (\Sigma x)^2}{n(n-1)}} = \sqrt{\frac{\Sigma x^2 - (\Sigma x)^2/n}{(n-1)}} \tag{14}$$

where:

s = estimated standard deviation,
x = value of single observation, and
n = number of observations.

13.4.3 Calculate and report the 95 % lower confidence estimate of the ratio as follows:

$$L_{95} = \bar{x} - 0.58\,s \tag{15}$$

where:

$\bar{x}$ = arithmetic mean of the set of observations, and
s = estimated standard deviation.

13.5 *Precision and Bias*:

13.5.1 *Precision*—The precision of the procedure in Test Methods C 1185 for warm water is being determined.

13.5.2 *Bias*—Since there is no accepted reference material suitable for determining the bias for the procedure in Test Methods C 1185 for warm water, no statement on bias is being made.

14. Heat/Rain—Wall Structures

14.1 *Significance and Use*—This test is used to assess the installed performance of the produce under cyclic changes in moisture content.

14.2 *Test Specimens*— Sheet specimens used for the test shall be drawn at random from stock of finished products. The number of sheets required will depend upon the manufacturer's installation recommendations and on the size of the sheets to be tested.

14.3 *Procedure*:

14.3.1 Assemble a test frame, according to the manufacturer's recommendations, that simulates the rigidity of the field installation. The frame construction should include provisions for at least one sheet joint in its central region. The perimeter

of the frame should allow for standard sheet edge finishing. The construction of the frame should meet the following requirements:

14.3.1.1 A minimum of 37.7 ft^2(3.5 m^2),

14.3.1.2 Allow sheets to be installed with normal orientation,

14.3.1.3 Allow installation of at least two sheets as follows, and

14.3.1.4 Avoid any significant external air flow during test period.

(*1*) Area per sheet >19.4 ft^2(1.8 m^2) for 2 specimens,

(*2*) Area per sheet <19.4 ft^2 (1.8 m^2) or a sufficient number of specimens to cover an area of 37.7 ft^2(3.5 m^2), and

(*3*) If the combined area of the sheets exceeds 37.7 ft^2(3.5 m^2) the sheet lengths may be reduced to provide a test area not less than 37.5 ft^2(3.5 m^2).

14.3.1.5 Avoid any significant external air flow during the test period.

14.3.2 Fix the sample sheets to the test frame, observing all manufacturer's recommendations. The edge fixing distance shall be the minimum allowed. The center distance between fixing shall be the maximum allowed. Include all weatherproofing and other attachments normally specified in the assembly. Where sheets are recommended to have overlapping joints, assemble the test frame accordingly. Set the sheeted test frame in a vertical position. Provide a water spray station to wet one surface, along with a heating station, to provide uniform radiant heat. Subject the sheeted test frame to the number of cycles specified in the applicable standard specification meeting the following requirements.

14.3.3 Water spray at a rate of 1 gal/min for a period of 2 h, 55 min, water temperature not to exceed 86°F (30°C),

14.3.4 Pause for a period of 5 min,

14.3.5 Radiant heat to give a measurement plate (1) temperature across the complete test frame surface of 140 ± 9°F (60 ± 5°C) for a period of 2 h, 55 min, and

14.3.6 Pause for a period of 5 min.

NOTE 6—A measurement plate is defined as an aluminum plate 2 by 2 in. (50 by 50 mm) of 0.040-in. (1-mm) thickness having a black matte finish. A suggested method for obtaining a black matte finish is to completely blacken the measurement plate with soot from a burning candle. The measurement plate shall have a thermal couple or similar device attached to the surface of the plate.

14.4 *Report*—On completion of the final test cycle, inspect the sheets with the unaided eye and report any damage or structural alteration caused by the test.

14.5 *Precision and Bias*—No statement is made about either the precision or bias of Test Methods C 1185 for heat/rain—wall structures, since the result merely states whether there is conformance to the criteria for success specified in the procedure.

15. Heat/Rain—Roof Structures

15.1 *Significance and Use*—This test is used to assess the installed performance of fiber cement roofing products under cyclic changes in moisture content.

15.2 Fiber cement roofing materials are fastened to a roofing frame in accordance with the manufacturer's recommended installation practices. The assembled frame is then subjected to alternate wetting and heating cycles, and any structural alteration of the roofing materials caused by the test is reported.

15.3 *Test Specimens*— Fiber cement roofing product specimens used for the test shall be drawn at random from the stock of finished products. The number of specimens required will depend upon the manufacturer's installation recommendations and the size of the assembly to be tested.

15.4 *Procedure*:

15.4.1 Assemble a roof test frame according to the manufacturer's recommendations that simulates the rigidity of the field installation. The construction of the frame should be a minimum of 47.7 ft^2(4.5 m^2).

15.4.1.1 Avoid any significant external air flow during the test period.

15.4.2 Fix the roofing materials to the test frame, observing all manufacturer's recommendations. The head lapping distance shall be the minimum allowed. All weatherproofing and other attachments normally specified shall be included in the assembly. The assembled test frame may be set in a plane down to a minimum slope of one in four, or alternatively may be set in a vertical position. A water spray station is provided to wet the top weather surface, along with a heating station to provide uniform radiant heat. The sheeted test frame should be subjected to the number of cycles specified in the applicable standard specification meeting the following requirements.

15.4.2.1 Water spray at a rate of 1 gal/min (4 L/min) for a period of 2 h, 55 min, with a water temperature not to exceed 86°F (40°C).

15.4.2.2 Pause for a period of 5 min.

15.4.2.3 Radiant heat to give a measurement plate (1) temperature across the complete test frame surface of 140 ± 9°F (60 ± 5°C) for a period of 2 h and 55 min.

15.4.2.4 Pause for a period of 5 min.

NOTE 7—A measurement plate is defined as an aluminum plate 2 by 2 in. (50 by 50 mm) of 0.040-in. (1-mm) thickness having a black matte finish. A suggested method for obtaining a black matte finish is to completely blacken the measurement plate with soot from a burning candle. The measurement plate shall have a thermal couple or similar device attached to the surface of the plate.

15.5 *Report*—On completion of the final test cycle, inspect the roofing products with the unaided eye and report any damage or structural alteration caused by the test.

15.6 *Precision and Bias*—No statement is made about either the precision or bias of Test Methods C 1185 for heat/rain—roof structures, since the result merely states whether there is conformance to the criteria for success specified in the procedure.

16. Freeze/Thaw—Roofing Products

16.1 *Significance and Use*—This test investigates the degradation of the product due to exposure to repeated freeze-thaw cycles. This test is a comparative one based on the percentage of strength reduction after a specified number of cycles.

16.2 *Test Specimens*—Twenty test specimens shall be cut from ten separate pieces of product. Product to be tested shall be conditioned for 28 days at 73 ± 4°F (23 ± 2°C) and a relative humidity of 50 ± 5 %. The specimens shall be 12 in. (305 mm) long and 6 in. (152 mm) wide or one-half the width of an individual piece, if the piece is less than 12 in. wide. Cut

two specimens from each piece of product, so that at least 50 % of the top surface area will come form the area of the piece that would normally be exposed, as specified in the manufacturer's installation instructions. There shall be at least one cut edge of 12 in. that exposes the substrate on each specimen. Label each piece to identify which two pieces were cut from a specific sample.

16.3 *Procedure*:

16.3.1 Divide the test specimens from each piece to form two sets of ten specimens each. One set is for control and one is for freeze/thaw testing. Control specimens shall be retained in a freezer at -10 ± 10°F (-23 ± 6°C) to retard hydration.

16.3.2 Saturate one set of ten test specimens by immersing them in water at a temperature of 60 ± 18°F (16 ± 10°C) for a minimum of 48 h.

16.3.3 The specimens shall be sealed individually into plastic bags surrounded on all sides by a minimum of 250 mL and a maximum of 500 mL of water; air shall be evacuated from the bag. The plastic bag shall have a thickness of between 8 mils (0.2 mm) and 12 mils (0.3 mm). The length and width of the bags shall not exceed the length and width of the specimen by more than 20 %, respectively.

16.3.3.1 Specimens shall be horizontal during freezing and thawing. It is permitted to test individual specimens or to stack specimens on top of each other, provided that spaces of at least ¼ in. (6 mm) thick are used between adjacent specimens, or individual perforated shelves are provided for each specimen to allow circulation of air and water between specimens.

16.3.3.2 When specimens are stacked, one of the specimens in the middle of the stack shall have a thermocouple embedded in a small hole 1/16 in. (1.5 mm) maximum diameter drilled in the center of the top surface to a depth of the mid-plane of the specimen, to determine when the specimens have reached the prescribed temperature.

16.3.4 Subject the specimens to the number of freeze/thaw cycles required in the applicable product specification to achieve the desired grade classification.

16.3.5 Freeze in a freezer where the specimen with the thermocouple shall reach at temperature of -10 ± 10°F (-23 ± 6°C) within 24 h and be held for a minimum of 1 h.

16.3.6 Thaw in air or water, where the specimen with the thermocouple shall reach a temperature of 60 ± 18°F (16 ± 10°C) within 24 h and be held for a minimum of 1 h before proceeding with freezing.

16.3.7 Each freeze/thaw cycle shall have a minimum cycle time of 4 h and a maximum of 48 h, but an interval of 72 h maximum can be taken between cycles.

16.3.8 The freezer unit shall be capable of being controlled to the prescribed freezing condition with a full load of test specimens.

16.3.9 During both the freezing and thawing cycles, the specimens shall be positioned to allow the free circulation of air/water around the individual bags. Care shall be taken to ensure that the proper quantity of water remains in the bag. Bags can be replaced or repaired during the test program.

16.3.10 Saturate the control specimens and the cycled specimens (removed from the bags) by immersing them in water at a temperature greater than 60°F (15°C) for a minimum of 48 h. On the same day, submit both sets of specimens to the saturated flexural test according to Section 5. Specimens with a uniform thickness shall have the strength recorded as MOR. Specimens with an uneven thickness shall have the strength recorded as the breaking load.

16.4 *Calculation and Report*—Calculate and report the ratio R of the strength averaged for the set undergoing freeze/thaw cycles (F_f) to the strength averaged for the control of reference set (F_r).

$$R = \frac{F_f}{F_r} \tag{16}$$

16.5 *Precision and Bias*:

16.5.1 *Precision*—The precision of the procedure in Test Methods C 1185 for freeze/thaw-roofing products is being determined.

16.5.2 *Bias*—Since there is no accepted reference material suitable for determining the bias for the procedures in Test Methods C 1185 for freeze/thaw-roofing products, no statement on bias is being made.

17. Keywords

17.1 accelerated aging; acceptable quality limit (AQL); cellulose fiber; clapboards; cracking; delamination; density; dimensional measurements; edge straightness measurement; equilibrium conditioning; flat sheet; flexural; freeze/thaw; granulated surface; heat/rain; inspection by attributes; inspection by variables; length measurement; linear change; long-term chemical interaction; modulus of rupture; moisture content; moisture movement; non-asbestos fiber cement; polyethylene fiber; polyvinyl alcohol fiber; radiant heat; roofing; sample conditioning; sample testing; sampling; sampling by attributes; sampling by variables; sampling schemes; saturated conditioning; serviceability; shakes; shingles; siding; slates; smooth surface; squareness measurement; strength; textured surface; thickness measurement; warm water; water absorption; water displacement method; water tightness; weather degradation; weathering exposure; weatherproofing; wet conditioning; width measurement

Designation: C 1186 – 02

Standard Specification for Flat Non-Asbestos Fiber-Cement Sheets[1]

This standard is issued under the fixed designation C 1186; 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 either untextured or surface textured non-asbestos fiber-cement flat sheets intended for exterior applications such as claddings, facades, curtain walls, soffits, etc.

1.2 This specification is not applicable to asbestos-cement flat sheets (Specification C 220), gypsum-based boards (Specifications C 442/C 442M, C 630, C 1177/C 1177M, C 1178/C 1178M), or particle boards (Terminology D 1554) discrete non-asbestos fiber-cement interior substrate sheets (Specification C 1288), fiber-mat reinforced non-asbestos cement interior substrate sheets (Specification C 1325), 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 provided for information only.

1.4 The text of this standard references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

2. Referenced Documents

2.1 *ASTM Standards:*

C 220 Specification for Flat Asbestos-Cement Sheets[2]

C 442/C 442M Specification for Gypsum Backing Board, Gypsum Coreboard, and Gypsum Shaftliner Board[3]

C 630/C 630M Specification for Water-Resistant Gypsum Backing Board[3]

C 1154 Terminology for Non-Asbestos Fiber-Reinforced Cement Products[2]

C 1177/C 1177M Specification for Glass Mat Gypsum Substrate for Use as Sheathing[3]

C 1178/C 1178M Specification for Glass Mat Water-Resistant Gypsum Backing Panel[3]

C 1185 Test Method for Sampling and Testing Non-Asbestos Fiber-Cement Flat Sheet, Roofing and Siding Shingles, and Clapboard[2]

C 1288 Specification for Discrete Non-Asbestos Fiber-Cement Interior Substrate Sheets[2]

C 1325 Specification for Non-Asbestos Fiber-Mat Reinforced Cement Interior Substrate Sheets[2]

D 1554 Terminology Relating to Wood-Base Fiber and Particle Panel Materials[4]

E 84 Test Method for Surface Burning Characteristics of Building Materials[5]

2.2 *British Standards:*[6]

BS 5669: Part 4 Specification for Cement Bonded Particleboard

2.3 *International Standards:*[6]

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 divided into two types, according to their intended application.

4.2 *Type A*—Sheets are intended for exterior applications, subjected to the direct action of sun, rain, or snow. They are supplied coated or uncoated.

4.3 *Type B*—Sheets are intended for exterior applications, not subjected to the direct action of sun, rain, or snow.

NOTE 1—If sheets of Type B are used in an exterior application, where they are directly exposed to the weather, but are protected by impregnation or coatings, the weather resistance of the product may be altered by the quality of the protection. Specification of this protection, as well as the method for control and test, are outside the scope of this specification.

4.4 The sheets are further classified into four grades according to their flexural strengths. The manufacturer shall declare the type and grade of a given product in the literature for that product.

5. Composition and Manufacture

5.1 *Composition*—This specification is applicable to fiber-reinforced cement flat sheets consisting essentially of an

[1] This specification is under the jurisdiction of ASTM Committee C17 on Fiber-Reinforced Cement Products and is the direct responsibility of Subcommittee C17.02 on Non-Asbestos Fiber Cement Products.

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

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

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

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

[6] Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

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 fiber-reinforced cement are not prohibited from being added.

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

6. Mechanical and Physical Requirements

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

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

6.2 *Mechanical Requirements*:

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

6.2.2 Type A sheets for exterior applications shall be tested and specified in both the wet and equilibrium conditions. Type A sheets 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.

6.2.3 Type B sheets shall be specified and tested in the equilibrium condition only.

NOTE 2—When sampling from continuous production, these tests may be conducted on dry, equilibrium, or saturated specimens, provided a relationship can be established between this testing and the specified values.

6.3 *Physical Requirements*:

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 Method C 1185, the value for density shall comply with the value stated by the manufacturer.

7. Dimensions and Tolerances

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

TABLE 1 Flexural Strength Requirements

NOTE—The values of Table 1 are lower limit values based on an acceptable quality level (AQL) of 4 % at a 90 % confidence level.

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

7.2 *Nominal Length and Width*—Fiber-cement sheets are typically supplied in nominal lengths of 96 in. (2438 mm), 120 in. (3048 mm) and nominal width of 48 in. (1219 mm). Greater or lesser nominal lengths and widths are not prohibited from being supplied.

7.3 *Nominal Thickness*—Fiber-cement sheets are normally available in thickness of ⅛ in. (3.5 mm) to 1 in. (25 mm), although thickness outside of this range is not prohibited from being supplied. Refer to Table 2.

7.4 *Length and Width Tolerance*—The tolerance from the nominal shall be ±0.5 % with a maximum variation of ±¼ in. (6 mm). A tolerance of ±⅛ in. 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. Thickness variation from sheet to sheet shall not exceed the tolerances shown 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 uniform surface on one side, and 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 *Color*—The surface of the sheet shall be the natural color of the product or colored by the addition of mineral pigments, chemical impregnation, pigmented coating, veneer, or embedded mineral granules.

9. Inspection

9.1 Inspection of material shall be made at the point of shipment. The inspector representing the purchaser shall have free access to the carriers being loaded for shipment to the purchaser. The purchaser shall be afforded all reasonable and available facilities at the point of shipment for sampling and inspection of the material, which shall be conducted as not to interfere unnecessarily with the loading of the carriers.

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

10. Rejection

10.1 If the sampling fails to conform to any one of the requirements of this specification, a second sample from the

TABLE 2 Thickness Requirements

Nominal Thickness, in. (mm)	Tolerance, in. (mm)
⅛ –3/16 (3.5–5)	±0.02 (0.5)
>3/16 –⅜ (>5–10)	±0.04 (1.0)
>⅜ –⅝ (>10–16)	±0.05 (1.3)
>⅝ –¾ (>16–20)	±0.06 (1.5)
>¾ (>20)	±10 % thickness

same lot shall be prepared and tested. The results of the retest shall be combined with the results of the original test, according to the sampling procedure, to determine compliance with this specification.

10.2 Failure to conform to any one of the requirements of this specification, upon retest as prescribed above, shall constitute grounds for rejection.

11. Product Marking

11.1 *Identification*—Product marking shall include 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.

12. Packaging and Storage

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

12.2 *Storage*—Flat sheets must be piled on sufficient firm supports that will keep the sheets level and flat. The sheets must be piled with the edges square and flush and covered to provide protection from the weather until used.

13. Keywords

13.1 air cured; appearance; autoclaved cured; cellulose fiber; density; edge straightness; exterior application; finish; flexural strength; frost resistance; heat/rain resistance; inspection; 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; polyvinyl alcohol fiber; pressure cured; rejection; sampling; sheet grading; shipping; squareness tolerance; storage; supplementary requirements; supplementary tests; surface burning characteristics; thickness requirements; thickness tolerance; third party certification; tolerance; Type A; Type B; type tests; warm water resistance; water absorption; water tightness; workmanship

SUPPLEMENTARY REQUIREMENTS

S1. Supplementary requirements for Type A and B sheets shall consist of once only supplementary test, with the manufacturer's statement of results provided upon customer's request. Fundamental changes in formulation or methods of manufacture, or both, shall require the subsequent retesting of the supplementary tests.

S1.1 The following supplementary tests shall be required for Type A and B sheets:

Supplementary Test	Type A	Type B
Moisture Movement	yes	yes
Water Absorption	yes	yes
Moisture Content	yes	yes
Water Tightness	yes	no
Surface Burning Characteristics	yes	yes
Frost Resistance	yes	no
Warm Water Resistance	yes	no
Heat/Rain Resistance	yes	no

S1.2 Supplementary requirements shall be determined on uncoated product wherever practical. Where products are supplied coated, this material shall also be tested with the results identified as applying to coated material.

S2. *Moisture Movement*—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 Method C 1185.

S3. *Water Absorption*—Calculate the amount of water absorbed from the increase in weight of the dried specimen during submersion for a period of 48 h. Express the water absorptions as the percentage by weight when tested in accordance with Test Method C 1185.

S4. *Moisture Content*—State the percentage of moisture content of the fiber-cement sheet when conditioned at 50 ± 5 % relative humidity and a temperature of 73 ± 4°F (23 ± 2°C) in accordance with Test Method C 1185.

S5. *Water Tightness*—The specimens, when tested in accordance with Test Method C 1185, are not prohibited from showing traces of moisture on the underside of the sheet, but in no instance shall there be any formation of drops of water.

S6. *Surface Burning Characteristics*—Fiber cement sheets of ¼ in. (6 mm) 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 thickness greater than ¼ in. (6 mm) shall meet this specification or shall be formed at ¼ in. (6 mm) thickness with the same formulation for test purposes.

S7. *Frost Resistance (Freeze/Thaw)*—The specimens, when tested in accordance with Test Method C 1185 (Section 12 on Freeze/Thaw—Cladding Products), for 50 cycles, shall not show visible cracks or structural alteration such as to affect their performance in use. The ratio of retained strength as calculated from the test results shall be at least 80 %.

S8. *Warm Water Resistance*—The specimens, when tested in accordance with Test Method C 1185, shall not show visible cracks or structural alteration, such as to affect their performance in use. The ratio of strengths as calculated from test results shall be reported.

S9. *Heat/Rain Resistance*—The specimens, when tested in accordance with Test Method C 1185 (Section 14 on Heat/Rain—Wall Structures), for 25 cycles, shall not show visible cracks or structural alteration of the sheets and frame assembly such as to affect their performance in use.

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EXHIBIT B

INSTALLATION GUIDELINES

DIRITEC CORP. P.O. Box 251138, Glendale, CA 91225 (818) 649-7009 phone (818) 649-7119 fax w.w.w.diritec.com

TRIM PLYCEM®

INSTALLATION INSTRUCTIONS

Plycem Trim® is an exterior decorative trim product for non-load bearing applications.

1 Storage & Handling

- Plycem Trim® must be stored in an area protected from the weather.
- Keep material flat and off ground on stringers or platform.
- If covered area is not available on the job site, place skids on wood blocking to allow air flow underneath and shelter with a waterproof covering.
- When banding, use corner protectors
- Store the material dry prior to and during installation. If wet, allow material to dry prior to installation.
- Lift and carry trim on edges.

2 Cutting

- Use a circular saw blade with carbide-tipped teeth.
- Avoid generating dust, use cutting tools equipped with a dust collector, and never use water while cutting.
- Always wear safety goggles and dust protection equipment when operating cutting tools.

3 Caulking

- Leave a minimum gap of 1/8" at trim for caulk. Use caulks that comply with either ASTM C 834 or ASTM C 920.
- Caulking should be applied in accordance with caulking manufacturer's written instructions.
- Use a high performance, paintable Low-modulus elastomeric sealant.

4 Painting

- Plycem Trim products must be painted.
- Always use paint and coatings that are permeable to water vapor; 100% acrylic latex paint is highly recommended.
- Follow the paint manufacturer's application recommendations.

5 Finishing

- Repair any dents, cracks, and over-driven nails by filling with a cementitious patching.

6 Nail Type

- To install Plycem Trims, use a corrosion resistant or stainless steel nail with a minimum .113" Gauge and minimum 9/32" head.
- Nails must penetrate at least 1" into solid wood.
- Electro-galvanized nails are acceptable but may exhibit premature corrosion.
- Plycem is not responsible for the corrosion resistance of fasteners.

7 Screw Type

- To install Plycem Trim to steel stud construction use a corrosion resistant or stainless steel screw.

8 Fastening

- Do not nail from the face of a board into the edge of another.
- Position fasteners no closer than 1" from the side edges of the trim and no closer then 3" from the end.
- Space fasteners a maximum of 24" on center.
- The fastener should be driven perpendicular to the board surface and must be long enough to penetrate the framing at least one inch.
- Always begin nailing at one end and proceed to the other to avoid stress on the board. Never nail from both ends to the middle.
- Fasteners should be driven flush.
- Do not use staples.
- When installing over lap siding, fasten trim by nailing through the trim and underlying siding, making sure to nail on the overlap or high points into framing

9 Roof Clearance

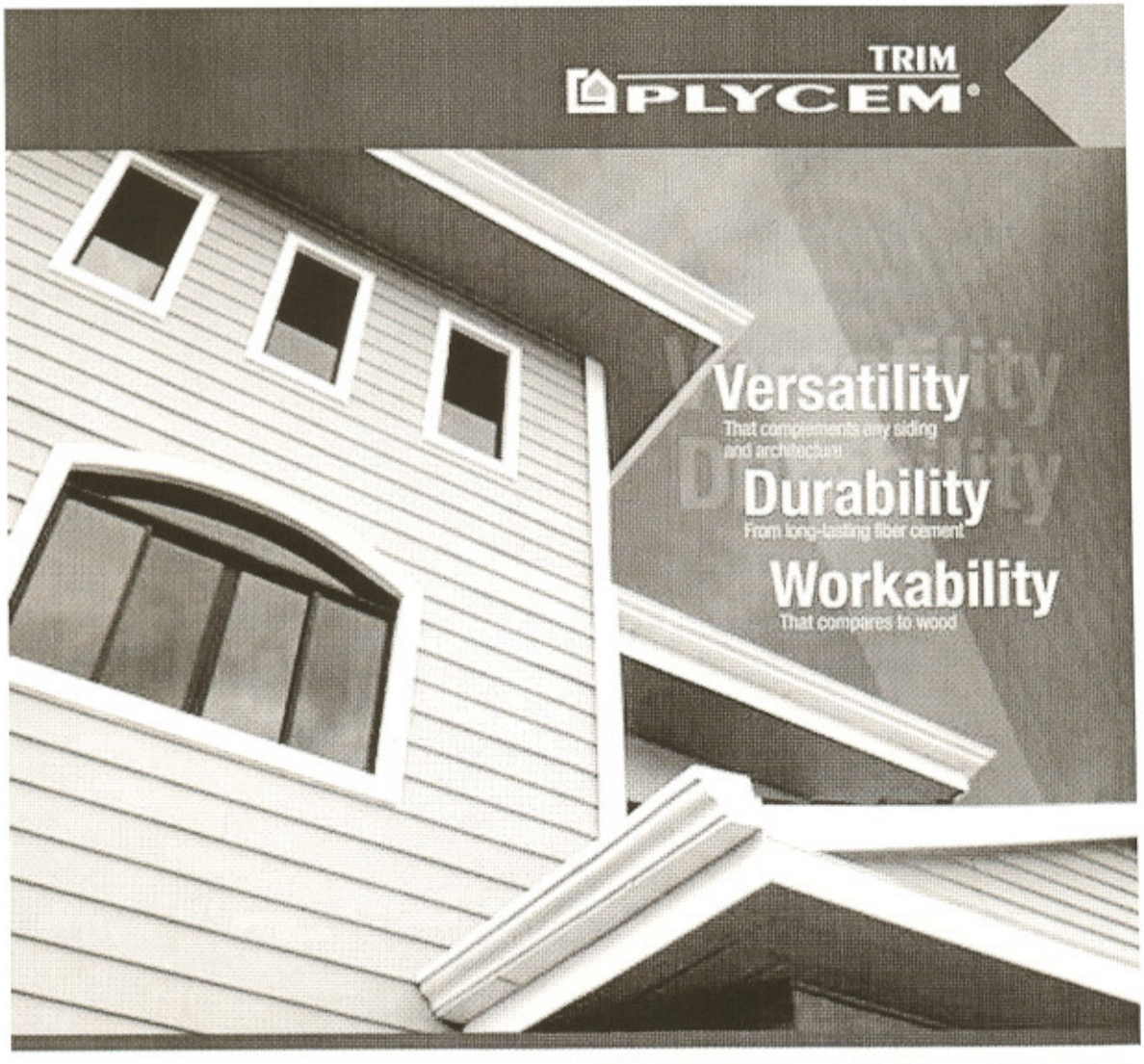
- Allow a minimum ¾" clearance between the roofing and bottom edges of trim.
- Flashing and counter flashing should be installed at the intersection of the roof and vertical surfaces as recommended by the roofing manufacturer.

10 Grade Clearance

- Plycem Trim should not be installed in contact with standing water, concrete slab or other deck materials.
- For the appropriate grade clearance consult your local Building Code requirements.

IMPORTANT—Read and understand these instructions. Failure to do so may void the warranty.

These installation instructions are based on our experience with normal applications. They are not intended to cover every installation or building code requirement, detail or variation. If questions arise concerning this product or its suitability for a particular use, contact Plycem or your local building code officials. Any unapproved deviation from these procedures shall be solely at the risk of the installer. Consult the manufacturer for specific instructions concerning re-siding over existing sidings or for instructions that apply to factory-built units.



Performance

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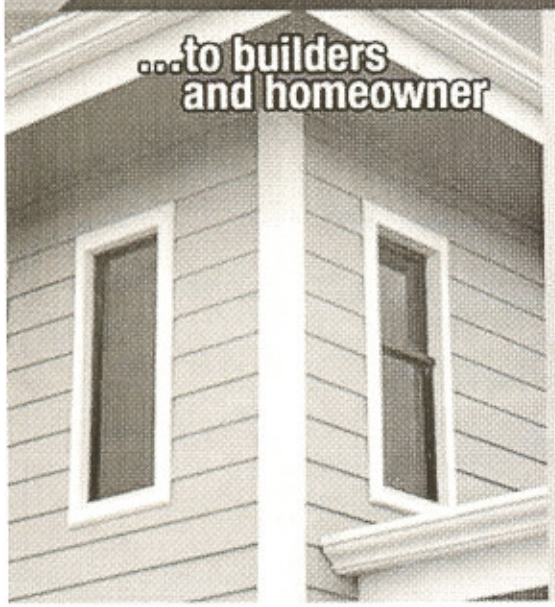
Advantages

PLYCEM TRIM



- Complements any siding and architecture
- Fiber cement for lasting performance
- Smooth square edges for finished appearance
- Primed on 6 sides
- Termite and weather resistant
- Contains eco-friendly recycled materials
- Manufactured using the following management systems: ISO 9001 (Quality), ISO 14001 (Environmental) and OHSAS 18001(Occupational Health & Safety)
- 25 year limited warranty

Finally, an exterior trim product that has all the advantages of wood trim without any of its shortcomings. Fiber cement trim significantly outperforms wood in ways that matter most to homeowners, builders and suppliers.

Plycem Exterior Trim has the strength and stability that maintains attractiveness for long-term durability and value. It's easy to cut and install on construction sites. And it provides an affordable alternative to other exterior trim products.

Versatile. Plycem Exterior Trim complements any siding product used today. Square Edges machined with high performance saws ensure the clean look and smooth finish of high end construction. Reversible for choice of rough texture or smooth surface, Plycem Exterior Trim is ideally suited for a variety of exterior corners, windows, columns, doors and more adding grace and elegance to any style architecture.

Durable. Plycem Exterior Trim withstands damage from impact and is termite resistant. Our temperature-controlled curing and drying adheres the refined fibers and cement into tight layers that will endure years of weather exposure.

Workable. No need to have specialized tools at the jobsite. Our fiber cement is cut with the same saws and installed with the same tools traditionally used for building with wood products.

Environmentally friendly. Plycem Exterior Trim is made from an amalgamation of non-aggressive materials that safeguard human health and the environment. Our manufacturing process employs principles of conservation that meet international environmental standards, such as ISO 14001.

Plycem Exterior Trim is the perfect combination of market - leading performance, company warranty and market value. This enables you to offer quality products to customers who have built their reputations on using only the finest materials in their construction projects.

Sizes		Width (in.)				
		4"	6"	8"	10"	12"
Thickness	4/4 (3/4")					
	5/4 (1")					
Length (ft.)		10'				

* Other widths and panels available upon request.

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EXHIBIT A

ASTM C -1186 TEST RESULTS

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