TESTING APPLICATION STANDARD (TAS) 135-95

STANDARD REQUIREMENTS FOR FIBERGLASS REINFORCED TILE, SHINGLES OR PANELS AND FIBER CEMENT SHINGLES, SHAKES OR PANELS

1. Scope:

1.1 This Protocol covers physical property requirements for fiberglass reinforced, composite tile, shingles or panels and non-asbestos, fiber cement shingles, shakes and panels.

Note: In addition to the requirements noted herein, reference shall be made to the appropriate Section(s) of TAS 110.

1.2 The designation of fiberglass reinforced composite products between tile, shingles or panels, and the corresponding test requirements thereof, shall be made by the Authority Having Jurisdiction.

1.3 The designation of non-asbestos, fiber cement products between shingles, shakes or panels, and the corresponding test requirements thereof, shall be made by the Authority Having Jurisdiction.

1.4 This Protocol specifically addresses laboratory testing of these products and does not provide guidance for actual field application. Field application of these products shall be in compliance with the manufacturer's Product Approval.

1.5 All testing shall be conducted by an approved testing agency and all test reports shall be signed by a Professional Engineer.

2. Referenced Documents:

2.1 *ASTM Standards*

C 1154 Terminology for Asbestos and Fibre-Cement

C 1185 Test Methods for Sampling and Testing Non-Asbestos Fiber-Cement Flat Sheet, Roofing and Siding Shingles, and Clapboards

C 1186 Specification for Flat Non-Asbestos Fiber-Cement Sheets

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

D 412 Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension

D 635 Test Method for Flammability of Self-Supporting Plastics

D 638 Test Method for Tensile Properties of Plastics

D 790 Test Method for Flexural Properties of Plastics

D 883 Definitions of Terms Relating to Plastics

D 1204 Standard Test Method for Linear Dimensional Changes of Nongrid Thermoplastic Sheeting or Film at Elevated Temperature

D 1494 Test Method for Diffuse Light Transmission Factor of Reinforced Plastic Materials

D 1929 Test Method for Self Ignition of Plastics

D 2583 Test Method for Indentation Hardness of Plastics by Means of a Barcol Impressor

D 2565 Practice for Operating Xenon-Arc Type Light-Exposure Apparatus With and Without Water for Exposure of Plastics

E 84 Test Method for Surface Burning Characteristics of Building Materials

E 96 Test Methods for Water Vapor Transmission of Materials

E 108 Test Methods for Fire Testing of Roof Coverings

E 380 Excerpts from Standard Practice for Use of the International System of Units (SI) (the Modernized Metric System)

G 23 Practice for Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials.

2.2 *The Florida Building Code, Building*

2.3 CGSB Standards

41-GP-6M Standard for Sheets, Thermosetting Polyester Plastics, Glass Fiber Reinforced

2.4 *Roof Consultants Institute*
Glossary of Terms

3. Terminology & Units:

3.1 Definitions - For definitions of terms used in this Protocol, refer to Chapter 2 and Section 1513 of the *Florida Building Code, Building* and/or The RCI Glossary of Terms; and/or ASTM D 883; and/or ASTM C 1154. Definitions from the *Florida Building Code*, *Building* shall take precedence.

3.2 Units - For conversion of U.S. customary units to SI units, refer to ASTM E 380.

4. Limitations and Precautions:

4.1 This Protocol may involve hazardous materials, operations and equipment. This Protocol does not purport to address all of the safety problems associated with its use. It is the responsibility of whomever uses this Protocol to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

7. Testing Requirements

7.1 Physical Properties - Fiberglass Reinforced, Composite Tile, Shingles or Panels

7.1.1 All fiberglass reinforced, composite tile, shingle or panel roofing components shall meet the physical property requirements noted in Table 1, below.

TABLE 1
PHYSICAL PROPERTY REQUIREMENTS FOR FIBERGLASS REINFORCED, COMPOSITE TILE, SHINGLES OR PANELS

Physical Property	Test Standard	Requirements
Thickness inches (mm)	See Section 7.1.2	+ 10% of that specified by manufacturer
Dimensions	NA	+ $^{3}/_{16}$ in. width
inches (mm)		+ $^{3}/_{8}$ in. for length of that specified by manufacturer
Glass Content (mass %)	See Section 7.1.3	min. 25% (average of 5) min. 20% (individual)
Flexural Strength psi (MPa)	D 790 Procedure A	min. 20,300 (140) for 1830 g min. 25,375 (175) for 2440 g
Flammability inch/min (mm/min)	D 635	max. 2.0 (50.0)
Flame Spread Index ft•min (m•min)	E 84	report
Smoke Density (%)	E 84	report
Self Ignition	D 1929	report
Fire Resistance	E 108	min. Class "B"
Hardness	D 2583	min. 45
Light Transmission (%)	D 1494	+ 10% of that specified by manufacturer
Water Absorption (%) (*24 hours @ 73.4°F*)	D 570	<0.25%
Accelerated Weathering	G 23 OR D 2565 (See Section 7.1.4)	no significant change in surface gloss or color and no fiberglass exposure and compliance with physical properties noted below
Before Accelerated Weathering-B.A.W.		
Tensile Strength-B.A.W. psi (MPa)	D 638	report
Elongation-B.A.W. %	D 638	report
After Accelerated Weathering-A.A.W.		
Tensile Strength-A.A.W. psi (MPa)	D 638 +	min. 95% of B.A.W.
Elongation-A.A.W. %	D 638	min. 80% of B.A.W.

7.1.2 *Thickness* - Measure the thickness of the smooth-finished panels perpendicular to the surface at the point of measurement with a thickness gauge to an accuracy of 0.0002 in. (0.025 mm).

7.1.2.1 For flat panels, make six measurements on each specimen as follows:

- one near the center of each end of the specimen, and
- two near each side of the specimen, each one-third of the distance from each end.

7.1.2.2 For configured panels, make 18 measurements on each specimen as follows:

- six at the crest;
- six at the bottom of the valleys; and
- six on the center of the web between the crest and the bottom.
- One set of measurements shall consist of one measurement each on a crest, web and bottom adjacent to one another.
- Make one set of measurements near the center of each end and two sets near each side, each one-third of the distance in from each end.

7.1.3 *Glass Content*

7.1.3.1 Test Specimens

- Take at least five test specimens from uniformly distributed parts of the sample, not contiguous to one another. Each specimen shall have a projected area not less than 10 in^2 (64 cm^2). The edges shall not be frayed.

7.1.3.2 Apparatus - The test apparatus shall consist of the following.

- an analytical balance;
- a dessicator;
- heat resistant, nonreactive crucibles; and
- a muffle furnace with temperature controls.

7.1.3.3 Procedure

- Weight the specimen on the analytical balance in a previously weighed, ignited crucible to the nearest 3.5 x 10^{-5} oz (1 mg).
- Place the crucible and specimen in a cold muffle furnace and ignite to constant mass at 1200°F + 57°F (649°C + 14°C). Avoid higher temperatures to prevent fusion of the glass and the entrapment of un-

burned carbon particles. The ignition generally requires from 2 to 6 hours.

- At the end of the ignition, the glass fabric residue shall be entirely white as contrasted to various egress of gray when all carbon is not removed. Moreover, the glass fabric residue shall show no sign of fusion.
- Allow the residue and crucible to cool to room temperature in a dessicator and reweigh on an analytic balance.
- If calcium carbonate is present, react the residual material remaining in the crucible with an excess of a concentrated solution of ammonium carbonate. Evaporate the specimen to dryness at 176°F + 37°F (80°C + 3°C) to drive off the excess ammonium salt, then heat at 230°F + 37°F (110°C + 3°C) for 2 hours.
- Following the ammonium carbonate treatment, transfer the residue to a beaker and treat with a slight excess of 3 N hydrochloric acid at 194°F (90°C) for 3 to 5 minutes.
- Filter out the acid-insoluble residue and wash with boiling distilled water until free of chloride ion as determined by the silver nitrate test.
- Place the filter paper containing the acid-insoluble glass fiber residue in a crucible, burn off the paper, allow the crucible and specimen to cool to room temperature and weigh the crucible and specimen.
- Some of the glass dissolves in the acid, the amount depending on the type of glass and the specific procedure. For E glass in this particular procedure, about 8.5% of the glass dissolves.

7.1.3.4 Calculations

- Calculate the glass content (G), as follows:

$$G = \frac{W_2}{W_1} \times 100$$ where,

G = glass content (% by mass);

W_1 = original mass of specimen; and

W_2 = mass of residue from calcination.

Note: The mass loss is equal to the mass of the resin, the volatilized or decomposed pare of the fiber finish, and carbon dioxide evolved from tech dissociation of any calcium carbonate filler that may be present. Other incombustible fillers

are included in the residue by tech procedure, and in these cases the glass content values are high.

- Calculate the E glass content, corrected for any calcium carbonate filler that may be present (G_c) as follows:

$$G_c = \frac{W_3}{0.915} \times \frac{100}{W_1}$$ where,

G_c = corrected glass content (% by mass);

W_3 = mass of residue after ammonium carbonate and hydrochloric acid treatments; and

W_1 = original mass of specimen.

7.1.3.5 If no calcium carbonate is present, use G. If calcium carbonate is present, use G_c.

7.1.4 Prior to subjecting test specimens to accelerated weathering in compliance with ASTM G 23 or ASTM D 2565, specimens shall be tested for tensile strength and percent elongation in compliance with ASTM D 638, the results of which shall be reported. Subsequent to accelerated weathering, specimens shall be re-tested for tensile strength and percent elongation, the results of which shall be not less than 95% and 80% of the pre-weathering valves, respectively.

7.2 Physical Properties - Fiber Cement Shingles, Shakes or Panels

7.2.1 All fiber cement shingle, shake or panel roofing components shall be tested in compliance with ASTM C 1225, meeting the physical property requirements noted in Table 2, below.

7.2.2 Tests noted in Table 2 are broken into three sets of tests, the first two of which entail consecutive testing to determine the effects of heat/rain and freeze/thaw on a particular property and the last of which are separate tests.

7.2.3 *Sampling* - Sampling shall be in compliance with Section 4 of ASTM C 1185.

7.2.4 *Inter Laminar Bond Test* - Fiber cement product shall meet the requirements noted in Test Set #2 in Table 1, above, when subjected to inter laminar bond testing as follows.

7.2.4.1 Apparatus

- Two round steel plates having 2.5 in. (63 mm) diameter fitted with device for attachment to tensile tester.
- Tensile tester capable of providing separation rate not less than 0.5 inch per minute.
- Load cell or other load measuring device capable of recording loads up to 1000 lbf.
- Epoxy cement compatible with the fiber cement product being tested.

7.2.4.2 Test Specimens

- Prepare four 3 in. x 3 in. (76 mm x 76 mm) specimens with each specimen coming from different product units.
- Bond the 2.5 in. diameter steel

plates to the center of the test specimen on opposite sides and allow to cure for not less than 12 hours.

7.2.4.3 Test Procedure

- Mount the test specimen, with steel plates bonded on opposite sides, in the tensile tester and apply tensile load at a rate of 0.5 inch per minute.
- Observe the test specimen for failure and record the load from the

TABLE 2
PHYSICAL PROPERTY REQUIREMENTS FOR FIBER CEMENT SHINGLES, SHAKES OR PANELS

Physical Property	Test Standard	Requirement
Test Set #1 (Consecutive Testing of Four Specimens)		
Flexural Strength (Saturated Modulus of Rupture psi (MPa)	C 1185 Section 5	min. 798 (5.5) *(for primary strength direction)* and min. 50% of primary strength dir. *(for weak strength direction)*
Heat/Rain (50 cycles)	C 1185 Section 14	no cracks or structural alteration such to affect performance in use
Flexural Strength-after heat/rain (Saturated Modulus of Rupture) psi (MPa)	C 1185 Section 5	min. 798 (5.5) *(for primary strength direction)* and min. 50% of primary strength dir. *(for weak strength direction)*
Freeze/Thaw (50 cycles)	C 1185 Section 12	R > 0.90 *(for both primary and weak strength directions)*
Test Set #2 (Consecutive Testing of Four Specimens)		
Inter Laminar Bond lbf (N)	See Section 7.2.4	min. 650 (2891)
Heat/Rain (50 cycles)	C 1185 Section 14	no cracks or structural alteration such to affect performance in use
Inter Laminar Bond-after heat/rain lbf (N)	See Section 7.2.4	min. 650 (2891)
Freeze/Thaw (50 cycles)	C 1185 Section 12 *(Substitute Inter Laminar Bond Test Noted in Section 7.2.4 for the Flexural Strength Test Noted in Section 12 of C 1185)*	R > 0.90 *(R = ration of inter laminar bond after freeze/thaw to that prior to freeze/thaw)*
Test Set #3 (Separate Testing)		
Density lb/ft^3 (kg/m^3)	C 1185 Section 6	compliance with value stated by manufacturer
Water Absorption mass %	C 1185 Section 9	30% to 90%
Moisture Content %	C 1185 Section 10	compliance with value stated by manufacturer
Length and Width inches (mm)	C 1185 Section 7.6	max. variation of $\pm 1/4$ in. (± 6 mm) from nominal
Thickness inches (mm)	C 1185 Section 7.3	max. variation of −10% or +25% from nominal
Water Tightness (report)	C 1185 Section 11	no formation of droplets
Warm Water Resistance (report)	C 1185 Section 13	no cracks or structural alteration such to affect performance in use
Fire Resistance	E 108	min. Class “B”

load measurement device at which failure occurs.

- Repeat the test for each of four test specimens and report the mean failure load.

7.3 Wind Driven Rain Testing

7.3.1 All fiberglass reinforced, composite tile, shingle or panel Roof Systems Assemblies and non-asbestos, fiber-cement shingle, shake or panel Roof System Assemblies shall be tested for resistance to wind driven rain in compliance with TAS 100 on all applications.

7.4 Uplift Resistance - Fiberglass Reinforced Tile or Fiber Cement Shakes

7.4.1 All fiberglass reinforced tile or fiber cement shake Roof System Assemblies shall be tested for static uplift resistance in compliance with:

- TAS 102 for mechanically attached components; or,
- TAS 102(A) for mechanically attached, clipped components.

7.4.2 Static uplift resistance testing shall be performed for each method of component attachment which the applicant wishes to include in the Roof System Assembly Product Approval (i.e., one nail, two nails, one screw, two screws, one nail with clip, one screw with clip, various clips, etc.).

7.4.3 Static uplift resistance testing shall be performed for each method of application which the applicant wishes to include in the Roof System Assembly Product Approval (i.e., counter-battened, direct deck and/or horizontal battened applications).

7.4.4 Fiberglass reinforced tile may be tested as "Moment Based System" or "Uplift Based System," as defined in TAS 102 and TAS 102(A), depending on:

- whether the system is an air permeable system and meets the size constraints for wind tunnel testing set forth in TAS 108; and,
- if the conditions noted above are met, whether the system has been tested for wind tunnel testing, in compliance with TAS 108, resulting in an aerodynamic multiplier (l) for the particular fiberglass reinforced tile profile.

These options are further discussed in Section 4 of TAS 102 and TAS 102(A).7.4.4. All fiber cement shakes shall be tested as "Uplift Based System" as defined in TAS 102 and TAS 102(A).

Notes:

1. The *Florida Building Code, Building* requires counter-batten applications for mechanically attached systems installed at roof pitches less than 4 in.:12 in. and horizontal batten applications for roof pitches in excess of 7 in:12 in.
2. The *Florida Building Code, Building* requires a clip on all eave components.

7.5 Uplift Resistance - Fiberglass Reinforced or Fiber Cement or Panels

7.5.1 All fiberglass reinforced or fiber cement panel Roof System Assemblies shall be tested for uplift pressure resistance in compliance with ASTM E 330.

7.5.2 Uplift pressure resistance testing shall be performed for each method of component attachment which the applicant wishes to include in the Roof System Assembly Product Approval.

7.5.3 Uplift pressure resistance testing shall be performed for each

method of application which the applicant wishes to include in the Roof System Assembly Product Approval (i.e., counter-battened, direct deck and/or horizontal battened applications).

7.5.4 A 2:1 margin of safety shall be applied to all uplift pressure resistance results.