**Florida Building Code, Test Protocols**

*[All of the highlighting didn’t transfer over well. – NB]*

**TAS 103-20**

**TESTING APPLICATION STANDARD (TAS) No. 103-20**

**TEST PROCEDURE FOR SELF-ADHERED UNDERLAYMENTS FOR USE IN ~~DISCONTINUOUS~~ TILE ROOF SYSTEMS**

Revise the following sections as follows:

**1. Scope**

1.1 This Protocol covers procedures for testing self-adhering, prefabricated~~, reinforced~~, polymer modified bituminous, and solid thermoplastic sheet roofing materials intended for use as underlayment in ~~Discontinuous~~ Tile Roof Systems to assist in the waterproofing to function in combination with a Prepared Roof Covering. These products may employ granular or particulate surfacing materials on one side. The Granular Adhesion test shall be required for all granular surfaced materials used as a bonding surface for mortar or adhesive set tile systems.

1.2 The test procedures outlined in this Protocol cover the determination of the Wind Uplift Resistance; the Thickness; the Dimensional Stability; the Tear Resistance; the Breaking Strength; the Elongation; ~~the Water Absorption;~~ the Low Temperature Flexibility; the Ultraviolet Resistance; the Accelerated Aging Performance; the Cyclic Elongation Performance; the Water Vapor Transmission; the Compound Stability; the Puncture Resistance; the Tile Slippage Resistance; ~~the Crack Cycling Resistance;~~ ~~and~~ the Peel Resistance; the Accelerated Weathering Performance of an underlayment material; the Tensile Adhesion properties of the exposed surface of the underlayment; and Granular Adhesion ~~of a mineral~~ for granular surfaced ~~roll roofing material, for use as an~~ underlayment.

1.3 These test methods appear in the following order:

Section

Conditioning 5

Thickness 6

Wind Uplift 7

Dimensional Stability 8

Tear Resistance 9

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Peel Resistance 21

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Tensile Adhesion 23

Accelerated Weathering 24

**2. Referenced Documents**

*2.1 ASTM Test Standards:*

~~C 794~~ ~~Adhesion-in-Peel of Elastomeric Joint Sealants~~ ~~D 570~~ ~~Water Absorption of Plastics~~

D 1079 Standard Definitions and Terms Relating to Roofing, Waterproofing and Bituminous Materials ~~D 1938~~ ~~Tear Propagation Resistance of Plastic Film and Thin Sheeting by a Single-Tear Method~~

D 4073 Standard Test Method For Tensile Tear Strength of Bituminous Roofing Membranes D 1970 Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing

Underlayment for Ice Dam Protection (Low Temperature Flexibility)

D 2523 Testing Load-Strain Properties of Roofing Membranes

D 1623 Standard Test Method For Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics D 5147 Sampling and Testing Modified Bituminous Sheet Materials

E 96 Water Vapor Transmission of Materials

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

*2.2 Reserved*

*2.3 Reserved*

2.4 *The Florida Building Code, Building*.

*2.5 Application Standards*

*2.6 Reserved*

**3. Terminology & Units**

3.1 Definitions - For definitions of terms used in this Protocol, refer to ASTM D 1079; Chapters 2 and 15 (High-Velocity Hurricane Zones) of the *Florida Building Code, Building*. The 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. Significance and Use**

4.1 The test procedures outlined in this Protocol provide a means of determining whether a self- adhering roofing material, intended for use as an underlayment in a Discontinuous Roof System, for use in the High-Velocity Hurricane Zones, meets the requirements of the *Florida Building Code, Building*.

**5. Conditioning**

5.1 Specimens shall be selected in accordance with ASTM D5147. Unless otherwise specified, condition test specimens for a minimum of four (4) hours at 73.4 ± 3.6°F and 50 ± 5%

relative humidity prior to testing. Note separate conditioning requirements for cold bend testing in Section 12.1.

**6. Thickness**

6.1 Materials shall be checked at five points across the roll width. Measurements shall be made at

two points, each being 6 ± 0.5 inches from each edge, and at three points equally spaced between these two points.

6.2 Compute the average thickness and the standard deviation of the thicknesses, in mils, based on the total number of point measurements from all of the rolls taken.

6.3 Report the individual point measurements, average, and standard deviation in mils.

6.4 Any modified bitumen and bituminous membrane test specimen which exhibits an average thickness less than sixty (60) mils shall be considered as failing the thickness test. For granular surfaced products, thickness measurements shall be at the selvage edge, not at a granular surface.

6.5 Nonbituminous membranes shall not have a thickness minimum. Performance shall be based on physical property testing.

**7. Wind Uplift**

7.1 This test covers the determination of the wind uplift resistance of materials specified in Section 1 of this Protocol in accordance with TAS 124 except as noted below.

7.1.1 Test Deck Construction

7.1.1.1 Test is being conducted on materials noted in Section 1 of this Protocol; therefore, any reference to “roof membrane” in TAS 124 shall be regarded as ‘underlayment.’

7.1.1.2 Four (4) 8' x 8' test decks shall be constructed of 40/20 19/32 in. APA Rated Plywood Sheathing attached to wood joists spaced 24 o.c. Each test deck shall consist of four (4) panels of said sheathing, the corners of which shall meet at the center of each test deck, leaving a 1/8 in. gap between panels.

7.1.1.3 Adhere one (1) layer of underlayment to each test deck.

7.1.2 Procedure

7.1.2.1 Test shall be a laboratory test not a field test; therefore, any instruction in TAS 124 which references “building or outdoor conditions” shall be regarded as “laboratory conditions.”

7.1.2.2 Regulate the negative pressure in the chamber. Begin by raising the negative pressure in the chamber to 30 lbf/ft2 and holding this pressure for one (1) minute. Thereafter, raise the negative pressure in increments of 15 lbf/ft2, holding each incremented pressure for one (1) minute, until the negative pressure has been held at 90 lbf/ft2 for one (1) minute.

7.1.3 Report

7.1.3.1 Any test specimen which exhibits any significant separation between the membrane and

tested substrate deflection or significant blistering from the sheathing surface shall be considered as failing the wind uplift test.

**8. Dimensional Stability**

8.1 Prepare five (5) 2 foot wide x 6 foot long specimens with a 4 inch overlap seam across the center of the 6 foot length. Prepare the specimens: one from each edge of the roll and three from random places in the roll. The length of each specimen should be in the “machine direction” of the roll.

8.2 The substrate shall be APA 32/16 span rated sheathing of a 15/32 in. thickness that has been reinforced on the back side with two angle irons.

8.3 Adhere the underlayment specimen on the substrate and install a 11/2 in. x 11/2 in. x 2′ wood termination batten to one “free” end of the underlayment using three (3) equally spaced #12 wood screws to secure the batten through the underlayment and the sheathing. Mechanically attach the other “free” end of the underlayment using three (3) equally spaced ~~10d~~ roofing nails, located two

(2) inches from the “free” end, with one nail at one inch from each edge, penetrating the sheathing a minimum of 1/2 inch.

8.4 Condition each specimen in an oven or under heat lamps maintained at 180 ± 5°F for a minimum of six (6) hours.

8.5 Report any tears or “tear drop” conditions which arise at fastener penetrations during and/or after conditioning is complete. Report any shrinking or wrinkling which appears to have compromised the lapped area of underlayment.

8.6 Any test specimen which exhibits conditions noted in Section 8.5 of this Protocol shall be considered as failing the dimensional stability test.

8.7 Provide before and after photographs of each specimen in the final test report.

**9. Tear Resistance**

9.1 This test covers the determination of the tear propagation resistance of materials specified in Section 1 of this Protocol in accordance with ASTM Test Method D 4073, except as noted below.

9.1.1 The prescribed Test Method shall be run in both the machine and the cross-machine direction of the roll material.

9.1.2 The final test report shall include average tear propagation force values and standard deviations of these value for both the machine and the cross-machine direction of the material.

9.1.3 Any test specimen which exhibits a tear propagation value less than 20 lbf (88.5 N) in either the machine or cross-machine directions shall be considered as failing the tear strength test.

**10. Breaking Strength and Elongation**

10.1 This test covers the determination of the breaking strength and elongation of materials specified in Section 1 of this Protocol in accordance with ASTM Test Method D 2523, except as

noted below.

10.1.1 Sampling

10.1.1.1 Ten specimens; five in the machine direction and five in the cross-machine direction of the roll, shall be cut to dimensions of 1 in. x 6 in.

10.1.2 Conditioning

10.1.2.1 Heat Aging, shall consist of seven (7) days in an air circulating oven at a controlled temperature of 149 ± 5°F.

10.1.2.2 UV Exposure shall consist of 460 hours of continuous ultraviolet light exposure in accordance with the apparatus and configuration in 13.1.2.1 herein.

10.1.3 Procedure

10.1.3.1 Each set of samples, as specified in 10.1.1.1 herein, shall be tested “as received”, after heat aging, and after UV exposure, as specified in 10.1.2.1 and 10.1.2.2 herein.

10.1.3.2 Grip separation rate shall be 20 ± 0.2 inches per minute for all tests conducted.

10.1.3.3 Temperatures of specimens and test grips during conditioning and testing shall ~~comply with ASTM D 2523~~ be 73.4 ± 3.6˚F.

10.1.4 Report

10.1.4.1 Report the grip separation rate used.

10.1.4.2 Breaking strength shall be reported, in lbf/inch of width, for all test specimens and shall be itemized in grouping of “as received,” after heat conditioning, and after UV exposure. The~~se grouping~~ test specimens shall be itemized in subgroups of machine direction and cross- machine direction. Any test specimen which exhibits a breaking strength value less than those listed in Table 1 shall be considered as failing the breaking strength test.

**TABLE 1 MINIMUM BREAKING STRENGTH VALUES**

|  |  |
| --- | --- |
| **SPECIMEN** | **BREAKING STRENGTH** |
|  | (Machine Direction or Cross-Machine Direction) |
| As Received | 25 lbf/inch of width (35 N/cm of width) |
| After Heat Aging | 25 lbf/inch of width (35 N/cm of width) |
| After UV Exposure | 25 lbf/inch of width (35 N/cm of width) |

10.1.4.3 Elongation shall be reported, in (%), for all test specimens and shall be itemized in groupings of “as received,” after heat conditioning, and after UV exposure. These groupings shall be itemized in subgroups of machine direction and cross-machine direction. Any test specimen which exhibits elongation values at ultimate load condition less than those listed in Table 2 shall be considered as failing the elongation test.

**TABLE 2 MINIMUM ELONGATION VALUES (%)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SPECIMEN** | **ORGANIC REINFORCEMENT** | **FIBERGLASS REINFORCED** | **POLYESTER OR POLYPROPYLENE**  **REINFORCED** | **SOLID THERMOPLASTIC SHEATHING SHEETS** |
|  |
| As Received | 6% | 3% | 25% | 225% |
| After Heat Aging | 5% | 2.5% | 21% | 191% |
| After UV Exposure | 5% | 2.5% | 21% | 191% |

**11. Reserved**

**12. Low Temperature Flexibility**

12.1 This test covers the determination of the low temperature flexibility of materials specified in Section 1 of this Protocol in accordance with ASTM Test Method D 1970 except as noted below. Membranes shall be tested at a maximum of -10°F.

12.1.1 Procedure

12.1.1.1 Each set of specimens shall be tested “as received” and after conditioning, as specified in ASTM D 1970 (7.4.2).

12.1.2 Report

12.1.2.1 Low temperature flexibility results shall be reported on a pass/fail basis, for all test specimens and shall be itemized in grouping of “as received” and after conditioning. No cracking at

- 10°F shall be considered as passing the low temperature flexibility test.

**13. Ultraviolet Resistance**

13.1 This test covers the determination of the ultraviolet resistance performance of materials specified in Section 1.

13.1.1 Sampling - Two 18 in. x ~~18~~48 in. specimens are to be cut.

13.1.2 Conditioning

13.1.2.1 Ultraviolet light shall be produced by four 275 watt UV lamps in an enclosure in accordance with Figure 1. Recommended lamps are: Ultra-Vitalux, 275 watt, 220-230 V, #E27; Osram 275 W lamps, or; equivalent bulbs providing UV characteristics of 5.0 W/m2/nm irradiance at a wavelength of 315 to 400 nm at one meter.

13.1.2.2 Specimens to be exposed for ~~200~~ 460 (± 2) continuous hours ~~(10 hours per day for 20 days)~~.

13.1.2.3 Specimen temperature to be maintained at 135-140°F throughout the ~~UV exposure portion of the~~ test period. ~~Specimens shall be maintained between 70°F +/- 15°F when not exposed to UV during the test period.~~

13.1.3 Report & Conditions of Acceptance

13.1.3.1 Report any visible peeling, chipping, cracking, flaking, pitting or other damage, under 5x magnification, which resulted from the ultraviolet conditioning. Report the type and location of the damage (if any).

13.1.3.2 Report the type of UV lamps used to condition the samples.

13.1.3.3 Any test specimen which exhibits damage as defined in Section 13.1.3.1 of this Protocol shall be considered as failing the ultraviolet resistance test.

**14. Accelerated Aging**

14.1 This test covers the determination of the accelerated aging performance of materials specified in Section 1 of this Protocol.

14.2 ~~Sampling~~ Specimen Preparation - Six (6) 12 in. x 12 in. specimens shall be prepared with three

(3) in the machine direction and three (3) in the cross-machine direction of the roll. Specimens shall be marked to indicate machine direction.

14.3 Accelerated Aging – The specimens prepared per Section 14.2 are aged by the following cyclic process. Twenty-five cycles are required, with each cycle consisting of the following:

1. Oven dry at 120°F for three hours with all surfaces exposed.

2. Immerse in water maintained at room temperature for three hours, with all surfaces exposed.

3. Remove from water and blot dry, then air dry for 18 hours at room temperature for eighteen hours with all surfaces exposed.

Samples shall be in the air dry period over weekends and holidays, which shall be confirmed in the test log. The room temperature shall be maintained at 73 ± 5°F (22.8 ± 2.8°C).

14.3.1 Conditions of Acceptance – No visible damage to the specimens, such as chipping, cracking, or delamination.

14.3.2 Breaking strength and elongation tests of aged specimens shall be conducted in accordance with Section 10 of this Protocol, except as noted below.

14.3.2.1 Sampling - After the six (6) 12 in. x 12 in. aged specimens have been examined for visible damage, prepare ten (10) 1 in. x 6 in. specimens from the aged material; five in the machine direction and five in the cross-machine direction of the roll. In addition to these ten aged specimens, prepare ten “as received” specimens of the same dimensions; five in the machine direction and five in the cross-machine direction of the roll.

14.3.2.2 Conditioning - No further conditioning is to be incurred on the aged specimens.

14.3.2.3 Procedure - Each set of samples, as specified in ~~13.1.3.1~~ 14.2 herein, shall be tested “as received” and after accelerated aging.

14.3.2.4 Report

14.3.2.4.1 Breaking strength shall be reported, in lbf/inch of width, for all test specimens and shall be itemized in grouping of “as received” and after accelerated aging. These ~~grouping~~ specimens shall be itemized in subgroups of machine direction and cross-machine direction. Any

aged specimen which exhibits a breaking strength less than the value listed in Table 2 shall be considered as failing the accelerated aging test.

14.3.2.4.2 Elongation shall be reported, in (%), for all test specimens and shall be itemized in grouping of ‘as received’ and after accelerated aging. These ~~grouping~~ specimens shall be itemized in subgroups of machine direction and cross-machine direction. Any aged specimen which exhibits an elongation value less than the applicable value listed in Table 2 shall be considered as failing the accelerated aging test.

**15. Cyclic Elongation**

15.1 This test covers the determination of the cyclic elongation performance of materials specified in Section 1 of this Protocol.

15.1.1 Three specimens are prepared with 15/32-inch-thick (12.7 mm), 3-inch-by-6-inch (76 mm by 152 mm) APA Rated A-C plywood. Each specimen includes two plywood pieces aligned so that the 6-inch (152 mm) edges are parallel and separated by 1/8 inch (3.2 mm). On~~c~~e piece of underlayment, 5 inches by 5 inches is attached to the plywood pieces across the joint and rolled 3 times back and forth (2-3s per direction) using a 26 lb. (11.8 kg) roller. The specimens are then conditioned at 73 ± 4°F (22.8 ± 2.2°C) for seven days. After conditioning, specimens are placed in a cold box, which is maintained at –20°F (–28.9°C) for ~~48~~ 24 hours ± 1 hour. Specimens are then cycled between a 1/8-inch (3.2 mm) and 1/4-inch (6.4 mm) plywood edge separation for 100 cycles while maintaining the temperature at –20°F (–28.9°C). The rate of movement shall be 1/8 inch (3.2 mm) per hour.

15.1.2 Conditions of Acceptance - Any test specimen which exhibits cracking of material shall be considered as failing the cyclic elongation test.

**16. Water Vapor Transmission**

16.1 This test covers the determination of the water vapor transmission of materials specified in Section 1 of this Protocol in accordance with ASTM Test Method E96, procedure B.

16.2 The water vapor transmission of the membrane shall not be greater than 1.0 g/m2 in 24 hours.

**17. Compound Stability**

17.1 This test covers the determination of the high temperature stability of materials specified in Section 1 of this Protocol in accordance with ASTM Test Method D 5147, Section 15, except as noted below.

17.1.1 Any test specimen which exhibits flowing, dripping or drop formation at a temperature less than 220°F shall be considered as failing the compound stability test.

**18. Puncture Resistance**

18.1 This test covers the determination of the puncture resistance of materials specified in Section 1 of this Protocol as noted below.

18.1.1 Two 12 in. x 25 in. specimens shall be prepared; one ultraviolet light conditioned and one accelerated aging conditioned, as specified in Sections 13 and 14 of this Protocol, respectively.

18.1.2 The puncture point shall be affixed to any shaft and have a right angle triangular pyramid shape that is 1 inch in height with rounded leading edges of 0.062 ± .002 inch radius. The point should be honed to a 0.062 inch radius and the base edges left sharp. The weight of the puncture point and shaft shall be 1.0lb ± 0.1lb.

18.1.2.1 Attach each specimen to a frame consisting of nominal wood members spaced 24 inches on center.

18.1.2.2 The test specimens shall have a maximum sag of 1 inch measured from the top of the framing member.

18.1.2.3 Drop the puncture point from a height of 30 inches above the top of the framing in five different locations.

18.1.3~~2~~ Any test specimen which exhibits any sign of puncture shall be considered as failing the puncture test.

**19. Tile Slippage Resistance**

19.1 Prepare three (3) 4 foot ~~wide~~ x 8 foot ~~long~~ test frames using min. 2 inch by 4 inch nominal lumber spaced at 24 inches on center. ~~specimens with a 4 inch overlap seam across the center of the 8 foot length. Prepare the specimens: one from one edge of the roll and one from the center of~~

~~the roll. The length of each specimen should be in the “machine direction” of the roll.~~

19.2 ~~The substrate shall be~~ Install ~~32/16~~ 15/32 in. APA 32/16 span rated sheathing on the test frames ~~that has been reinforced on the back side with two angle irons~~.

19.3 Adhere the underlayment to the substrate with a side lap and back nailed per the manufacturer’s installation instructions. The side lap width and back nailing details shall be included in the final test report.

19.4 Condition each test deck in an oven or under heat lamps maintained at 165 ± 5°F for a minimum of four (4) hours. Thereafter, the deck shall be cooled for minimum three hours at 75°

± 5°F.

19.5 After conditioning, position one test deck at a slope of 4 in:12 in.; one at a slope of 5 in:12 in.; and the third at a slope of 6 in:12 in. The 5 in:12 in. test deck may be omitted if requested by the client.

19.6 Onto each sloped test deck, place one (1) stack of 10 flat concrete tiles and one (1) stack of 10 profiled tiles manufactured with “lugs” on the underside of each tile. Allow the tile stacks to sit on the underlayment surface for ~~72~~ minimum 36 hours while maintaining a controlled surface temperature of 165 ± 5°F. Temperature to be maintained by a ~~surface mounted~~ thermocouple mounted on the surface of the underlayment.

19.7 Report any of the following: ~~tears or tile slippage on any portion of the underlayment.~~

~~Report any tile sliding which has damaged any portion of the top surface of the underlayment.~~

 Any tile slippage on any portion of the underlayment

 Any tears in the underlayment

 Any tears in the underlayment surfacing

 Any delamination of the underlayment facing from the adhesive layer

19.8 Any test specimen which exhibits conditions noted in Section 19.7 of this Protocol shall be considered as failing the tile slippage resistance test.

19.9 Provide before and after photographs of each specimen in the final test report.

19.10 Alternate stacking configurations shall be permitted to be approved as part of a Product Approval. Details of such stacking configurations shall be included in the final test report.

**20. Crack Cycling Reserved**

20.1 This test covers the determination of the crack cycling performance of materials ~~specified in Section 1 of this Protocol in accordance with the ICBO Acceptance Criteria For Roof Underlayment For Use In Severe Climate Areas (Section IV, F), except as noted below.~~

20.1.1 ~~Three specimens are prepared with~~ ~~15~~/~~32~~~~-inch-thick (12.7 mm), 3-inch-by-6-inch (76 mm~~ by ~~152 mm) APA Rated A-C plywood. Each specimen includes two plywood pieces aligned so that the 6-inch (152 mm) edges are parallel and separated by 1/8 inch (3.2 mm). The underlayment is attached to the plywood pieces across the joint and rolled 3 times back and forth (2-3s per direction) using a 26 lb. (11.8 kg) roller. The specimens are then conditioned at 73 ± 4°F (22.8 ± 2.2°C) for seven days. After conditioning, specimens are placed in an oven which is maintained at 180 ± 5°F and 55 ± 5% relative humidity for 48 hours ± 1 hour. Specimens are then cycled between a 1/8-inch (3.2 mm) and 1/4-inch (6.4 mm) plywood edge separation for 100 cycles while maintaining the temperature at 180°F and 55 ± 5% relative humidity. The rate of movement shall be 1/8 inch (3.2 mm) per hour.~~

~~Specimens shall be adhered over the two pieces of sheathing.~~

20.1.2 ~~The three specimens shall be prepared with 32/16~~ ~~15~~/~~32~~ ~~in. x 3 in. x 6 in. APA span~~ rated ~~plywood sheathing.~~

20.1.3 ~~Conditioning shall consist of exposure to a controlled temperature of 180 ± 5°F and 55~~

~~± 5% relative humidity for a period of seven (7) days.~~

~~20.1.42 Conditions of Acceptance - Any test specimen which exhibits cracking of material shall be considered as failing the cyclic elongation test.~~

**21. Peel Adhesion**

21.1 This test covers the determination of the peel adhesion to substrate performance of materials specified in Section 1 of this Protocol in accordance with the applicable provisions of ASTM Test Method D 1970 and as noted below.

21.1.1 Specimen Preparation

21.1.1.1 The substrate shall be APA 32/16 span rated plywood sheathing of a 15/32 in. thickness.

21.1.2 Conditioning

21.1.2.1 One set of samples shall be conditioned at 73.4~~5~~ ± ~~2~~3.6°F for four (4) hours; a second and third set shall be conditioned per Sections 13 and 14 of this protocol for accelerated aging and ultraviolet resistance, respectively.

21.~~1.1~~3 Report

21.1.3.1 Peel Adhesion shall be reported, in lbf/foot of width, for all test specimens and shall be itemized in grouping of “conditioned at 73.4~~5~~°F,” “after accelerated aging” and “after ultraviolet conditioning.”

21.1.3.2 Any “conditioned” specimen which exhibits a peel strength less than 6.5 lbf/foot of width shall be considered as failing the peel adhesion test.

21.1.3.3 Any aged or ultraviolet conditioned specimen which exhibits a peel strength less than 4.9 lbf/foot of width shall be considered as failing the peel adhesion test.

**FOR MINERAL SURFACED ~~ROLL~~ MATERIAL TO BE USED AS A MORTAR OR ADHESIVE SET TILE UNDERLAYMENT**

**22. Granule Adhesion**

22.1 This test covers the determination of granule loss of materials specified in Section 1 of this Protocol, which employ a fine or granular surfacing on one side, in accordance with ASTM Test Method D 5147 except as noted below.

22.1.1 Any test specimen which exhibits an average granule loss greater than 0.75 grams shall be considered as failing the granule adhesion test.

**FOR UNDERLAYMENTS TO BE USED WITH ADHESIVE SET TILE SYSTEMS**

**23. Tensile Adhesion of Tile Adhesives**

23.1 This test covers the determination of the tensile adhesion bond between a tile adhesive and the underlayment surface.

23.2 This test is required to be performed on all adhesives for which approval is sought.

23.3 Sample Preparation and Testing

23.3.1 Prepare 20 (5 each) specimens for testing at 0 days (control), 14 days, 60 days, and 120 days:

23.3.1.1 Bond a 2 inch wide by 24 inch long piece of underlayment to a 2 inch wide by 24 inch long

piece of 23/32” B-C APA rated plywood. Take care that the method of bonding does not

interfere with or otherwise alter the surface of the underlayment to which the tile adhesive is to be applied. Prepare (6) underlayment/plywood strips in this fashion.

23.3.1.2 Place 2 prepared specimens with the long edge horizontal in a jig such that there is a max.

¾ inches between specimens and the specimens are braced to prevent expansion. The exposed surface of the specimens should be facing each other.

23.3.1.3 Apply foam adhesive in the void between specimens in a manner specified by the adhesive manufacturer’s instructions.

23.3.1.4 Allow the adhesive to cure for min. two hours.

23.3.1.5 Remove the adhered specimens from the jig and trim excess adhesive from all edges.

23.3.1.6 Cut each adhered specimen into 2 inch by 2 inch squares.

23.3.2 Condition the 2 inch by 2 inch specimens as follows:

23.3.2.1 Control specimens shall be conditioned at 73.4 ± 3.6°F and 50% relative humidity for 4 hours.

23.3.2.2 All remaining specimens shall be conditioned at 180 ± 2°F and 65% relative humidity. Six specimens each shall be conditioned for 14, 60, and 120 days.

23.3.3 Test all samples in accordance with ASTM D1623. Testing shall be performed after a stabilization at 73.4 ± 3.6°F and 50% relative humidity.

23.4 The average tensile adhesion of (5) specimens after 0, 14, 60, and 120 days shall be min. 15 psi. Any set of specimens with an average tensile adhesion below 15 psi will be considered as having failed this test.

**24. Accelerated Weathering**

24.1 Underlayments for which an outdoor exposure greater than 30 days is desired must comply with the requirements of this section.

24.2 Underlayments shall be exposed to accelerated weathering in accordance with ASTM D4798, Cycle A-1.

24.2.1 Exposure Limitations shall be established per Table 24.1.

24.2.2 At the conclusion of the required accelerated weathering, the weathered underlayment shall be tested per Table 24.2. Any product not achieving the values therein will be considered as having failed the test.

24.3 Report the results of testing per Table 24.2 and the duration of Accelerated Weathering exposure.

TABLE 24.1

Days of Allowable Outdoor Exposure

Accelerated Weathering Duration (Hours)

45

60

90

120

150

180

1,000

833

666

500

333

250

TABLE 24.2

**Property Tested Section Number Minimum Requirement (MD & CD)**

Breaking Strength 10 25 lbf/in

Elongation

10

Organic Reinforcement

6%

Low Temperature Flexibilty

12

Fiberglass Reinforcement

3%

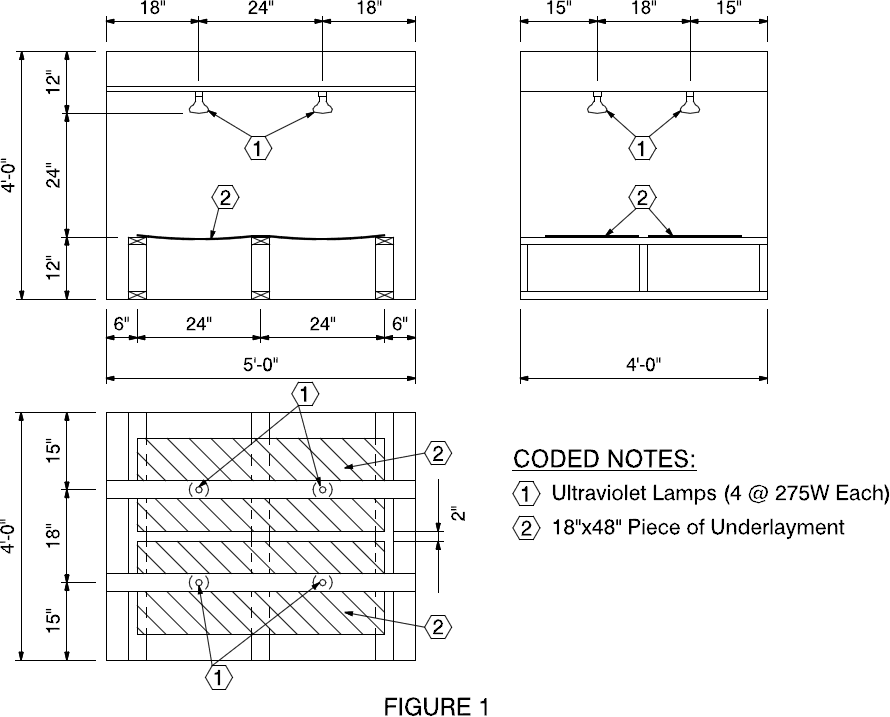
No Cracking

Polyester or Polypropylene

Reinforced 25%

Solid Thermoplastic

Sheeting 225%



(S- TP- Comment #1)

**:**

**TAS 104-20**

**TESTING APPLICATION STANDARD (TAS) No. 104-~~95~~20**

**TEST PROCEDURE FOR NAIL-ON UNDERLAYMENT FOR USE IN ~~DISCONTINUOUS~~ TILE ROOF SYSTEMS**

Revise the following sections as follows:

**1. Scope**

1.1 This Protocol covers procedures for testing mechanically attached, prefabricated, ~~reinforced,~~ polymer modified bituminous, and solid thermoplastic sheet roofing materials intended for use as underlayment in ~~Discontinuous~~ Tile Roof Systems to assist in the waterproofing to function in combination with a Prepared Roof Covering. These products may employ fine or granular surfacing materials on one side in which case the “Granular Adhesion” test, as specified herein, shall also be conducted. The Granular Adhesion test shall be required for all granular surfaced materials used as a bonding surface for mortar or adhesive set tile.

1.2 The test procedures outlined in this Protocol cover the determination of the Thickness; the Dimensional Stability; the Tear Resistance; the Breaking Strength; the Elongation; ~~the Water Absorption;~~ the Low Temperature Flexibility; the Ultraviolet Resistance; the Accelerated Aging Performance; the Cyclic Elongation Performance; the Water Vapor Transmission; the Puncture Resistance; and the Tile Slippage Resistance of an underlayment material; the Accelerated Weathering Performance of an underlayment material; the Tensile Adhesion properties of the exposed surface of the underlayment; and Granular Adhesion ~~of a mineral~~ for granular surfaced ~~roll roofing material, for use as an~~ underlayment.

1.3 These test methods appear in the following order:

Section

Conditioning 5

Thickness 6

Dimensional Stability 7

Tear Resistance 8

Breaking Strength and Elongation 9

Reserved 10

Low Temperature Flexibility 11

Ultraviolet Resistance 12

Accelerated Aging 13

Cyclic Elongation 14

Water Vapor Transmission 15

Puncture Resistance 16

Tile Slippage Resistance 17

Granule Adhesion 18

Tensile Adhesion 19

Accelerated Weathering 20

**2. Referenced Documents**

*2.1 ASTM Test Standards*

~~D 570~~ ~~Water Absorption of Plastics~~

D 1079 Standard Definitions and Terms Relating to Roofing, Waterproofing and Bituminous Materials

~~D 1938~~ ~~Tear Propagation Resistance of Plastic Film and Thin Sheeting by a Single-Tear Method~~

D 4073 Standard Test Method For Tensile Tear Strength of Bituminous Roofing Membranes

D 1970 Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection ~~(Low Temperature Flexibility)~~

D 2523 Testing Load-Strain Properties of Roofing Membranes

D 1623 Standard Test Method For Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics

D 5147 Sampling and Testing Modified Bituminous Sheet Materials

E 96 Water Vapor Transmission of Materials

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

*2.2 The Florida Building Code, Building*

**3. Terminology & Units**

3.1 Definitions - For definitions of terms used in this Protocol, refer to ASTM D 1079; Chapters 2 and 15 (High- Velocity Hurricane Zones) of the *Florida Building Code, Building.* The 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. Significance and Use**

4.1 The test procedures outlined in this Protocol provide a means of determining whether a mechanically attached roofing material, intended for use as an underlayment in a Discontinuous Roof System, for use in the High-Velocity Hurricane Zones, meets the requirements of the *Florida Building Code, Building*.

**5. Conditioning**

5.1 Specimens shall be selected in accordance with ASTM D5147. Unless otherwise specified, condition test specimens for a minimum of four (4) hours at 73.4 ± 3.6°F and 50 ± 5 % relative humidity prior to testing. Note separate conditioning requirements for ~~cold bend~~ low temperature flexibility testing in Section 11.1.

**6. Thickness**

6.1 Materials shall be checked at five points across the roll width. Measurements shall be made at two points, each being 6 ± 0.5 inches from each edge, and at three points equally spaced between these two points.

6.2 Compute the average thickness and the standard deviation of the thicknesses, in mils, based on the total number of point measurements from all of the rolls taken.

6.3 Report the individual point measurements, average, and standard deviation in mils.

6.4 Any modified bitumen ~~and~~ or bituminous test specimen which exhibits an average thickness less than sixty

(60) mils shall be considered as failing the thickness test. For granular surfaced products, ~~T~~thickness measurements shall be at the selvage edge, not at a granular surface.

6.5 Non-bituminous membranes shall not nave a thickness minimum. Performance shall be based on physical property testing.

**7. Dimensional Stability**

7.1 Prepare five (5) 2 foot wide x 6 foot long specimens with a 4 inch overlap seam across the center of the 6 foot length. Prepare the specimens: one from each edge of the roll and three from random places in the roll. The length of each specimen should be in the ‘machine direction’ of the roll.

7.2 The substrate shall be 32/16 APA span rated plywood sheathing of a 15/32 in. thickness that has been reinforced on the back side with two angle irons.

7.3 Place the underlayment specimen on the substrate and install a 11/2 in. x 11/2 in. x 2' wood termination batten to one “free” end of the underlayment using three (3) equally spaced #12 wood screws to secure the batten through the underlayment and the sheathing. Mechanically attach the other “free” end of the underlayment using three (3) equally spaced ~~10d~~ roofing nails, located two (2) inches from the “free” end, with one nail at one inch from each edge, penetrating the sheathing a minimum of 1/2 inch.

7.4 Condition each specimen in an oven or under heat lamps maintained at 180 ± 5°F for a minimum of six (6) hours.

7.5 Report any tears or “tear drop” conditions which arise at fastener penetrations during and/or after conditioning is complete. Report any shrinking or wrinkling which appears to have compromised the lapped area of underlayment.

7.6 Any test specimen which exhibits conditions noted in Section 7.5 of this Protocol shall be considered as failing the dimensional stability test.

7.7 Provide before and after photographs of each specimen in the final test report.

**8. Tear Resistance**

8.1 This test covers the determination of the tear propagation resistance of materials specified in Section 1 of this Protocol in accordance with ASTM Test Method D 4073, except as noted below.

8.1.1 The prescribed Test Method shall be run in both the machine and the cross-machine direction of the roll material.

8.1.2 The final test report shall include average tear propagation force values and standard deviations of these value for both the machine and the cross-machine direction of the material.

8.1.3 Any test specimen which exhibits a tear propagation value less than 20 lbf (88.5 N) in either the machine or cross-machine directions shall be considered as failing the tear strength test.

**9. Breaking Strength and Elongation**

9.1 This test covers the determination of the breaking strength and elongation of materials specified in Section 1 of this Protocol in accordance with ASTM Test Method D 2523, except as noted below.

9.1.1 Sampling

9.1.1.1 Ten specimens; five in the machine direction and five in the cross-machine direction of the roll, shall be cut to dimensions of 1 in. x 6 in.

9.1.2 Conditioning

9.1.2.1 Heat Aging, shall consist of seven (7) days in an air circulating oven at a controlled temperature of 149 ± 5°F.

9.1.2.2 UV Exposure, shall consist of 460 hours of continuous ultraviolet light exposure per Section 12.1.2.2.

9.1.3 Procedure

9.1.3.1 Each set of samples, as specified in 9.1.1.1 herein, shall be tested “as received,” after heat aging, and after UV exposure, as specified in 9.1.2.1 and 9.1.2.2 herein.

9.1.3.2 Grip separation rate shall be 20 ± 0.2 inches per minute for all tests conducted.

9.1.3.3 Testing shall be performed at 73.4 ± 3.6°F for all tests.

9.1.3.4 Specimens and testing grips shall be conditioned at 73.4 ± 3.6°F 77°F for a minimum of one

(1) hour prior to testing.

9.1.4 Report

9.1.4.1 Report the grip separation rate used.

9.1.4.2 Breaking strength shall be reported, in lbf/inch of width, for all test specimens and shall be itemized in grouping of “as received,” after heat conditioning, and UV exposure as specified in

9.1.2.1 and 9.1.2.2 herein. The~~se grouping~~ test specimens shall be itemized in subgroups of machine direction and cross-machine direction. Any test specimen which exhibits a breaking strength value less than those listed in Table 1 shall be considered as failing the breaking strength test.

**TABLE 1 MINIMUM BREAKING STRENGTH VALUES (%)**

|  |  |
| --- | --- |
| **SPECIMEN** | **BREAKING STRENGTH**  (Machine Direction or Cross-Machine Direction) |
| As Received | 25 lbf/inch of width (35 N/cm of width) |
| After Heat Aging | 25 lbf/inch of width (35 N/cm of width) |
| After QUV Exposure | 25 lbf/inch of width (35 N/cm of width) |

9.1.4.3 Elongation shall be reported, in (%), for all test specimens and shall be itemized in grouping of “as received,” after heat conditioning, and after UV exposure. These grouping shall be itemized in subgroups of machine direction and cross-machine direction. Any test specimen which exhibits elongation values less than those listed in Table 2 shall be considered as failing the elongation test.

**10. Reserved**

**11. Low Temperature Flexibility**

11.1 This test covers the determination of the low temperature flexibility of materials specified in Section 1 of this Protocol in accordance with ASTM Test Method D 1970 except as noted below. Membranes shall be test at a maximum of 10°F.

11.1.1 Procedure

11.1.1.1 Each set of specimens shall be tested “as received” and after conditioning, as specified in ASTM D 1970.

11.1.2 Report

11.1.2.1 Low temperature flexibility results shall be reported on a pass/fail basis, for all test specimens and shall be itemized in grouping of “as received” and after conditioning. No cracking at - 10°F shall be considered as passing the low temperature flexibility test.

**TABLE 2 MINIMUM ELONGATION VALUES (%)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SPECIMEN** | **ORGANIC REINFORCEMENT** | **FIBERGLASS REINFORCED** | **POLYESTER OR POLYPROPYLENE REINFORCED** | **SOLID THERMOPLASTIC ~~SHEATHING~~SHEETS** |
| As Received | 6% | 3% | 25% | 225% |
| After Heat Aging | 5% | 2.5% | 21% | 191% |
| After QUV Exposure | 5% | 2.5% | 21% | 191% |

**12. Ultraviolet Resistance**

12.1 This test covers the determination of the ultraviolet resistance performance of materials specified in Section 1.

12.1.1 Sampling - Two 18 in. x ~~18~~ 48 in. specimens are to be cut.

12.1.2 Conditioning

12.1.2.~~2~~1 Ultraviolet light shall be produced by four ~~300~~ 275 W~~watt~~ UV lamps in an enclosure in accordance with Figure 1. Recommended lamps are: Ultra-Vitalux, ~~300~~ 275 W, 220-230 V, #E27;~~, or~~ O~~o~~s~~h~~ram ~~300~~ 275 W lamps, or; equivalent bulbs providing UV characteristics of 5.0 W/m2/nm irradiance at a wavelength of 315 to 400 nm at one meter..

12.1.2.~~3~~2 Specimens to be exposed for ~~200~~ 460 (± 2) continuous hours ~~(10 hours per day for 20 days)~~.

12.1.2.~~4~~3 Specimen temperature to be maintained at 135-140°F throughout the ~~UV exposure portion of the~~ test period. ~~Specimens shall be maintained between 70°F +/- 15°F when not exposed to UV during the test period.~~

12.1.3 Report & Conditions of Acceptance

12.1.3.1 Report any visible peeling, chipping, cracking, flaking, pitting or other damage, under 5x magnification, which resulted from the ultraviolet conditioning. Report the type and location of the damage (if any).

12.1.3.2 Report the type of UV lamps used to condition the samples.

12.1.3.3 Any test specimen which exhibits damage as defined in Section 12.1.3.1 of this Protocol shall be considered as failing the ultraviolet resistance test.

**13. Accelerated Aging**

13.1 This test covers the determination of the accelerated aging performance of materials specified in Section 1 of this protocol.

13.2 ~~Sampling~~ Specimen Preparation - Six (6) 12 in. x 12 in. specimens shall be prepared with three

(3) in the machine direction and three (3) in the cross-machine direction of the roll. Specimens shall be marked to indicate machine direction.

13.2.13 Accelerated Aging – The specimens prepared per Section 14.1 are aged by the following cyclic process. Twenty-five cycles cycles are required, with each cycle consisting of the following:

1. Oven dry at 120°F (48.9°C) for three hours with all surfaces exposed.

2. Immerse in water maintained at room temperature for three hours, with all surfaces exposed.

3. Remove from water and blot dry, then air dry for 18 hours at room temperature for eighteen hours with all surfaces exposed.

Samples shall be in the air dry period over weekends and holidays, which shall be confirmed in the test log. The room temperature shall be maintained at 73.4 ± ~~5~~3.6°F (23~~2.8~~ ± 2~~.8~~°C).

13.~~2.2~~3.1 Conditions of Acceptance – No visible damage to the specimens, such as chipping, cracking, or delamination.

13.2.3.2 Breaking strength and elongation tests of aged specimens shall be conducted in accordance with Section 9 of this Protocol, except as noted below.

13.2.3.2.1 Sampling - After the six (6) 12 in. x 12 in. aged specimens have been examined for visible damage, prepare ten (10) 1 in. x 6 in. specimens from the aged material; five in the machine direction and five in the cross-machine direction of the roll. In addition to these ten aged specimens, prepare ten “as received” specimens of the same dimensions; five in the machine direction and five in the cross-machine direction of the roll.

13.2.3.2.2 Conditioning - No further conditioning is to be incurred on the aged specimens.

13.2.3.3 Procedure - Each set of samples, as specified in 13.2.3.1 herein, shall be tested “as received” and after accelerated aging.

13.2.3.4 Report

13.2.3.4.1 Breaking strength shall be reported, in lbf/inch of width, for all test specimens and shall be itemized in grouping of “as received” and after accelerated aging. These ~~grouping~~ specimens shall be itemized in subgroups of machine direction and cross-machine direction. Any aged specimen which exhibits a breaking strength less than the value listed in Table 2 shall be considered as failing the accelerated aging test.

13.2.3.4.2 Elongation shall be reported, in (%), for all test specimens and shall be itemized in grouping of ‘as received’ and after accelerated aging. These ~~grouping~~ specimens shall be itemized in subgroups of machine direction and cross-machine direction. Any aged specimen which exhibits an elongation value less than the applicable value listed in Table 2 shall be considered as failing the accelerated aging test.

**14. Cyclic Elongation**

14.1 This test covers the determination of the cyclic elongation performance of materials specified in Section 1 of this Protocol.

14.1.1 Three specimens are prepared with 15/32-inch-thick (12.7 mm), 3-inch-by-6-inch (76 mm by 152 mm) APA Rated A-C plywood. Each specimen includes two plywood pieces aligned so that the 6-inch (152 mm) edges are parallel and separated by 1/8 inch (3.2 mm). Once piece of underlayment, 5~~-1/2~~ inches by 5~~-1/2~~ inches, is attached to the plywood pieces across the joint using four (4) ~~10d~~ roofing nails, one at each outside corner of the underlayment. See Figure 2. The specimens are then conditioned at 73 ± 4°F (22.8 ± 2.2°C) for seven days. After conditioning, specimens are placed in a cold box, which is maintained at –20°F (–28.9°C) for ~~48~~ 24 hours ± 1 hour. Specimens are then cycled between a 1/8-inch (3.2 mm) and 1/4-inch (6.4 mm) plywood edge separation for 100 cycles while maintaining the temperature at –20°F (–28.9°C). The rate of movement shall be 1/8 inch (3.2 mm) per hour.

14.1.2 Conditions of Acceptance - Any test specimen which exhibits cracking of material shall be considered as failing the cyclic elongation test.

**15. Water Vapor Transmission**

15.1 This test covers the determination of the water vapor transmission of materials specified in Section 1 of this Protocol in accordance with ASTM Test Method E 96, Procedure B.

15.2 The water vapor transmission of the membrane shall not be greater than 1.0 g/m2 in 24 hours.

**16. Puncture Resistance**

16.1 This test covers the determination of the puncture resistance of materials specified in Section 1 of this Protocol as noted below.

16.1.1 Two 12 in. x 25 in. specimens shall be prepared; one ultraviolet light conditioned and one accelerated aging conditioned, as specified in Sections 13 and 14 of this Protocol, respectively.

16.1.2 The puncture point shall be affixed to any shaft and have a right angle triangular pyramid shape that is 1 inch in height with rounded leading edges of 0.062 ± .002 inch radius. The point should be honed to a 0.062 inch radius and the base edges left sharp. The weight of the puncture point and shaft shall be 1.0lb ± 0.1lb.

16.1.2.1 Attach each specimen to a frame consisting of nominal wood members spaced 24 inches on center.

16.1.2.2 The test specimens shall have a maximum sag of 1 inch measured from the top of the framing member.

16.1.2.3 Drop the puncture point from a height of 30 inches above the top of the framing in five different locations.

16.1.3~~2~~ Any test specimen which exhibits any sign of puncture shall be considered as failing the puncture test..

**17. Tile Slippage Resistance**

17.1 Prepare three (3) 4 foot ~~wide~~ x 8 foot ~~long~~ test frames using min. 2 inch by 4 inch nominal lumber spaced at 24 inches on center. ~~specimens with a 4 inch overlap seam across the center of the 8 foot length.~~

~~Prepare the specimens: one from one edge of the roll and one from the center of~~

~~the roll. The length of each specimen should be in the “machine direction” of the roll.~~

17.2 ~~The substrate shall be~~ Install ~~32/16~~ 15/32 in. APA 32/16 span rated sheathing on the test frames ~~that has been reinforced on the back side with two angle irons~~.

17.3 Nail the underlayment to the substrate through “tin caps,” not less than 15/8 in. and not more than 2 in. in diameter and of not less than 32 gage (0.010 in.) sheet metal, using ~~10d~~ roofing nails, in a grid pattern of 12 in. with 6 in. spacing at the lap, penetrating the sheathing a minimum of 1/2 inch, with a side lap per the manufacturer’s installation instructions. The side lap width shall be included in the final test report.

17.4 Condition each test deck in a~~n oven or under heat lamps~~ conditioning cell or room maintained at 165 ± 5°F for a minimum of four (4) hours. Thereafter, the deck shall be cooled for minimum three hours at 75° ± 5°F.

17.5 After conditioning, position one test deck at a slope of 4 in:12 in.; one at 5 in:12 in. and the third at a slope of 6 in:12 in.. A 5 in:12 in. test deck may be omitted if requested by the client.

17.6 Onto each sloped test deck, place one (1) stack of 10 flat concrete tiles and one (1) stack of 10 profiled ~~clay~~ tiles manufactured ~~equipped~~ with “lugs” on the underside of each tile ~~at the center of each underlayment piece, equidistant from the edge and the seam~~, to simulate actual loading conditions. Allow the tile stacks to sit on the underlayment surface for ~~72~~ minimum 36 hours while maintaining a controlled surface temperature of 165° ± 5°F. Temperature to be maintained by a ~~surface mounted~~ thermocouple mounted on the surface of the underlayment.

17.7 Report any of the following: ~~tears, slippage, or “tear drop” condition which arise at fastener penterations during the test. Report any tile sliding which has damaged any portion of the top surface of the underlayment.~~

 Any tile slippage on any portion of the underlayment

 Any tears in the underlayment

 Any tears in the underlayment surfacing

 Any delamination of the underlayment facing from the adhesive layer

 Any “tear drop” conditions at fastener penetrations

17.8 Any test specimen which exhibits conditions noted in Section 17.7 of this Protocol shall be considered as failing the tile slippage resistance test.

17.9 Provide before and after photographs of each specimen in the final test report.

17.10 Alternate ~~slippage resistance testing and~~ stacking configurations shall be permitted to be approved as part of a Product Approval. Details of such stacking configurations shall be included in the final test report.

**FOR MINERAL SURFACED ~~ROLL~~ MATERIALS TO BE USED AS A MORTAR OR ADHESIVE SET TILE UNDERLAYMENT**

**18. Granule Adhesion**

18.1 This test covers the determination of granule loss of materials specified in Section 1 of this Protocol, which employ a fine or granular surfacing on one side, in accordance with ASTM Test Method D 5147, except as noted below.

18.1.1 Any test specimen which exhibits an average granule loss greater than 0.75 grams shall be considered as failing the granule adhesion test.

**FOR UNDERLAYMENTS TO BE USED WITH ADHESIVE SET TILE SYSTEMS**

**19. Tensile Adhesion of Tile Adhesives**

19.1 This test covers the determination of the tensile adhesion bond between a tile adhesive and the underlayment surface.

19.2 This test is required to be performed on all adhesives for which approval is sought.

19.3 Sample Preparation and Testing

19.3.1 Prepare 20 (5 each) specimens for testing at 0 days (control), 14 days, 60 days, and 120 days:

19.3.1.1 Bond a 2 inch wide by 24 inch long piece of underlayment to a 2 inch wide by 24 inch long

piece of 23/32” B-C APA rated plywood. Take care that the method of bonding does not interfere with or otherwise alter the surface of the underlayment to which the tile adhesive is to be applied. Prepare (6) underlayment/plywood strips in this fashion.

19.3.1.2 Place 2 prepared specimens with the long edge horizontal in a jig such that there is a max.

¾ inches between specimens and the specimens are braced to prevent expansion. The exposed surface of the specimens should be facing each other.

19.3.1.3 Apply foam adhesive in void between the specimens in the manner specified by the adhesive manufacturer’s instructions.

19.3.1.4 Allow the adhesive to cure for min. two hours.

19.3.1.5 Remove the adhered specimens from the jig and trim excess adhesive from all edges.

19.3.1.6 Cut each adhered specimen into 2 inch by 2 inch squares.

19.3.2 Condition the 2 inch by 2 inch specimens as follows:

19.3.2.1 Control specimens shall be conditioned at 77 ± 2.5°F and 50% relative humidity for 4 hours.

19.3.2.2 All remaining specimens shall be conditioned at 180 ± 2°F and 65% relative humidity. Six specimens each shall be conditioned for 14, 60, and 120 days.

19.3.3 Test samples in accordance with ASTM D1623. Testing shall be performed after a stabilization at 77 ± 2.5°F and 50% relative humidity.

19.4 The average tensile adhesion of (5) specimens after 0, 14, 60, and 120 days shall be min. 15 psi. Any set of specimens with an average tensile adhesion below 15 psi will be considered as having failed this test.

**20. Accelerated Weathering**

20.1 Underlayments for which an outdoor exposure greater than 30 days is desired must comply with the requirements of this section.

20.2 Underlayments shall be exposed to accelerated weathering in accordance with ASTM D4798, Cycle A-1.

20.2.1 Exposure Limitations shall be established per Table 20.1.

20.2.2 At the conclusion of the required accelerated weathering, the weathered underlayment shall be tested per Table 20.2. Any product not achieving the values therein will be considered as having failed the test.

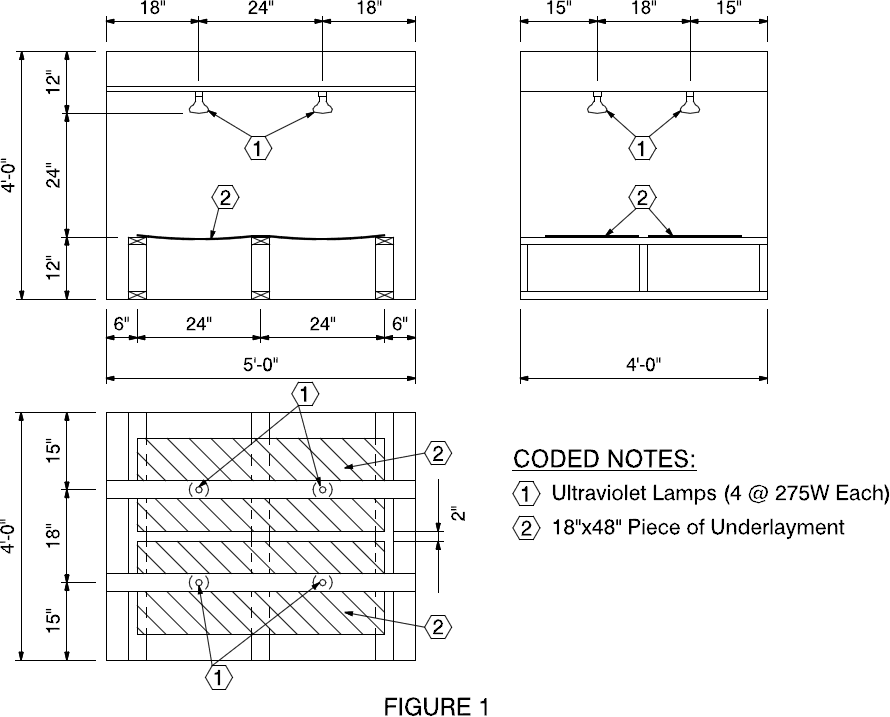
20.3 Report the results of testing per Table 20.2 and the duration of Accelerated Weathering exposure.

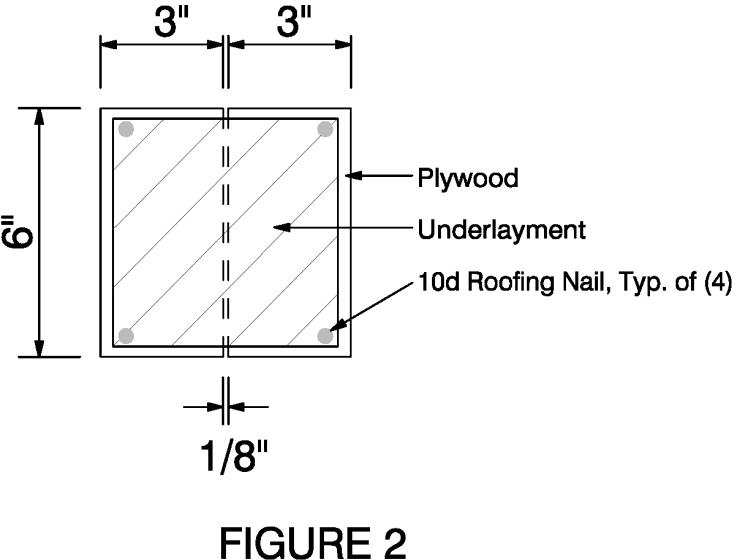
TABLE 20.1

|  |  |
| --- | --- |
| Days of Allowable Outdoor Exposure | Accelerated Weathering Duration (Hours) |
| 45 | 250 |
| 60 | 333 |
| 90 | 500 |
| 120 | 666 |
| 150 | 833 |
| 180 | 1,000 |

TABLE 20.2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Property Tested** | **Section Number** | **Minimum Requirement (MD & CD)** | | |  |
| Breaking Strength | 10 | 25 lbf/in | | | |
| Elongation | 10 | Organic Reinforcement | Fiberglass Reinforcement | Polyester or  Polypropylene Reinforced | Solid  Thermoplastic Sheeting |
|  |  | 6% | 3% | 25% | 225% |
| Low Temperature Flexibilty | 12 | No Cracking | | | |





(S- TP- Comment #1)

**RAS 127-20**

**ROOFING APPLICATION STANDARD (RAS) No. 127-20 PROCEDURE FOR DETERMINING THE MOMENT OF RESISTANCE AND MINIMUM**

**CHARACTERISTIC RESISTANCE LOAD TO INSTALL A TILE SYSTEM ON A BUILDING OF A SPECIFIED ROOF SLOPE AND HEIGHT USING ALLOWABLE STRESS DESIGN (ASD) IN ACCORDANCE WITH ASCE 7**

Revise the following sections as follows:

**1. Scope**

This standard covers the procedure for determining the Moment of Resistance (Mr) and Minimum Characteristic Resistance Load (*F'*) to install a tile system on buildings of a specified roof slope and height. Compliance with the requirements and procedures herein specified, where the design wind uplift pressures (Pasd) have been determined based on Tables 1-3, ~~or~~ Tables ~~2~~ 4-6, Tables 7-9 or Tables10-12 of this standard, as applicable, do not require additional signed and sealed engineering design calculation. All other calculations must be prepared, signed and sealed by a professional engineer or registered architect. Tables 1-3 ~~is~~ are applicable to a wind speed of 175 mph, risk category II buildings with gable roofs with overhangs, and exposure category C. Tables ~~2~~ 4-6 ~~is~~ are applicable to a wind speed of 175 mph, risk category II buildings with gable roofs with overhangs, and exposure category D. Tables 7-9 are applicable to a wind speed of 175 mph, for risk category II buildings with hip roofs and overhangs, and exposure category C. Tables 10-12 are applicable to a wind speed of 175 mph, for risk category II buildings with hip roofs and overhangs, and exposure category D.

For steep slope roof systems other than tile, Tables 1-3, Tables 4-6, Tables 7-9 or

Tables10-12 of this standard, as applicable, do not require additional signed and sealed engineering design calculation when determining the use of a specific product approval. All other calculations must be prepared, signed and sealed by a professional engineer or registered architect.

All calculations must be submitted to the building official at time of permitting.

**2. How to determine the Moment Resistance (Mr) (Moment Based Systems)**

2.1 Determine the minimum design wind pressures for ~~the field, perimeter and corner areas (P~~asd ~~1, P P~~asd ~~2 and P~~asd ~~3, respectively)~~ each roof pressure zone using the values given in Tables 1-3, or Tables ~~2~~ 4-6, Tables 7-9 or Tables10-12, as applicable, or those obtained by engineering analysis prepared, signed and sealed by a professional engineer or registered architect based on ASCE 7.

2.2 Locate the aerodynamic multiplier (?) in tile Product Approval.

2.3 Determine the restoring moment due to gravity (Mg) per Product Approval.

2.4 Determine the attachment resistance (Mf) per Product Approval.

2.5 Determine the Moment of Resistance (Mr) per following formula: Mr = (Pasd ?) - Mg

2.6 Compare the values for Mr, with the values for Mf, noted in the Product Approval. If the Mf values are greater than or equal to the Mr values, for each area of the roof

~~[i.e., field Pasd(1), perimeter Pasd(2) and corner Pasd(3) areas]~~, then the tile attachment method is acceptable.

.

**3. How to determine the Minimum Characteristic Resistance Load (*F'*) (Uplift Based System)**

3.1 Determine the minimum design pressures for ~~the field, perimeter and corner areas [Pasd(1), Pasd(2) and Pasd(3), respectively]~~ each roof pressure zone using the values given in Table 1 or Table 2, as applicable, or those obtained by engineering analysis prepared, signed and sealed by a professional engineer or registered architect based on the criteria set forth in ASCE 7.

3.2 Determine the angle (?) of roof slope, from Tables 1-3, ~~or~~ Tables ~~2~~ 4-6, Tables 7-9 or Tables10-12, as applicable.

3.3 Determine the length (l), width (w) and average tile weight (W) of tile, per Product Approval.

3.4 Determine the required uplift resistance (Fr) per following formula: Fr = [(Pasd x l x w) - W] x cos θ

3.5 Compare the values for Fr with the values for *F*' noted in the Product Approval. If the *F*' values are greater than or equal to the Fr values, for each area of ~~roof [i.e., field Pasd(1) perimeter (Pasd(2) and corner Pasd(3) areas]~~, then the tile attachment method is acceptable.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **~~TABLE 1 — RISK CATEGORY II EXPOSURE CATEGORY “C”1~~ ~~MINIMUM DESIGN WIND UPLIFT PRESSURES IN PSF FOR FIELD [Pasd(1)],~~**  **~~PERIMETER [Pasd(2)] AND CORNER [Pasd(3)] AREAS OF ROOFS~~**  **~~FOR EXPOSURE C BUILDINGS WITH A ROOF MEAN HEIGHT AS SPECIFIED3~~** | | | | | |
| ~~ROOF~~ ~~SLOPE~~ | ~~> 2:12 to £ 6:12~~ | | | ~~> 6:12 to £12:12~~ | |
| ~~Roof mean~~ ~~height~~ | ~~Pasd(1)~~ | ~~Pasd(2)~~ | ~~Pasd(3)2~~ | ~~Pasd(1)~~ | ~~Pasd(1)~~ ~~Pasd(2) &~~  ~~Pasd(3)~~ |
| ~~£ 20'~~ | ~~-39.1~~ | ~~-68.1~~ | ~~-100.7~~ | ~~-42.8~~ | ~~-50.0~~ |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ~~> 20' to = 25'~~ | ~~-40.9~~ | ~~-71.3~~ | ~~-105.4~~ | ~~-44.8~~ | ~~-52.3~~ |
| ~~> 25' to = 30'~~ | ~~-42.4~~ | ~~-73.9~~ | ~~-109.3~~ | ~~-46.4~~ | ~~-54.3~~ |
| ~~> 30' to = 35'~~ | ~~-43.9~~ | ~~-76.6~~ | ~~-113.2~~ | ~~-48.1~~ | ~~-56.2~~ |
| ~~> 35' to = 40'~~ | ~~-45.1~~ | ~~-78.7~~ | ~~-116.3~~ | ~~-49.4~~ | ~~-57.8~~ |

~~1 Calculated in accordance with ASCE.~~

~~2 For Hip Roofs with slope ??5.5:12, Pasd(3) shall be treated as Pasd(2). 3 Pasd = 0.6Pult~~

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **~~TABLE 2 — RISK CATEGORY II EXPOSURE CATEGORY “D”1~~ ~~MINIMUM DESIGN WIND UPLIFT PRESSURES IN PSF FOR FIELD [Pasd(1)],~~**  **~~PERIMETER [Pasd(2)] AND CORNER [Pasd(3)] AREAS OF ROOFS~~**  **~~FOR EXPOSURE D BUILDINGS WITH A ROOF MEAN HEIGHT AS SPECIFIED3~~** | | | | | |
| ~~ROOF~~ ~~SLOPE~~ | ~~> 2:12 to £ 6:12~~ | | | ~~> 6:12 to £12:12~~ | |
| ~~Roof mean~~ ~~height~~ | ~~Pasd(1)~~ | ~~Pasd(2)~~ | ~~Pasd(3)2~~ | ~~Pasd(1)~~ | ~~Pasd(1)~~ ~~Pasd(2) &~~  ~~Pasd(3)~~ |
| ~~£ 20'~~ | ~~-47.0~~ | ~~-81.9~~ | ~~-121.0~~ | ~~-51.4~~ | ~~-60.1~~ |
| ~~> 20' to = 25'~~ | ~~-48.8~~ | ~~-85.0~~ | ~~-125.7~~ | ~~-53.4~~ | ~~-62.4~~ |
| ~~> 25' to = 30'~~ | ~~-50.3~~ | ~~-87.7~~ | ~~-129.6~~ | ~~-55.0~~ | ~~-64.4~~ |
| ~~> 30' to = 35'~~ | ~~-51.5~~ | ~~-89.9~~ | ~~-132.7~~ | ~~-56.4~~ | ~~-65.9~~ |
| ~~> 35' to = 40'~~ | ~~-52.7~~ | ~~-91.9~~ | ~~-135.8~~ | ~~- -57.7~~ | ~~-67.9~~ |

~~1 Calculated in accordance with ASCE 7.~~

~~2 For Hip Roofs with slope  5.5:12, P~~~~asd~~~~(3) shall be treated as P~~~~asd~~~~(2).~~

~~3 Pasd = 0.6Pul~~t

|  |  |  |  |
| --- | --- | --- | --- |
| **TABLE 1 — Gable Roofs**  **MINIMUM ASD DESIGN WIND UPLIFT PRESSURES IN PSF FOR ROOF SLOPE ≥2:12 to ≤4:12**  **RISK CATEGORY II EXPOSURE CATEGORY “C”**  **~~(Overhang)~~** | | | |
| **Roof Mean Height** | **Roof Pressure Zones** | | |
| **1 and 2e** | **2n, 2r and 3e** | **3r** |

|  |  |  |  |
| --- | --- | --- | --- |
| **≤15’** | **-74** | **-108** | **-128** |
| **>15 to ≤20’** | **-78** | **-114** | **-136** |
| **>20’ to ≤25’** | **-82** | **-120** | **-142** |
| **>25’ to ≤30’** | **-85** | **-125** | **-148** |
| **>30 to ≤35’** | **-88** | **-129** | **-153** |
| **>35 to ≤40’** | **-91** | **-132** | **-157** |
| **>40’ to ≤45’** | **-93** | **-136** | **-162** |
| **>45’ to ≤50’** | **-95** | **-139** | **-165** |
| **>50’ to ≤55’** | **-97** | **-142** | **-169** |
| **>55’ to ≤60’** | **-98** | **-144** | **-171** |

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| **TABLE 2 — Gable Roofs**  **MINIMUM ASD DESIGN WIND UPLIFT PRESSURES IN PSF FOR ROOF SLOPE ˃4:12 to ≤6:12**  **RISK CATEGORY II EXPOSURE CATEGORY “C”**  **~~(Overhang)~~** | |
|  | **Roof Pressure Zones** |

|  |  |  |  |
| --- | --- | --- | --- |
| **Roof Mean Height** | **1 and 2e** | **2n, 2r and 3e** | **3r** |
| **≤15’** | **-57** | **-91** | **-128** |
| **>15 to ≤20’** | **-60** | **-96** | **-136** |
| **>20’ to ≤25’** | **-63** | **-101** | **-142** |
| **>25’ to ≤30’** | **-66** | **-105** | **-148** |
| **>30 to ≤35’** | **-68** | **-109** | **-153** |
| **>35 to ≤40’** | **-70** | **-111** | **-157** |
| **>40’ to ≤45’** | **-72** | **-115** | **-162** |
| **>45’ to ≤50’** | **-73** | **-117** | **-165** |
| **>50’ to ≤55’** | **-75** | **-120** | **-169** |
| **>55’ to ≤60’** | **-76** | **-121** | **-171** |

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|  |  |  |  |
| --- | --- | --- | --- |
| **Roof Mean Height** | **Roof Pressure Zones** | | |
| **1, 2e and 2r** | **2n and 3r** | **3e** |
| **≤15’** | **-67** | **-74** | **-115** |
| **>15 to ≤20’** | **-71** | **-78** | **-122** |
| **>20’ to ≤25’** | **-74** | **-82** | **-127** |
| **>25’ to ≤30’** | **-78** | **-85** | **-132** |
| **>30 to ≤35’** | **-80** | **-88** | **-137** |
| **>35 to ≤40’** | **-82** | **-91** | **-141** |
| **>40’ to ≤45’** | **-85** | **-93** | **-146** |
| **>45’ to ≤50’** | **-86** | **-95** | **-147** |
| **>50’ to ≤55’** | **-88** | **-97** | **-151** |
| **>55’ to ≤60’** | **-89** | **-98** | **-153** |

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| --- | --- | --- | --- |
| **TABLE 4 — Gable Roofs**  **MINIMUM ASD DESIGN WIND UPLIFT PRESSURES IN PSF FOR ROOF SLOPE ≥2:12 to ≤4:12**  **RISK CATEGORY II EXPOSURE CATEGORY “D”**  **~~(Overhang)~~** | | | |
| **Roof Mean Height** | **Roof Pressure Zones** | | |
| **1 and 2e** | **2n, 2r and 3e** | **3r** |
| **≤15’** | **-90** | **-131** | **-156** |
| **>15 to ≤20’** | **-94** | **-137** | **-163** |
| **>20’ to ≤25’** | **-98** | **-142** | **-169** |
| **>25’ to ≤30’** | **-101** | **-148** | **-175** |
| **>30 to ≤35’** | **-104** | **-152** | **-180** |
| **>35 to ≤40’** | **-106** | **-155** | **-184** |
| **>40’ to ≤45’** | **-109** | **-157** | **-189** |
| **>45’ to ≤50’** | **-111** | **-161** | **-192** |
| **>50’ to ≤55’** | **-113** | **-164** | **-195** |

|  |  |  |  |
| --- | --- | --- | --- |
| **>55’ to ≤60’** | **-114** | **-167** | **-198** |

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| --- | --- | --- | --- |
| **TABLE 5 — Gable Roofs**  **MINIMUM ASD DESIGN WIND UPLIFT PRESSURES IN PSF FOR ROOF SLOPE ˃4:12 to ≤6:12**  **RISK CATEGORY II EXPOSURE CATEGORY“D”**  **~~(Overhang)~~** | | | |
| **Roof Mean Height** | **Roof Pressure Zones** | | |
| **1 and 2e** | **2n, 2r and 3e** | **3r** |
| **≤15’** | **-69** | **-110** | **-156** |
| **>15 to ≤20’** | **-73** | **-116** | **-163** |
| **>20’ to ≤25’** | **-75** | **-120** | **-169** |
| **>25’ to ≤30’** | **-78** | **-124** | **-175** |
| **>30 to ≤35’** | **-80** | **-128** | **-180** |
| **>35 to ≤40’** | **-82** | **-131** | **-184** |
| **>40’ to ≤45’** | **-84** | **-134** | **-189** |
| **>45’ to ≤50’** | **-85** | **-136** | **-192** |

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| --- | --- | --- | --- |
| **>50’ to ≤55’** | **-87** | **-138** | **-195** |
| **>55’ to ≤60’** | **-88** | **-140** | **-198** |

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| --- | --- | --- | --- |
| **TABLE 6 — Gable Roofs**  **MINIMUM ASD DESIGN WIND UPLIFT PRESSURES IN PSF FOR ROOF SLOPE ˃6:12 to ≤12:12**  **RISK CATEGORY II EXPOSURE CATEGORY“D”**  **~~(Overhang)~~** | | | |
| **Roof Mean Height** | **Roof Pressure Zones** | | |
| **1, 2e and 2r** | **2n and 3r** | **3e** |
| **≤15’** | **-82** | **-90** | **-140** |
| **>15 to ≤20’** | **-86** | **-94** | **-146** |
| **>20’ to ≤25’** | **-87** | **-98** | **-151** |
| **>25’ to ≤30’** | **-92** | **-101** | **-157** |
| **>30 to ≤35’** | **-94** | **-103** | **-161** |
| **>35 to ≤40’** | **-97** | **-106** | **-165** |
| **>40’ to ≤45’** | **-99** | **-109** | **-168** |
| **>45’ to ≤50’** | **-101** | **-111** | **-172** |
| **>50’ to ≤55’** | **-102** | **-112** | **-174** |

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| --- | --- | --- | --- |
| **>55’ to ≤60’** | **-104** | **-114** | **-177** |

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| --- | --- | --- | --- |
| **TABLE 7 — Hip Roofs**  **MINIMUM ASD DESIGN WIND UPLIFT PRESSURES IN PSF FOR ROOF SLOPE ≥2:12 to ≤4:12**  **RISK CATEGORY II EXPOSURE CATEGORY “C”**  **~~(Overhang)~~** | | | |
| **Roof Mean Height** | **Roof Pressure Zones** | | |
| **1** | **2r** | **2e and 3** |
| **≤15’** | **‐67** | **‐88** | **‐94** |
| **>15 to ≤20’** | **‐71** | **‐93** | **‐100** |
| **>20’ to ≤25’** | **‐75** | **‐97** | **‐104** |
| **>25’ to ≤30’** | **‐78** | **‐101** | **‐109** |
| **>30 to ≤35’** | **‐80** | **‐105** | **‐113** |
| **>35 to ≤40’** | **‐82** | **‐107** | **‐115** |
| **>40’ to ≤45’** | **‐85** | **‐110** | **‐119** |
| **>45’ to ≤50’** | **‐86** | **‐112** | **‐121** |

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| --- | --- | --- | --- |
| **>50’ to ≤55’** | **‐88** | **‐115** | **‐124** |
| **>55’ to ≤60’** | **‐89** | **‐117** | **‐125** |

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| **TABLE 8 — Hip Roofs**  **MINIMUM ASD DESIGN WIND UPLIFT PRESSURES IN PSF FOR ROOF SLOPE ˃4:12 to ≤6:12**  **RISK CATEGORY II EXPOSURE CATEGORY “C”**  **~~(Overhang)~~** | | | |
| **Roof Mean Height** | **Roof Pressure Zones** | | |
| **1** | **2r and 2e** | **3** |
| **≤15’** | **‐71** | **‐91** | **‐111** |
| **>15 to ≤20’** | **‐75** | **‐97** | **‐118** |
| **>20’ to ≤25’** | **‐79** | **‐101** | **‐124** |
| **>25’ to ≤30’** | **‐82** | **‐105** | **‐129** |
| **>30 to ≤35’** | **‐84** | **‐109** | **‐133** |
| **>35 to ≤40’** | **‐87** | **‐112** | **‐137** |
| **>40’ to ≤45’** | **‐89** | **‐114** | **‐140** |
| **>45’ to ≤50’** | **‐91** | **‐117** | **‐143** |
| **>50’ to ≤55’** | **‐93** | **‐120** | **‐146** |

|  |  |  |  |
| --- | --- | --- | --- |
| **>55’ to ≤60’** | **‐94** | **‐122** | **‐149** |

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| --- | --- | --- | --- | --- |
| **TABLE 9 — Hip Roofs**  **MINIMUM ASD DESIGN WIND UPLIFT PRESSURES IN PSF FOR ROOF SLOPE ˃6:12 to ≤12:12**  **RISK CATEGORY II EXPOSURE CATEGORY “C”**  **~~(Overhang)~~** | | | | |
| **Roof Mean Height** | **Roof Pressure Zones** | | | |
| **1** | **2r** | **2e** | **3** |
| **≤15’** | **‐57** | **‐98** | **‐101** | **‐128** |
| **>15 to ≤20’** | **‐60** | **‐104** | **‐108** | **‐136** |
| **>20’ to ≤25’** | **‐63** | **‐109** | **‐113** | **‐143** |
| **>25’ to ≤30’** | **‐66** | **‐113** | **‐117** | **‐149** |
| **>30 to ≤35’** | **‐67** | **‐117** | **‐121** | **‐153** |
| **>35 to ≤40’** | **‐70** | **‐120** | **‐124** | **‐158** |
| **>40’ to ≤45’** | **‐71** | **‐123** | **‐128** | **‐162** |
| **>45’ to ≤50’** | **‐73** | **‐126** | **‐130** | **‐165** |

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| --- | --- | --- | --- | --- |
| **>50’ to ≤55’** | **‐75** | **‐129** | **‐133** | **‐169** |
| **>55’ to ≤60’** | **‐76** | **‐131** | **‐135** | **‐172** |

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| **TABLE 10 — Hip Roofs**  **MINIMUM ASD DESIGN WIND UPLIFT PRESSURES IN PSF FOR ROOF SLOPE ≥2:12 to ≤4:12**  **RISK CATEGORY II EXPOSURE CATEGORY“D”1, 2**  **~~(Overhang)~~** | | | |
| **Roof Mean Height** | **Roof Pressure Zones** | | |
| **1** | **2r** | **2e and 3** |
| **≤15’** | **‐82** | **‐106** | **‐114** |
| **>15 to ≤20’** | **‐86** | **‐111** | **‐120** |
| **>20’ to ≤25’** | **‐89** | **‐116** | **‐124** |
| **>25’ to ≤30’** | **‐91** | **‐120** | **‐129** |
| **>30 to ≤35’** | **‐94** | **‐123** | **‐132** |
| **>35 to ≤40’** | **‐97** | **‐126** | **‐136** |
| **>40’ to ≤45’** | **‐99** | **‐128** | **‐138** |
| **>45’ to ≤50’** | **‐101** | **‐131** | **‐141** |
| **>50’ to ≤55’** | **‐102** | **‐133** | **‐143** |

|  |  |  |  |
| --- | --- | --- | --- |
| **>55’ to ≤60’** | **‐104** | **‐135** | **‐146** |

|  |  |  |
| --- | --- | --- |
| **TABLE 11 — Hip Roofs**  **MINIMUM ASD DESIGN WIND UPLIFT PRESSURES IN PSF FOR ROOF SLOPE >4:12 to ≤6:12**  **RISK CATEGORY II EXPOSURE CATEGORY“D”1, 2**  **~~(Overhang)~~** | | |
| **Roof Mean Height** | **Roof Pressure Zones** | |
| **1** | **2e, 2r and 3** |
| **≤15’** | **‐65** | **‐90** |
| **>15 to ≤20’** | **‐68** | **‐94** |
| **>20’ to ≤25’** | **‐71** | **‐98** |
| **>25’ to ≤30’** | **‐73** | **‐101** |
| **>30 to ≤35’** | **‐75** | **‐104** |
| **>35 to ≤40’** | **‐77** | **‐106** |
| **>40’ to ≤45’** | **‐79** | **‐109** |

|  |  |  |
| --- | --- | --- |
| **>45’ to ≤50’** | **‐80** | **‐111** |
| **>50’ to ≤55’** | **‐82** | **‐112** |
| **>55’ to ≤60’** | **‐83** | **‐114** |

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| --- | --- | --- | --- | --- |
| **TABLE 12 — Hip Roofs**  **MINIMUM ASD DESIGN WIND UPLIFT PRESSURES IN PSF FOR ROOF SLOPE >6:12 to ≤12:12**  **RISK CATEGORY II EXPOSURE CATEGORY“D”1, 2**  **~~(Overhang)~~** | | | | |
| **Roof Mean Height** | **Roof Pressure Zones** | | | |
| **1** | **2e** | **2r** | **3** |
| **≤15’** | **‐69** | **‐119** | **‐123** | **‐156** |
| **>15 to ≤20’** | **‐73** | **‐124** | **‐129** | **‐163** |
| **>20’ to ≤25’** | **‐75** | **‐129** | **‐133** | **‐169** |
| **>25’ to ≤30’** | **‐78** | **‐134** | **‐138** | **‐175** |
| **>30 to ≤35’** | **‐80** | **‐137** | **‐142** | **‐180** |
| **>35 to ≤40’** | **‐82** | **‐141** | **‐145** | **‐184** |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **>40’ to ≤45’** | **‐84** | **‐143** | **‐148** | **‐188** |
| **>45’ to ≤50’** | **‐85** | **‐146** | **‐151** | **‐192** |
| **>50’ to ≤55’** | **‐87** | **‐149** | **‐154** | **‐195** |
| **>55’ to ≤60’** | **‐88** | **‐151** | **‐156** | **‐198** |

|  |  |  |
| --- | --- | --- |
| **TABLE 13**  **WHERE TO OBTAIN INFORMATION** | | |
| **Description** | **Symbol** | **Where to find** |
| Roof Zone Design Pressure | Pasd~~(1) or Pasd(2)~~ ~~or Pasd(3)~~ | Tables 1-3, ~~or~~ Tables ~~2~~ 4-6, Tables 7-9 or Tables10-12, as applicable, or by an engineer analysis prepared, signed and sealed by a professional engineer based on ASCE 7 |
| Mean Roof Height | H | Job Site |
| Roof Slope | ? | Job Site |
| Aerodynamic Multiplier | ? | Product Approval |
| Restoring Moment due to Gravity | Mg | Product Approval |
| Attachment Resistance | Mf | Product Approval |
| Required Moment Resistance | Mr | Calculated |
| Minimum Characteristic Resistance Load | F' | Product Approval |
| Required Uplift Resistance | Fr | Calculated |
| Average Tile Weight | W | Product Approval |
| Tile Dimensions | l = length w = width | Product Approval |

~~All calculations must be submitted to the building official at the time of permitting.~~

(S- TP- Comment #1)

**RAS 128-20**

# ROOFING APPLICATION STANDARD (RAS) No. 128-20 STANDARD PROCEDURE FOR DETERMINING APPLICABLE WIND ALLOWABLE STRESS DESIGN PRESSURES FOR LOW SLOPE ROOF IN ACCORDANCE WITH ASCE 7

**1. Scope**

1.1 This roofing application standard has been developed to provide a responsive method of complying with the requirements of Chapters 15 & 16 (High-Velocity Hurricane Zones) of the *Florida Building Code, Building*. Compliance with the requirements and procedures herein specified, where the pressures (Pasd) have been determined based on Table 1 or 2, of this standard, as applicable, do not require additional signed and sealed engineering design calculations. All other calculations must be prepared, signed and sealed by a professional engineer or registered architect.

# 2. Definitions

*2.1* For definitions of terms used in this application standard, refer to ASTM D1079 and the *Florida Building Code, Building.*

# 3. Applicability

3.1 This application standard applies to buildings meeting all of the following:

a. located in ~~e~~Exposure Category C ~~and~~ or D ~~category buildings, with and without overhangs~~; and

b. ~~building~~ eave heights of less than or equal to ~~40~~ 60 feet; and

c. roof incline (~~pitch~~ slope) ~~is not greater than~~ ≤1.5~~1/2~~ in.:12 in., and

d. risk category II ~~buildings~~ only.

3.2 Using Table 1 or 2 below, as applicable, determine the minimum design pressure for each respective roof area, which corresponds to the applicable roof height range.

3.3 Referencing the selected Roof Assembly Product Approval, check that the listed maximum allowable components and cladding design pressure for the ~~particular~~ approved system meets or exceeds those listed in Table 1 or 2 ~~above~~ below, as applicable.

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|  |  |  |  |
| --- | --- | --- | --- |
| **~~EXPOSURE “C” BUILDINGS~~** | | | |
| ~~Roof mean~~ ~~height (below)~~ | ~~Pasd(1) (Field)~~ | ~~Pasd(2)~~ ~~(Perimeter)~~ | ~~Pasd(3) (Corners)~~ |
| ~~20~~ | ~~-42.8~~ | ~~-71.7~~ | ~~-108.0~~ |
| ~~25~~ | ~~-44.8~~ | ~~-75.1~~ | ~~-113.0~~ |
| ~~30~~ | ~~-46.4~~ | ~~-77.8~~ | ~~-117.2~~ |
| ~~35~~ | ~~-48.1~~ | ~~-80.6~~ | ~~-121.3~~ |
| ~~40~~ | ~~-49.4~~ | ~~-82.9~~ | ~~-124.7~~ |

~~1 Calculated in accordance with ASCE 7. 2 Pasd = 0.6Pult~~

|  |  |  |  |
| --- | --- | --- | --- |
| **~~TABLE 2 — RISK CATEGORY II EXPOSURE CATEGORY “D”~~1, 2**  **~~MINIMUM DESIGN WIND UPLIFT PRESSURES, IN PSF FOR FIELD [Pasd(1)],~~ ~~PERIMETER [Pasd(2)]~~**  **~~AND CORNER [Pasd(3)] AREAS OF ROOFS FOR EXPOSURE “D”~~ ~~BUILDINGS~~** | | | |
| ~~Roof mean~~ ~~height (below)~~ | ~~Pasd(1) (Field)~~ | ~~Pasd(2)~~ ~~(Perimeter)~~ | ~~Pasd(3) (Corners)~~ |
| ~~20~~ | ~~-51.4~~ | ~~-86.2~~ | ~~-129.7~~ |
| ~~25~~ | ~~-53.4~~ | ~~-89.5~~ | ~~-134.7~~ |
| ~~30~~ | ~~- -55.0~~ | ~~-92.3~~ | ~~-138.9~~ |
| ~~35~~ | ~~-56.4~~ | ~~-94.5~~ | ~~-142.3~~ |
| ~~40~~ | ~~-57.7~~ | ~~-96.8~~ | ~~-145.6~~ |

~~1 Calculated in accordance with ASCE 7. 2 Pasd = 0.6Pult~~

**~~TABLE 1 —MINIMUM ASD DESIGN WIND UPLIFT PRESSURES, IN PSF FOR~~ ~~ROOF SLOPE - =1½ :12~~**

**~~RISK CATEGORY II EXPOSURE CATEGORY “C”~~**

**~~(Overhang)~~**

**~~Roof Pressure Zones~~**

**~~Eave Height~~**

**~~1’ and 1~~**

**2**

**3**

**~~=15’~~**

**~~-64~~**

**~~-84~~**

**~~-115~~**

**~~>15 to =20’~~**

**~~-68~~**

**~~-89~~**

**~~-122~~**

**~~>20’ to =25’~~**

**~~-71~~**

**~~-94~~**

**~~-128~~**

**~~>25’ to =30’~~**

**~~-74~~**

**~~-97~~**

**~~-133~~**

**~~>30’ to =35’~~**

**~~-76~~**

**~~-101~~**

**~~-137~~**

**~~>35’ to =40’~~**

**~~-78~~**

**~~-104~~**

**~~-141~~**

**~~>40’ to =45’~~**

**~~-80~~**

**~~-106~~**

**~~-145~~**

**~~>45’ to =50’~~**

**~~-82~~**

**~~-109~~**

**~~-148~~**

**~~>50’ to =55’~~**

**~~-84~~**

**~~-111~~**

**~~-151~~**

**~~>55’ to =60’~~**

**~~-85~~**

**~~-113~~**

**~~-154~~**

**~~TABLE 2 - MINIMUM ASD DESIGN WIND UPLIFT PRESSURES, IN PSF FOR~~ ~~ROOF SLOPE - =1½ :12~~**

**~~RISK CATEGORY II EXPOSURE CATEGORY“D”~~**

**~~(Overhang)~~**

**~~Roof Pressure Zones~~**

**~~Eave Height~~**

**~~1’ and 1~~**

**2**

**3**

**~~=15’~~**

**~~-77~~**

**~~-102~~**

**~~-139~~**

**~~>15 to =20’~~**

**~~-81~~**

**~~-107~~**

**~~-146~~**

**~~>20’ to =25’~~**

**~~-85~~**

**~~-112~~**

**~~-152~~**

**~~>25’ to =30’~~**

**~~-87~~**

**~~-115~~**

**~~-157~~**

**~~>30 to =35’~~**

**~~-90~~**

**~~-118~~**

**~~-161~~**

**~~>35 to =40’~~**

**~~-92~~**

**~~-121~~**

**~~-165~~**

**~~>40’ to =45’~~**

**~~-94~~**

**~~-124~~**

**~~-169~~**

**~~>45’ to =50’~~**

**~~-96~~**

**~~-126~~**

**~~-172~~**

**~~>50’ to =55’~~**

**~~-97~~**

**~~-128~~**

**~~-175~~**

**~~>55’ to =60’~~**

**~~-99~~**

**~~-130~~**

**~~-177~~**

**TABLE ~~3~~1 -- MINIMUM ASD DESIGN WIND UPLIFT PRESSURES, IN PSF FOR ROOF SLOPE ≤1½ :12**

**RISK CATEGORY II EXPOSURE CATEGORY “C”**

**~~(Roof)~~**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Eave Height** | **Roof Pressure Zones** | | | |
| **1’** | **1** | **2** | **3** |
| **≤15’** | **-37** | **-64** | **-84** | **-115** |
| **>15 to ≤20’** | **-39** | **-68** | **-89** | **-122** |
| **>20’ to ≤25’** | **-41** | **-71** | **-94** | **-128** |
| **>25’ to ≤30’** | **-42** | **-74** | **-97** | **-133** |
| **>30 to ≤35’** | **-44** | **-76** | **-101** | **-137** |
| **>35 to ≤40’** | **-45** | **-78** | **-103** | **-141** |
| **>40’ to ≤45’** | **-46** | **-80** | **-106** | **-145** |
| **>45’ to ≤50’** | **-47** | **-82** | **-109** | **-148** |
| **>50’ to ≤55’** | **-48** | **-84** | **-111** | **-151** |
| **>55’ to ≤60’** | **-49** | **-85** | **-113** | **-154** |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **TABLE ~~4~~2 -- MINIMUM ASD DESIGN WIND UPLIFT PRESSURES, IN PSF FOR ROOF SLOPE ≤1½ :12**  **RISK CATEGORY II EXPOSURE CATEGORY “D”**  **~~(Roof~~)** | | | | |
| **Eave Height** | **Roof Pressure Zones** | | | |
| **1’** | **1** | **2** | **3** |
| **≤15’** | **-45** | **-77** | **-102** | **-139** |
| **>15 to ≤20’** | **-47** | **-81** | **-107** | **-146** |
| **>20’ to ≤25’** | **-49** | **-85** | **-112** | **-152** |
| **>25’ to ≤30’** | **-50** | **-87** | **-115** | **-157** |
| **>30 to ≤35’** | **-52** | **-90** | **-118** | **-161** |
| **>35 to ≤40’** | **-53** | **-92** | **-121** | **-165** |
| **>40’ to ≤45’** | **-54** | **-94** | **-124** | **-169** |
| **>45’ to ≤50’** | **-55** | **-96** | **-126** | **-172** |
| **>50’ to ≤55’** | **-56** | **-97** | **-128** | **-175** |
| **>55’ to ≤60’** | **-57** | **-99** | **-130** | **-177** |

(S – TP - Comment #2)