**Supplement to the 6th Edition (2017) Florida Building Code, Test Protocol**

**Note 1**: Throughout the document, change International Building Code to Florida Building Code, Building; change the International Energy Conservation Code tothe Florida Building Code, Energy Conservation; change the International Existing Building Code to Florida Building Code, Existing Building; change the International Fire code to Florida Fire Prevention Code; change International Fuel Gas Code to Florida Building Code, Fuel Gas; change the International Mechanical Code to Florida Building Code, Mechanical; change the International Plumbing Code to Florida Building Code, Plumbing; change the International Residential Code to Florida Building Code, Residential.

RAS-111

**ROOFING APPLICATION STANDARD (RAS) No. 111-20**

**STANDARD REQUIREMENTS FOR ATTACHMENT OF PERIMETER WOODBLOCKING AND METAL FLASHING**

Revise the following sections as follows:

3.3 Woodblocking Fastener Spacing

3.3.1 The attachment criteria for woodblocking shall be 250 plf for Zone 2 ~~perimeter~~ areas and 300 plf for Zone 3 ~~corner~~ areas.

 3.4.5 All woodblocking, shall be only ~~salt pressure~~ preservative treated in accordance with the American Wood Preservers Association, AWPA U-1, Use Category 2 or higher ~~C-2orC-9~~,or any decay resistant species.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **TABLE 2**  **HOOK STRIP/CONTINUOUS CLEAT THICKNESS REQUIREMENTS FOR EDGE METAL AND COPINGS FACE DIMENSIONS** | | | | | | |
| **GALVANIZED METAL OR STAINLESS STEEL** | | | | | | |
| Min. Component Gage | | 26 ga | 24 ga | 22 ga | 20 ga | 18 ga |
| Max. Vertical (Face) Flange | | 4 in. | 6 in. | 8 in. | 10 in. | 12 in. |
| Min. Hook Strip/Cleat Gage1 | | 24 ga | 22 ga | 20 ga | 18 ga | 16 ga |
| **ALUMINUM** | | | | | | |
| Min. Component Gage | 0.032 in. | 0.032 in. | 0.040 in. | 0.050 in. | 0.060 in. | 0.070 in. |
| Max. Vertical (Face) Flange | < 3 in. | 3 in. | 4 in. | 6 in. | 8 in. | 10 in. |
| Min. Hook Strip/Cleat Gage | Not Required | 0.040 in. | 0.050 in. | 0.060 in. | 0.070 in. | 0.080 in. |
| **COPPER** | | | | | | |
| Min. Component Gage | |  | 16 oz | 20 oz. | 24 oz. | 32 oz |
| Max. Vertical (Face) Flange | |  | 3.5 in. | 6 in. | 8 in. | 10 in. |
| Min. Hook Strip/Cleat Weight1 | |  | 20 oz. | 24 oz. | 32 oz | 48 oz |

For SI: 1 inch = 25.4 mm.

1When utilizing the maximum vertical (face) flange a hook strip/cleat is required. The h~~H~~ook strip/cleat shall be one thickness greater than that of the metal profile material, as commercially available.

**5.2.3 When a continuous cleat (hook strip) is required and the vertical flange exceeds 7 in. the “butt-joint” method shall be utilized and a cover plate shall be installed.**

NOTE: All metal surfaces receiving hot bitumen or approved flashing cement shall be fully primed with ASTM D41 or ASTM D43, as required, primer. Primer which is in a quick dry formulation is acceptable. All fasteners shall be covered with either:

(R7191)

RAS-115

**ROOFING APPLICATION STANDARD (RAS) No. 115**

**STANDARD PROCEDURES FOR ASPHALT SHINGLE INSTALLATION**

Revise the following sections as follows:

4.2 All underlayments shall be fastened with approved minimum 12 gage by 11/4 in. corrosion-resistant annular ring shank roofing nails fastened through minimum 32 gage by 1 5/8 in. diameter approved tin caps. ~~Maximum fastener spacing shall be 6 in. o.c. at the laps with two additional rows in the field at a maximum spacing of 12 in. o.c.~~Underlayment shall be attached to a nailable deck in a grid pattern of 12 inches (305 mm) between the overlaps, with 6-inch (152 mm) spacing at the overlaps. Nails shall be of sufficient length to penetrate through the sheathing or wood plank a minimum of 3/16 in. or penetrate 1 inch (25 mm) or greater thickness of lumber a minimum of 1 in., except where architectural appearance is to be preserved, in which case a minimum of 3/4 in. nail may be used.

(R7349)

5.3 Eave and gable drip metal shall be joined by a minimum 4 inch lap~~ped~~ ~~of a minimum of 4 in. and the entire interior of the joints shall be coated with approved flashing cement~~. Eave and gable drip metal shall be installed over the underlayment and be fastened with minimum 12 gauge annular ring shank nails at a maximum spacing of 4 in. o.c. The nails shall be manufactured from similar and compatible material to the termination profile. All composite materials shall be fastened with nonferrous nails. All metal profiles shall be installed in compliance with RAS 111.

(R7221 A2 Only)

RAS-117

**ROOFING APPLICATION STANDARD (RAS) No.117-20  
STANDARD REQUIREMENTS FOR BONDING OR MECHANICAL ATTACHMENT OF  
INSULATION PANELS AND MECHANICAL ATTACHMENT OF ANCHOR AND/OR  
BASE SHEETS TO SUBSTRATES**

Revise the following sections as follows:

**1. Scope**

1.1 The standards set forth herein provide a means of determining proper attachment of anchor and/or base sheets and insulation panels.

1.2 All testing shall be conducted by an approved testing agency. 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, procedures and examples specified herein, when using the Tables contained in RAS 128, do not require additional signed and sealed engineering design calculations. All other calculations must be prepared, signed and sealed by a ~~A~~ Professional Engineer, or Registered Architect~~, shall sign and seal all calculations~~.

 (S7167)

Section 3.10

Tapered insulation may be substituted for any flat stock type listed in the Roof System Assembly Product Approval. The fastening requirements shall remain the same and have a minimum thickness as specified in the Roof System Assembly Product Approval. ~~Polyisocyanurate tapered insulation systems shall have a minimum aver- age thickness per panel of 1 in.~~

(R7297/S8298)

**8. Perimeter, and Corner Roof Areas**

8.1 The roofing assembly Product Approval shall list the maximum design pressure for the accepted assembly. Such pressure shall be applicable to Zone 1’ or Zone 1, as applicable and ~~the field of the roof area (1)~~ as defined in ASCE 7. Should the roof assembly Product Approval allow extrapolation to Zone 1, Zone 2 or Zone 3 , as applicable and ~~perimeter and corners areas (2 and 3)~~ as defined in ASCE 7, the following shall apply.

 The maximum extrapolation shall not be greater than ~~280~~ 300 percent except as noted in Section 9.2.

 The minimum fastener separation shall not be less than 4 in. o.c.

 If Zone 1, Zone 2 or Zone 3, as applicable shall ~~the perimeter and/or corner areas of the roof~~ have calculated design pressures which are less than or equal to the maximum design pressures noted in the roof assembly Product Approval, then specified anchor/base sheet or insulation attachment shall also apply in these areas.

 If the minimum design pressure exceeds the roof assembly maximum design pressure such roofing system may be granted a one-time approval by the authority having jurisdiction, provided the applicant demonstrates, by testing and/or rational analysis that such roofing system complies with the provision of the Florida Building Code.

**9. Insulation Attachment — New Construction/Reroof Application**

9.1 Example of Data Extrapolation:

9.1.1 Given:

~~A building having a roof mean height less than 60 feet where the design pressures are as follows:~~

***Zone 1’:*** *-37.0 psf*

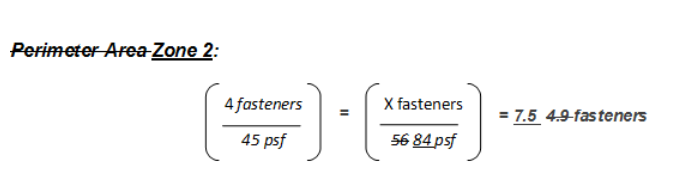
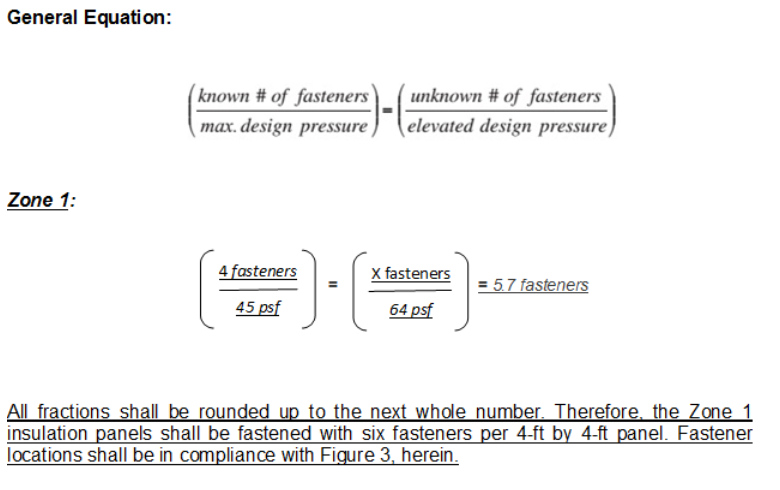
***Zone 1 ~~Field Area~~:*** *~~- 43.0~~ -64.0 psf*

***Zone 2 ~~Perimeter Area~~****: ~~- 56.~~0 -84.0 psf*

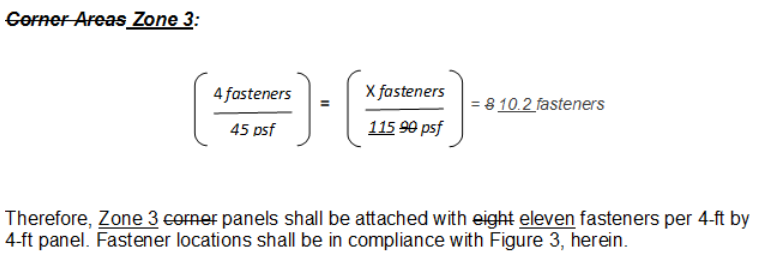
***Zone 3 ~~Corner Areas~~****: ~~- 90.0~~ ~~-~~115.0 psf*

Consider a Roof Assembly Product Approval, which includes a system having an accepted maximum design pressure of -45 pound per square foot (2155 Pa). The Product Approval specifies 4-ft by 4-ft insulation panels attached with four fasteners per panel.

9.1.2 Determine the required number of fasteners per insulation panel to meet the design pressures in the elevated pressure zones.



All fractions shall be rounded up to the next whole number. Therefore, the Zone 2 ~~perimeter~~ insulation panels shall be fastened with eight ~~five~~ fasteners per 4-ft by 4-ft panel. Fastener locations shall be in compliance with Figure 3, herein.



9.2 If the data extrapolation results in a number of fasteners for an elevated pressure zone which exceeds ~~280~~ 300 percent of that for the field area, additional testing, as determined by the building official, may be required to confirm the performance of the Roof System Assembly.

9.3 If an insulation panel overlaps into an elevated pressure zone ~~(i.e. field area insulation panel overlapping into the perimeter or corner area of the roof, or a perimeter area insulation panel overlapping into the corner area of the roof)~~, the more stringent fastener density shall apply to the entire overlapping panel.

9.4 For multilayer insulation systems, the fastener density specified for the top panel shall be used. If the top layer is bonded in hot asphalt, the fastener density of the base insulation layer shall be used.

9.5 Alternatively, the base sheet of an approved roof assembly may be mechanically attached with insulation fasteners and plates through the insulation panels to the structural deck to increase the uplift performance of the roof assembly. Base sheet fastener spacing shall be as listed in roof assembly Product Approval, or may be determined in compliance with Section 10, herein.

~~9.6 For buildings of mean roof height greater than 60 feet the example above shall also apply.~~

10.4 **Example of Data Extrapolation:**

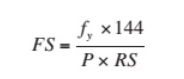
10.4.1 Given: A building having a concrete deck and a roof mean height less than 60 feet where the design pressures are as follows:

|  |  |
| --- | --- |
| ***Zone 1’:*** | -37.0 *psf* |
| ***~~Field Area~~ Zone 1:*** | - *64.0 psf ~~-43.0 psf~~* |
| ***~~Perimeter Area~~ Zone2:*** | - *84.0 psf ~~-56.0 psf~~* |
| ***~~Corner Area~~ Zone 3****:* | - *115.0 psf ~~-90.0 psf~~* |

Consider a roof assembly Product Approval, which includes a system having a maximum design pressure of -45 psf (2155 Pa). The Product Approval specifies an anchor/base sheet, having a width of 36 in. attached with approved fasteners and bearing plates at a spacing of 12 in. o.c. at a 4 in. side lap and two rows staggered in the center of the sheet, 24 in. o.c.

10.4.4 Determine anchor/base sheet fastener spacing (FS) to meet the design pressures in the elevated pressure zones of the roof.

10.4.5 **General Equation:**



**FS = fastener spacing (in.);**

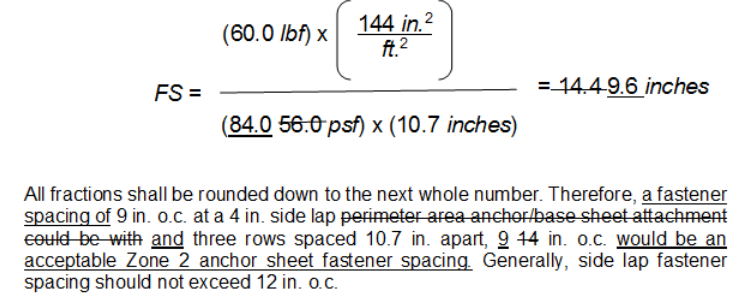
**fy = fastener value (lbf):**

**P = design pressure (psf): and**

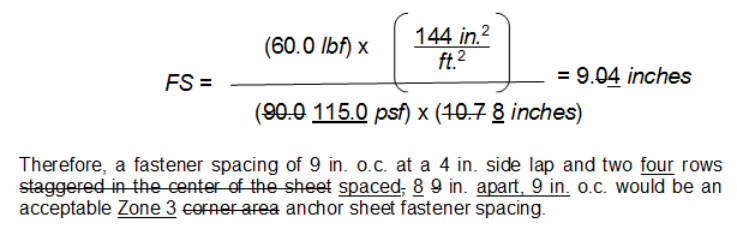
**RS = row spacing (in.).**

|  |  |
| --- | --- |
| |  | | --- | | Note: As noted in the above equation, the row spacing is not needed to determine the fastener spacing. The row spacing is merely the net width of the sheet divided by the number of rows. For this case, the net width is 32 in. and there are three fastener rows (i.e. one side lap row and two center rows). This leads to a row spacing of 10.7 in. For Zone 3 a row spacing of 8 in. is necessary. | |

**~~1Perimeter Area~~ Zone 2:**



***~~Corner Areas~~*Zone 3:**



11.2 Example of Data Extrapolation:

11.2.1 Given: ~~A building having a roof mean height less than 60 feet where the design pressures are as follows:~~

|  |  |
| --- | --- |
| ***Zone 1’ ~~Field Area~~:*** | ~~-~~ *~~43.0~~ -37.0 psf* |
| ***Zone 1:*** | -64.0 psf |
| ***Zone 2 ~~Perimeter Area~~:*** | ~~-~~ *~~56.~~0 -84.0 psf* |
| ***Zone 3 ~~Corner Areas~~****:* | *~~90.0~~ -115.0 psf* |

Consider an architectural appearance application in which an ASTM D226, Type II base sheet, having a width of 36 in., is to be mechanically attached with a 3-in. side lap, to nominal 1-in. wood plank (13/16-in. tongue and groove) using #8 wood screws and 15/8-inch diameter tin caps. One ply of approved mineral surfaced roll roofing is to be applied over the mechanically attached base sheet in a full mopping of hot asphalt.

11.2.3 Determine a base sheet fastener spacing (FS) to meet the design pressures in each pressure zone of the roof.

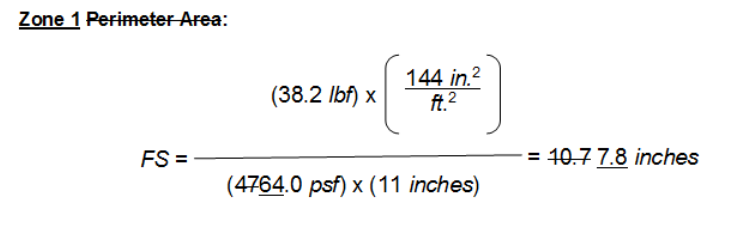
**General Equation:**



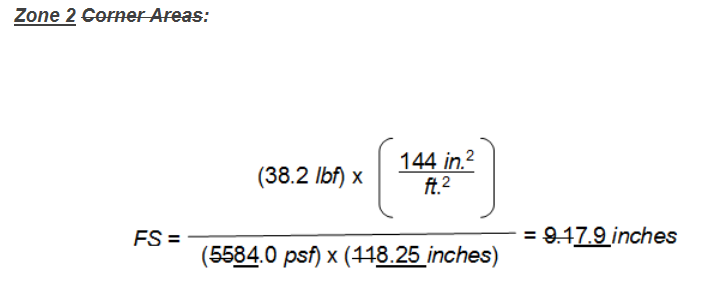
|  |  |
| --- | --- |
| Note: | The side lap, for this case is specified at 3 in. Therefore, the row spacing (RS) in the above noted equation shall be 11 inch for Zone 1’ and Zone 1 [i.e., sheet width (36 inch) minus side lap width (3 inch) divided by the number of fastener rows (3)]. The row spacing (RS) for Zone 2 and Zone 3 shall be 8.25 inches [i.e., sheet width (36 inch) minus side lap width (3 inch) divided by the number of fastener rows (4)]. |



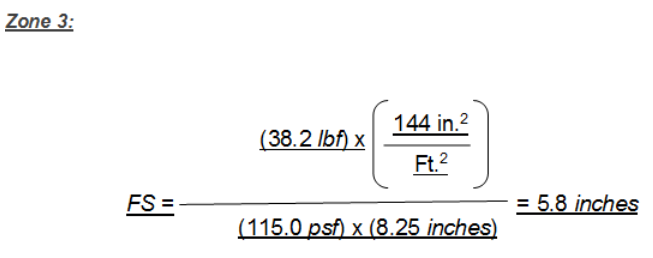
All fractions shall be rounded down to the next whole number. Therefore, a fastener spacing of ~~12~~ 13 in. o.c. at a 3-in. side lap and two rows staggered in the center of the sheet, ~~12~~ 13 in. o.c. would be an acceptable Zone 1’ ~~field area~~ base sheet fastener spacing.



All fractions shall be rounded down to the next whole number. Therefore, a fastener spacing of ~~10~~ 7 in. o.c. at a 3-in. side lap and two rows staggered in the center of the sheet, ~~10~~ 7 in. o.c. would be an acceptable Zone 1 ~~perimeter area~~ base sheet fastener spacing.



**For Zone 2, an additional fourth row has been added. All fractions shall be rounded down to the next whole number. Therefore, a fastener spacing of ~~9~~ 7 in. o.c. at a 3-in. side lap and ~~two~~ three rows staggered in the center of the sheet, ~~9~~ 7 in. o.c. would be an acceptable Zone 2 ~~perimeter area~~ base sheet fastener spacing.**



For Zone 3, an additional fourth row has been added. All fractions shall be rounded down to the next whole number. Therefore, a fastener spacing of 5 in. o.c. at a 3-in. side lap and three rows staggered in the center of the sheet, 5 in. o.c. would be an acceptable Zone 3 base sheet fastener spacing.

(S7167)

RAS-118

**ROOFING APPLICATION STANDARD (RAS) No. 118-20 INSTALLATION OF MECHANICALLY FASTENED ROOF TILE SYSTEMS Direct Deck & Counter Battens Only**

Revise the following sections as follows:

2.01 Fasteners:

A. Tile Fasteners

1. All roof tile nails or fasteners, except those made of copper, monel, aluminum, or stainless steel, shall be tested for corrosion in compliance with TAS 114, Appendix E, Section 2 (ASTM G85), for salt spray for 1,000 hours. Tile fasteners used within 1500 feet landward of the reach of the mean high tide ~~in coastal building zones, as define in Chapter 16 (High-Velocity Hurricane Zones)~~, shall be copper, monel, aluminum or stainless steel.

2.07 Sheathing material shall conform to APA-rated sheathing, in compliance with Chapter 23 (High-Velocity Hurricane Zones) of the Florida Building Code, Building.

A.        Battens – material to be decay resistant species or ~~pressure~~ preservative treated in compliance with American Wood Preservers Association, AWPA U-1, Use Category 2 or higher, or any decay resistant species ~~C2~~.

1. Battens shall not be bowed or twisted.

2. Vertical battens shall be a minimum of nominal 1 in. by 4 in., horizontal battens shall be a minimum of nominal 1 in. by 2 in.

(R7198)

3.06 Pipes, Stacks, Vents, etc., (see Drawings 8 & 9).

A. Apply approved plastic roof cement around base of protrusion and on the bottom side of metal flanges sealing unit base flashing to the underlayment.

B. Nail all sides within 1 in. of outside edge of base flashing 6 in. on center. Make certain base is flush to deck.

C. Pipes, vents, stacks shall terminate a minimum 2 in. above upper most adjacent finished tile surface.

(R7351)

RAS-119

**ROOFING APPLICATION STANDARD (RAS) No. 119-20 INSTALLATION OF MECHANICALLY FASTENED ROOF TILE SYSTEMS**

**Direct Deck& Horizontal Battens Only**

**(Preformed Metals With Edge Returns)**

Revise the following sections as follows:

2.01 Fasteners:

A. Tile Fasteners

1. All roof tile nails or fasteners, except those made of copper, monel, aluminum, or stainless steel, shall be tested for corrosion in compliance with TAS 114, Appendix E, Section 2 (ASTM G85), for salt spray for 1,000 hours. Tile fasteners used within 1500 feet landward of the reach of the mean high tide ~~in coastal building zones, as define in Chapter 16 (High-Velocity Hurricane Zones)~~, shall be copper, monel, aluminum or stainless steel.

2.07 Sheathing material shall conform to APA-rated sheathing, in compliance with Chapter 23 (High-Velocity Hurricane Zones) of the Florida Building Code, Building.

A. Battens – material to be decay resistant species or ~~pressure~~ preservative treated in compliance with American Wood Preservers Association,AWPA U-1, Use Category 2 or higher, or any decay resistant species ~~C2~~.

1. Battens shall not be bowed or twisted.

2. Vertical battens shall be a minimum of nominal 1in. by 4in.,horizontal battens shall be a minimum of nominal 1 in. by 2 in.

(R7200)

RAS-120

**ROOFING APPLICATION STANDARD (RAS) No. 120-20 MORTAR AND ADHESIVE SET TILE APPLICATION**

Revise the following sections as follows:

2.01 Fasteners:

A. Tile Fasteners

1. All roof tile nails or fasteners, except those made of copper, monel, aluminum, or stainless steel, shall be tested for corrosion in compliance with TAS 114, Appendix E, Section 2 (ASTM G85), for salt spray for 1,000 hours. Tile fasteners used within 1500 feet landward of the reach of the mean high tide ~~in coastal building zones, as define in Chapter 16 (High-Velocity Hurricane Zones)~~, shall be copper, monel, aluminum or stainless steel.

2.07 Sheathing material shall conform to APA-rated sheathing, in compliance with Chapter 23 (High-Velocity Hurricane Zones) of the Florida Building Code, Building.

A. Battens – material to be decay resistant species or ~~pressure~~ preservative treated in compliance with American Wood Preservers Association, AWPA U-1, Use Category 2 or higher, or any decay resistant species ~~C2~~.

1. Battens shall not be bowed or twisted.

2. Vertical battens shall be a minimum of nominal 1in. by4in.,horizontal battens shall be a minimum of nominal 1 in. by 2 in.

(R7201)

3.01Underlayment Applications - CHOOSE ONE of the following:

D. Product Approved Anchor/Base Sheet/Self - Adhered Underlayment System. The roof cover is terminated at approved metal flashings. Any approved anchor/base sheet as listed in the Product Approval shall be mechanically attached to the wood deck with approved fasteners spaced in a 12 in. grid staggered in two~~0ws~~ rows in the field and 6 in. on center at the laps or as specified in the underlayment manufacturers Product Approval. Anchor/base sheet end laps shall be a minimum of 6 in. and head laps shall be a minimum of 4 in. Over anchor/base sheet, apply one layer of any Product approved, self-adhered underlayment in compliance with the self-adhered underlayment manufacturers’ Approval/Requirements. Head laps shall be backnailed 12 in. on center with approved nails through tincaps or by prefabricated fasteners in accordance with Section 1517.5.1 and 1517.5.2 Florida Building Code, Building.

3.06 Pipes, Stacks, Vents, etc., (see Drawings 8 & 9).

A. Apply approved plastic roof cement around base of protrusion and on the bottom side of metal flanges sealing unit base flashing to the underlayment.

B. Nail all sides within 1 in. of outside edge of base flashing 6 in. on center. Make certain base is flush to deck.

C. Pipes, vents, stacks shall terminate a minimum 2 in. above upper most adjacent finished tile surface.

(R7592)

RAS-127

**ROOFING APPLICATION STANDARD (RAS) No. 127**

**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, Pasd(3) shall be treated as Pasd(2).~~

~~3 Pasd = 0.6Pult~~

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| **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 and 2r** | **3e** | **3r** |
| **≤15’** | **-91** | **-125** | **-145** | **-166** |
| **>15 to ≤20’** | **-97** | **-133** | **-154** | **-176** |
| **>20’ to ≤25’** | **-101** | **-139** | **-162** | **-184** |
| **>25’ to ≤30’** | **-105** | **-145** | **-168** | **-192** |
| **>30 to ≤35’** | **-109** | **-149** | **-174** | **-198** |
| **>35 to ≤40’** | **-112** | **-154** | **-179** | **-204** |
| **>40’ to ≤45’** | **-115** | **-157** | **-183** | **-209** |
| **>45’ to ≤50’** | **-117** | **-161** | **-187** | **-213** |
| **>50’ to ≤55’** | **-120** | **-164** | **-191** | **-218** |
| **>55’ to ≤60’** | **-122** | **-167** | **-194** | **-222** |

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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 Mean Height** | **Roof Pressure Zones** | | | |
| **1 and 2e** | **2n and 2r** | **3e** | **3r** |
| **≤15’** | **-74** | **-108** | **-128** | **-166** |
| **>15 to≤ 20’** | **-79** | **-115** | **-136** | **-176** |
| **>20’ to≤ 25’** | **-82** | **-120** | **-143** | **-184** |
| **>25’ to≤ 30’** | **-86** | **-125** | **-148** | **-192** |
| **>30 to ≤35’** | **-88** | **-129** | **-153** | **-198** |
| **>35 to≤ 40’** | **-91** | **-133** | **-158** | **-204** |
| **>40’ to≤ 45’** | **-93** | **-136** | **-161** | **-209** |
| **>45’ to≤ 50’** | **-95** | **-139** | **-165** | **-213** |
| **>50’ to≤ 55’** | **-97** | **-142** | **-169** | **-218** |
| **>55’ to ≤60’** | **-99** | **-145** | **-172** | **-222** |

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| **TABLE 3 — Gable Roofs**    **MINIMUM ASD DESIGN WIND UPLIFT PRESSURES IN PSF**  **FOR ROOF SLOPE - >6:12 to 1≤ 2:12**  **RISK CATEGORY II EXPOSURE CATEGORY “C”**    **(Overhang)** | | | |
| **Roof Mean Height** | **Roof Pressure Zones** | | |
| **1, 2e and 2r** | **2n and 3r** | **3e** |
| **≤15’** | **-94** | **-101** | **-142** |
| **>15 to≤ 20’** | **-100** | **-107** | **-151** |
| **>20’ to≤ 25’** | **-105** | **-113** | **-158** |
| **>25’ to≤ 30’** | **-109** | **-117** | **-164** |
| **>30 to≤ 35’** | **-113** | **-121** | **-170** |
| **>35 to ≤40’** | **-116** | **-124** | **-174** |
| **>40’ to ≤45’** | **-119** | **-127** | **-179** |
| **>45’ to≤ 50’** | **-122** | **-130** | **-183** |
| **>50’ to ≤55’** | **-124** | **-133** | **-186** |
| **>55’ to≤ 60’** | **-126** | **-135** | **-190** |

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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 and 2r** | **3e** | **3r** |
| **≤15’** | **-110** | **-152** | **-176** | **-201** |
| **>15 to ≤ 20’** | **-116** | **-159** | **-185** | **-211** |
| **>20’ to ≤ 25’** | **-121** | **-166** | **-193** | **-220** |
| **>25’ to ≤ 30’** | **-125** | **-171** | **-199** | **-227** |
| **>30 to ≤ 35’** | **-128** | **-176** | **-204** | **-233** |
| **>35 to ≤ 40’** | **-131** | **-180** | **-209** | **-238** |
| **>40’ to ≤ 45’** | **-134** | **-183** | **-213** | **-243** |
| **>45’ to ≤ 50’** | **-136** | **-187** | **-217** | **-248** |
| **>50’ to ≤ 55’** | **-138** | **-190** | **-221** | **-252** |
| **>55’ to ≤ 60’** | **-140** | **-193** | **-224** | **-256** |

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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 and 2r** | **3e** | **3r** |
| **≤15’** | **-90** | **-131** | **-156** | **-201** |
| **>15 to ≤ 20’** | **-94** | **-138** | **-164** | **-211** |
| **>20’ to ≤ 25’** | **-98** | **-143** | **-170** | **-220** |
| **>25’ to ≤ 30’** | **-101** | **-148** | **-176** | **-227** |
| **>30 to ≤ 35’** | **-104** | **-151** | **-180** | **-233** |
| **>35 to ≤ 40’** | **-107** | **-155** | **-185** | **-238** |
| **>40’ to ≤ 45’** | **-109** | **-159** | **-188** | **-243** |
| **>45’ to ≤ 50’** | **-111** | **-161** | **-192** | **-248** |
| **>50’ to ≤ 55’** | **-113** | **-164** | **-195** | **-252** |
| **>55’ to ≤ 60’** | **-114** | **-167** | **-198** | **-256** |

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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’** | **-115** | **-123** | **-172** |
| **>15 to≤ 20’** | **-120** | **-129** | **-181** |
| **>20’ to ≤ 25’** | **-125** | **-134** | **-188** |
| **>25’ to ≤ 30’** | **-129** | **-138** | **-194** |
| **>30 to ≤ 35’** | **-133** | **-142** | **-200** |
| **>35 to ≤ 40’** | **-136** | **-146** | **-204** |
| **>40’ to ≤ 45’** | **-139** | **-149** | **-208** |
| **>45’ to ≤ 50’** | **-141** | **-151** | **-212** |
| **>50’ to ≤ 55’** | **-143** | **-154** | **-216** |
| **>55’ to ≤ 60’** | **-146** | **-156** | **-219** |

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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** | **3** |
| **≤15’** | **-84** | **-105** | **-111** | **-132** |
| **>15 to ≤20’** | **-89** | **-111** | **-118** | **-140** |
| **>20’ to ≤25’** | **-94** | **-116** | **-124** | **-147** |
| **>25’ to ≤30’** | **-97** | **-121** | **-129** | **-152** |
| **>30 to ≤35’** | **-101** | **-125** | **-133** | **-157** |
| **>35 to ≤40’** | **-103** | **-129** | **-137** | **-162** |
| **>40’ to ≤45’** | **-106** | **-132** | **-140** | **-166** |
| **>45’ to ≤50’** | **-108** | **-135** | **-143** | **-170** |
| **>50’ to ≤55’** | **-111** | **-137** | **-146** | **-173** |
| **>55’ to ≤60’** | **-113** | **-140** | **-149** | **-176** |

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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’** | **-84** | **-125** | **-128** | **-155** |
| **>15 to ≤20’** | **-89** | **-133** | **-136** | **-165** |
| **>20’ to ≤25’** | **-94** | **-139** | **-143** | **-173** |
| **>25’ to ≤30’** | **-97** | **-145** | **-148** | **-180** |
| **>30 to ≤35’** | **-101** | **-149** | **-153** | **-186** |
| **>35 to ≤40’** | **-103** | **-154** | **-158** | **-191** |
| **>40’ to ≤45’** | **-106** | **-157** | **-162** | **-196** |
| **>45’ to ≤50’** | **-108** | **-161** | **-165** | **-200** |
| **>50’ to ≤55’** | **-111** | **-164** | **-169** | **-204** |
| **>55’ to ≤60’** | **-113** | **-167** | **-172** | **-208** |

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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** | **3** |
| **≤15’** | **-102** | **-127** | **-135** | **-160** |
| **>15 to ≤20’** | **-107** | **-133** | **-142** | **-168** |
| **>20’ to ≤25’** | **-112** | **-139** | **-148** | **-175** |
| **>25’ to ≤30’** | **-115** | **-143** | **-152** | **-180** |
| **>30 to ≤35’** | **-118** | **-147** | **-157** | **-185** |
| **>35 to ≤40’** | **-121** | **-151** | **-160** | **-190** |
| **>40’ to ≤45’** | **-124** | **-154** | **-164** | **-193** |
| **>45’ to ≤50’** | **-126** | **-156** | **-167** | **-197** |
| **>50’ to ≤55’** | **-128** | **-159** | **-169** | **-200** |
| **>55’ to ≤60’** | **-130** | **-161** | **-172** | **-203** |

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| **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 and 2r** | **3** |
| **≤15’** | **-85.2** | **-110** | **-135** |
| **>15 to ≤20’** | **-90** | **-116** | **-142** |
| **>20’ to ≤25’** | **-94** | **-121** | **-148** |
| **>25’ to ≤30’** | **-97** | **-125** | **-152** |
| **>30 to ≤35’** | **-99** | **-128** | **-157** |
| **>35 to ≤40’** | **-102** | **-131** | **-160** |
| **>40’ to ≤45’** | **-104** | **-134** | **-164** |
| **>45’ to ≤50’** | **-106** | **-136** | **-167** |
| **>50’ to ≤55’** | **-107** | **-138** | **-169** |
| **>55’ to ≤60’** | **-109** | **-140** | **-172** |

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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’** | **-102** | **-156** | **-152** | **-189** |
| **>15 to ≤20’** | **-107** | **-164** | **-159** | **-198** |
| **>20’ to ≤25’** | **-112** | **-170** | **-166** | **-206** |
| **>25’ to ≤30’** | **-115** | **-176** | **-171** | **-213** |
| **>30 to ≤35’** | **-118** | **-180** | **-176** | **-219** |
| **>35 to ≤40’** | **-121** | **-185** | **-180** | **-224** |
| **>40’ to ≤45’** | **-124** | **-188** | **-183** | **-228** |
| **>45’ to ≤50’** | **-126** | **-192** | **-187** | **-233** |
| **>50’ to ≤55’** | **-128** | **-195** | **-190** | **-236** |
| **>55’ to ≤60’** | **-130** | **-198** | **-193** | **-240** |

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| **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.~~

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ROOFING APPLICATION STANDARD (RAS) No. 128 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*. Compliancewith the requirements and proceduresherein specified, where the pressures (Pasd) have been determined based on Table 1, ~~or Table~~ 2, 3 or 4, 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, 3 or 4 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 Table~~ 2, 3 or 4 ~~above~~ below, as applicable.     |  |  |  |  | | --- | --- | --- | --- | | **~~TABLE 1 — RISK CATEGORY II EXPOSURE CATEGORY “C”~~~~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 “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)** | | | | | **Eave Height** | **Roof Pressure Zones** | | | | **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)** | | | | | **Eave Height** | **Roof Pressure Zones** | | | | **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 —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 —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** | |
|  |

(S7157)

RAS-130

**ROOFING APPLICATION STANDARD (RAS) No.130-20  
INSTALLATION CRITERIA FOR ROOF SHINGLES AND SHAKES APPLICATION**

Revise the following sections as follows:

4. Wood Shingles

4.1 Underlayment

|  |  |
| --- | --- |
| Solid Sheathing: | Two plies of ASTM D226, Type 1 felt overlapped 19 in., or a single layer of ASTM D226 Type II felt overlapped a minimum of 4 in. on side laps, and 6 in. on the end laps. Fastened with corrosion resistant 12 ga. roofing nails through tin caps. Fasten with two staggered rows in the field of the sheet with a maximum fastener spacing of 12 in. o.c., and one row at the laps fastened 6 in. o.c. |
| Spaced Sheathing: | Underlayment shall be installed at a minimum of 36 in. wide sheet at the eave line~~, and shall be a minimum of two plies of ASTM D226, Type I felt overlapped 19 in., or a single layer of ASTM D226 Type II felt~~ ~~overlapped a minimum of 4 in. on side laps, and 6 in. on the end laps~~. Fastened with corrosion resistant 12 ga. roofing nails through tin caps. Fasten with two staggered rows in the field of the sheet with a maximum fastener spacing of 12 in. o.c~~., and one row at the laps fastened 6 in. o.c., at a minimum of 36 in. from the eave of the roof~~. |
| Roofing nails shall be of sufficient length to penetrate through the plywood panel or wood plank decking not less than 3/16 in., or to penetrate into a 1 in., or greater, thickness of lumber not less than 1 in. |

4.3 Valleys may be installed open or closed. A 36 in. wide sheet of minimum ASTM D226 Type II organic felt shall be installed ~~over the underlayment and~~ centered in the valley, fastened 6 in. o.c. through tin-caps at each edge of the sheet. Minimum end laps shall be 12 in. and fully adhered with approved flashing cement.

4.7 Reserved. ~~An optional interlayment sheet may be installed between wood shingles in solid sheathing applications. Interlayment shall be required in all spaced sheathing applications. Interlayment shall be a minimum of ASTM D226, Type I felt with a minimum width of 18 in. and shall be applied between each succeeding course of wood shingles. Interlayment shall be fastened on the upper edge of the sheet. The bottom edge of the interlayment shall be positioned above the butt edge of each course of wood shingles, a distance equal to triple the weather exposure of the wood shingles. Extend interlayment up vertical surfaces a minimum of 4 in. No felt shall be exposed.~~

4.8 The beginning or starter course of wood shingles at the eave line shall be doubled as a minimum. The wood shingles shall ~~be~~ project a minimum 3/4 in. to a maximum of 2 in. beyond the drip edge at both eaves and rakes. Spacing between shingles (joints or key ways) shall be a minimum of 1/4 in. and a maximum of 3/8 in. Shingles shall be positioned so that they cover the joints in the preceding course and adjacent courses shall be offset a minimum of 11/2 in. In any three courses (adjacent), no two joints should be directly aligned (see Detail B).

4.10 Hip and ridges may be installed from pre-manufactured units or field assembled units from manufacturer’s shingles. The exposed juncture of the roof hip and ridge areas shall be covered with a minimum 6 in. wide strip of ASTM D226 Type II organic felt, prior to installing the hip and ridge units. No felt shall be left exposed. Lay alternate overlapping hip and ridge units, starting with a double starter course. The weather exposure of the hip and ridge units shall be the same exposure as the field shingles. Each side of the hip and ridge units shall be a minimum of 4 in. wide. Each hip and ridge unit shall be fastened to the roof with two fasteners of the same type as that used for the field shingles. Fasteners shall be of sufficient length to penetrate the plywood panel or wood plank decking not less than 3/16 in.; or to penetrate into a 1 in., or greater, thickness of lumber not less than 1 in. Nails shall be driven straight and flush. Nails shall not be overdriven (see Detail C).

5. Wood Shakes

5.1 Underlayments:

|  |  |
| --- | --- |
| Solid Sheathing: | Underlayment shall be installed at a minimum of 36 in. wide sheet at the eave line ~~Two plies of ASTM D226, Type I felt overlapped 19 in., or a single layer of ASTM D226 Type II felt overlapped a minimum of 4 in. on side laps and 6 in. on the end laps.~~ Fasten with corrosion resistant 12 ga. roofing nails through tin caps. Fasten with two staggered rows in the field of the sheet with a maximum fastener spacing of 12 in. o.c~~., and one row at the laps fastened 6 in. o.c., at a minimum of 36 in. from the eave of the roof~~. |
| Spaced Sheathing: | Underlayment shall be installed at a minimum of 36 in. wide sheet at the eave line~~, and shall be a minimum of two plies of ASTM D226, Type I felt overlapped 19 in., or a single layer of ASTM D226 Type II felt~~ ~~overlapped a minimum of 4 in. on side laps, and 6 in. on the end laps~~. Fastened with corrosion resistant 12 ga. roofing nails through tin caps. Fasten with two staggered rows in the field of the sheet with a maximum fastener spacing of 12 in. o.c~~., and one row at the laps fastened 6 in. o.c., at a minimum of 36 in. from the eave of the roof~~. |
| Roofing nails shall be of sufficient length to penetrate through the plywood panel or wood plank decking not less than 3/16 in., or to penetrate into a 1 in., or greater, thickness of lumber not less than 1 in. |

 5.8 Spacing between shakes (joints or key ways) shall be a minimum ~~1~~~~/~~~~4~~ 3/8 in. and a maximum of 5/8 in. Shakes shall be positioned so that they cover the joints in the preceding course. Adjacent courses shall be offset a minimum of 11/2 in. In any three courses (adjacent), no two joints should be directly aligned (see Detail D).

5.10 Hip and ridges may be installed from pre-manufactured units or field assembled units from manufacturer’s shakes. The exposed juncture of the roof hip and ridge areas shall be covered with a minimum 6 in. wide strip of ASTM D226 Type II organic felt, prior to installing the hip and ridge units. No felt shall be left exposed. Lay alternate overlapping hip and ridge units, starting with a double starter course. The weather exposure of the hip and ridge units shall be the same exposure as the field shingles. Each side of the hip and ridge units shall be a minimum of 4 in. wide. Each hip and ridge unit shall be fastened to the roof with two fasteners of the same type as that used for the field shakes. Fasteners shall be of sufficient length to penetrate the plywood panel or wood plank decking not less than 3/16 in.; or to penetrate into a 1 in., or greater, thickness of lumber not less than 1 in. Nails shall be driven straight and flush. Nails shall not be overdriven. (see Detail C).

(R7384)

RAS-137

**ROOFING APPLICATION STANDARD (RAS) No. 137**

**STANDARD REQUIREMENTS FOR MECHANICAL ATTACHMENT OF SINGLE-PLY**

**ROOF COVERINGS TO VARIOUS SUBSTRATES**

Revise the following sections as follows:

**4.2** The roofing assembly Product Approval shall list the maximum design pressure for the accepted assembly. Such pressure shall be applicable to the field of the roof area (1) as defined in ASCE 7. Should the roof assembly Product Approval allow extrapolation to perimeter and corners areas [(2) and (3)] as defined in ASCE 7, the following shall apply:

* The maximum extrapolation shall not be greater than ~~280~~ 300 percent.
* The minimum fastener separation shall not be less than 6 inches o.c. Should determined fastener density require closer fastener spacing, then the membrane width shall be reduced, (e.g., half sheets).
* If the perimeter and/or corner areas of the roof have calculated design pressures which are less than or equal to the maximum design pressures noted in the roof assembly Product Approval, then specified membrane attachment shall also apply in these areas.

**5. Single-Ply Membrane Attachment**

5.1 Should the roof assembly Product Approval allow extrapolation to Zone 1, Zone 2 and Zone 3 ~~perimeter and corners areas [(2) and (3)]~~ as defined in ASCE 7, the following shall apply:

5.1.1 Single-ply membrane attachment for elevated pressure zones may be determined through extrapolation of the data for field area attachment.

5.1.1.1 Alternatively, the mechanically attached, single-ply roof assembly may be tested for dynamic uplift pressure resistance, in compliance with Appendix B of TAS 114 resulting in a “fastener assembly design value.” This “Fastener Assembly Design Value” will be listed in the single-ply roof assembly Product Approval for use in determining fastener spacing.

**6. Example of Data Extrapolation**

Notes: The following data extrapolation example results in a “Fastener Value” which is based on the maximum design pressure from a particular roof assembly Product Approval. The maximum design pressures are the result of laboratory uplift testing of the assembly after a 2:1 margin of safety is applied. Therefore, the “Fastener Value” determined herein inherently has a 2:1 margin of safety applied.

6.1 Known:

~~Consider a building having an uninsulated concrete deck and a roof mean height less than 60 feet where the~~ The design pressures are as follows:

***Zone 1’:*** *-37.0 psf*

***Zone 1 ~~Field Area~~:*** *~~- 43.0~~ -64.0 psf*

***Zone 2 ~~Perimeter Area~~****: ~~- 56.~~0 -84.0 psf*

***Zone 3 ~~Corner Areas~~****: ~~- 90.0~~ ~~-~~115.0 psf*

Consider a roof assembly Product Approval which includes a system having a maximum design pressure of -45 psf. The Product Approval specifies a single-ply membrane mechanically attached 18 in. o.c. through 4.5 in. wide fastening tabs spaced 18 in. o.c. on the underside of the membrane.

6.1.1 Determine the number of square feet per fastener (x):

The following equation may be utilized to determine the number of square feet per fastener (x) if this number is unknown.

*X = (row spacing x fastener spacing)*

                               144

For this case, this results in 2.25 ft2 per fastener, as shown below.

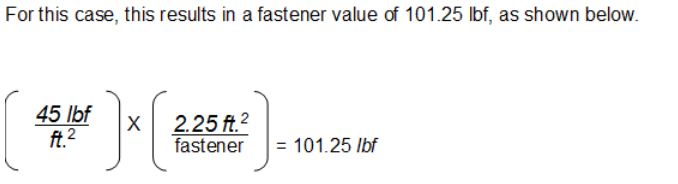
*X = (18 in x 18 in)* = 2.25 *ft2*

               144

6.1.2 Determine the "Fastener Value."

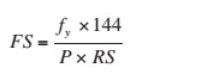
***General Equation:***

*fv* = (max.*design pressure)* *x* [*square feet per fastener (X)*]



6.1.3 Determine a fastener spacing (FS) to meet the design pressures in the elevated pressure zones of the roof.

***General Equation:***



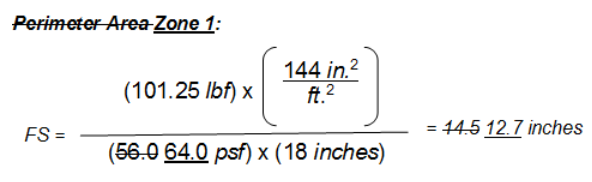
where:

FS = fastener spacing (in);

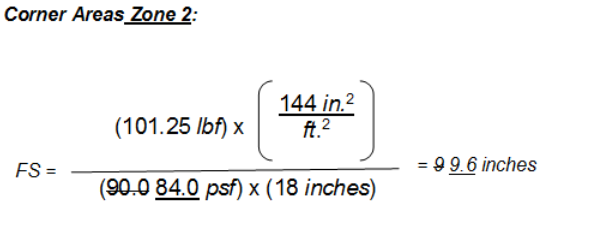
fv = fastener value (lbf);

P = design pressure (psf); and,

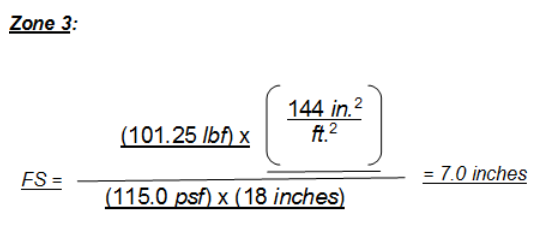
RS = row spacing (in.)



All fractions shall be rounded down to the next whole number. Therefore, a fastener spacing of ~~14~~ 12 in. o.c. through 4.5 in. wide fastening tabs spaced 18 in. o.c. on the underside of the membrane would be acceptable for the perimeter area.



Therefore, a fastener spacing of 9 in. o.c. through 4.5 in. wide fastening tabs spaced 18 in. o.c. on the underside of the membrane would be acceptable for the corner areas.



Therefore, a fastener spacing of 7 in. o.c. through 4.5 in. wide fastening tabs spaced 18 in. o.c. on the underside of the membrane would be acceptable for the corner areas.

(S7164)

TAS 103-95

**TESTING APPLICATION STANDARD (TAS) No. 103-95 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 |
| Breaking Strength and Elongation | 10 |
| Reserved | 11 |
| Low Temperature Flexibility | 12 |
| Ultraviolet Resistance | 13 |
| Accelerated Aging | 14 |
| Cyclic Elongation | 15 |
| Water Vapor Transmission | 16 |
| Compound Stability | 17 |
| Puncture Resistance | 18 |
| Tile Slippage Resistance | 19 |
| ~~Crack Cycling~~ Reserved | 20 |
| Peel Resistance | 21 |
| Granule Adhesion | 22 |
| 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*

|  |  |
| --- | --- |
| TAS 124 | Test Procedure for Field Uplift Testing of Existing Membrane Roof Systems |

*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 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.

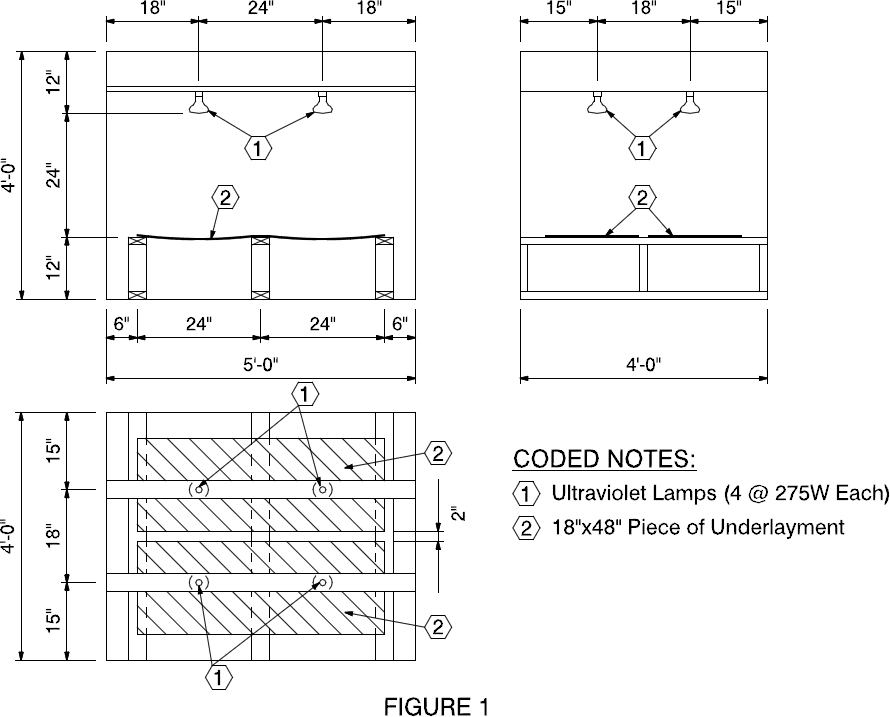
24.3 Report the results of testing per Table 24.2 and the duration of Accelerated Weathering exposure.

TABLE 24.1

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

TABLE 24.2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **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 | | | |



(R8282)

TAS-104

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

12.1.2.4 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.

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

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

13.2.3.1 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 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.

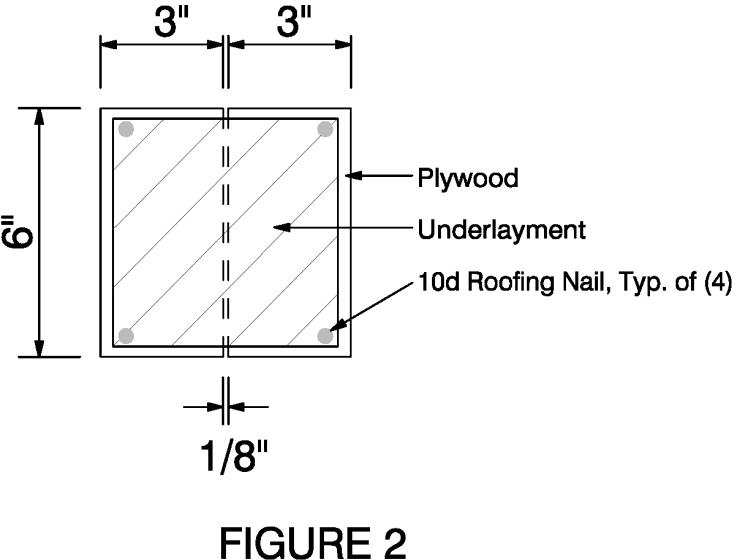
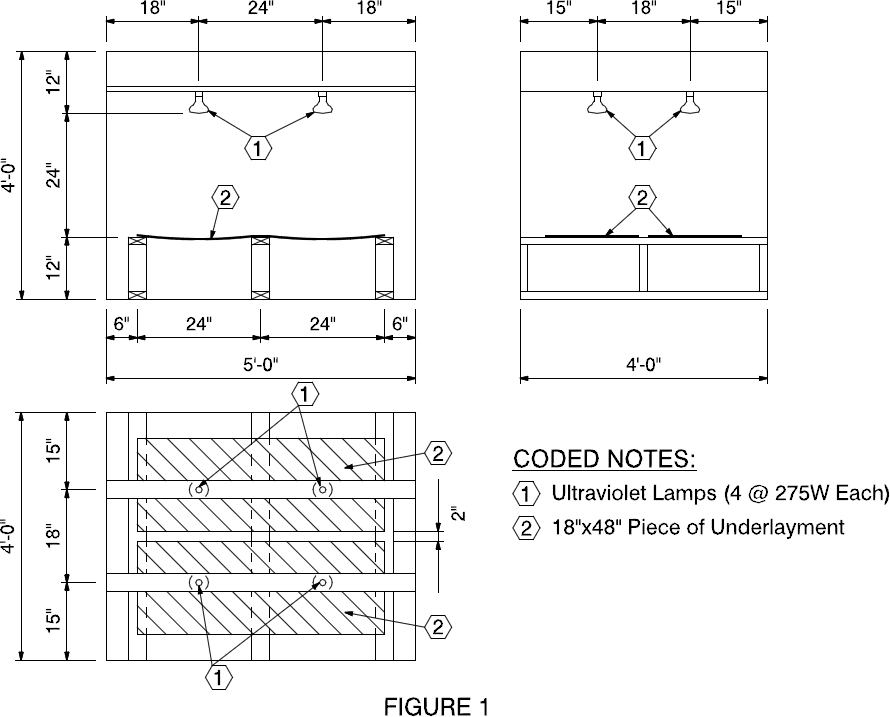
20.3 Report the results of testing per Table 20.2 and the duration of Accelerated Weathering exposure.

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 | | | |



(R8283)

TAS-105

**TESTING APPLICATION STANDARD (TAS) No. 105-~~11~~20**

**TEST PROCEDURE FOR FIELD WITHDRAWAL RESISTANCE TESTING**

Revise the following sections as follows:

**8.         Test Procedure for Anchor or Base Sheet, Insulation, and Membrane Attachment testing**

8.1 On roof decks of 100 squares or less, ten (10) withdrawal resistance tests shall be conducted, not less than three (3) of which shall be in Zone 2 ~~the perimeter areas (2)~~, three (3) in Zone 3 ~~corner areas (3)~~, the remainders in Zone 1’ and Zone 1 ~~the field areas (1)~~ as defined in ASCE7.

8.6 Stair towers, mechanical penthouses and mechanical rooms shall have a minimum of four (4) withdrawal resistance tests, two of which shall be taken ~~at perimeter areas~~ in Zones 2 & 3, as defined in ASCE 7.

10.1.10 Field fastener withdrawal testing shall be performed in the preceding three (3) months, unless otherwise authorized by the *building official.*

**TESTING APPLICATION STANDARD (TAS) 105-~~98~~20**

**APPENDIX A**

**FIELD WITHDRAWAL RESISTANCE TEST RESULTS REPORT**

**FIELD WITHDRAWAL RESISTANCE TEST RECORDING SHEET**

**See Section 8 to determine number of tests (If drill bit is high tolerance, include range in 1/1000" tolerances)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **SAMPLE NO.** | **PLAN IDENTIFIER** | **INITIAL FAILURE LOAD (lbf)** | **Zone 1’, Zone 1, Zone 2 or Zone 3 (Circle one)**  **FIELD PERIMETER OR CORNER AREA (circle one)** | | | |
|  |  |  | Z-1’~~F~~ | Z-1~~P~~ | ~~C~~ Z-2 | Z-3 |
|  |  |  | Z-1’~~F~~ | Z-1~~P~~ | ~~C~~ Z-2 | Z-3 |
|  |  |  | Z-1’~~F~~ | Z-1~~P~~ | ~~C~~ Z-2 | Z-3 |
|  |  |  | Z-1’~~F~~ | Z-1~~P~~ | ~~C~~ Z-2 | Z-3 |
|  |  |  | Z-1’~~F~~ | Z-1~~P~~ | ~~C~~ Z-2 | Z-3 |
|  |  |  | Z-1’~~F~~ | Z-1~~P~~ | ~~C~~ Z-2 | Z-3 |
|  |  |  | Z-1’~~F~~ | Z-1~~P~~ | ~~C~~ Z-2 | Z-3 |
|  |  |  | Z-1’~~F~~ | Z-1~~P~~ | ~~C~~ Z-2 | Z-3 |
|  |  |  | Z-1’~~F~~ | Z-1~~P~~ | ~~C~~ Z-2 | Z-3 |
|  |  |  | Z-1’~~F~~ | Z-1~~P~~ | ~~C~~ Z-2 | Z-3 |
|  |  |  | Z-1’~~F~~ | Z-1~~P~~ | ~~C~~ Z-2 | Z-3 |
|  |  |  | Z-1’~~F~~ | Z-1~~P~~ | ~~C~~ Z-2 | Z-3 |
|  |  |  | Z-1’~~F~~ | Z-1~~P~~ | ~~C~~ Z-2 | Z-3 |
|  |  |  | Z-1’~~F~~ | Z-1~~P~~ | ~~C~~ Z-2 | Z-3 |
|  |  |  | Z-1’~~F~~ | Z-1~~P~~ | ~~C~~ Z-2 | Z-3 |
|  |  |  | Z-1’~~F~~ | Z-1~~P~~ | ~~C~~ Z-2 | Z-3 |
|  |  |  | Z-1’~~F~~ | Z-1~~P~~ | ~~C~~ Z-2 | Z-3 |
|  |  |  | Z-1’~~F~~ | Z-1~~P~~ | ~~C~~ Z-2 | Z-3 |
|  |  |  | Z-1’~~F~~ | Z-1~~P~~ | ~~C~~ Z-2 | Z-3 |
|  |  |  | Z-1’~~F~~ | Z-1~~P~~ | ~~C~~ Z-2 | Z-3 |
|  |  |  | Z-1’~~F~~ | Z-1~~P~~ | ~~C~~ Z-2 | Z-3 |
|  |  |  | Z-1’~~F~~ | Z-1~~P~~ | ~~C~~ Z-2 | Z-3 |
|  |  |  | Z-1’~~F~~ | Z-1~~P~~ | ~~C~~ Z-2 | Z-3 |
|  |  |  | Z-1’~~F~~ | Z-1~~P~~ | ~~C~~ Z-2 | Z-3 |

(R7184)

TAS-107

**TESTING APPLICATION STANDARD (TAS) No. 107-~~95~~20**

**TEST PROCEDURE FOR WIND RESISTANCE TESTING OF NON-RIGID, DISCONTINUOUS ROOF SYSTEM ASSEMBLIES**

**(Modified from ASTM D3161)**

Revise the following sections as follows:

**1. Scope**

1.1 This test method covers the determination of the resistance to wind blow-up ~~or blow-off~~ of asphalt shingles, metal shingles or other non-rigid, discontinuous Roof System Assemblies when installed in compliance with the manufacturer’s current, published installation instructions.

**2. Referenced Documents**

*2.1 ASTM Standards*

D3161 Standard Test Method for Wind Resistance of Asphalt Shingles

E380 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 specification, refer to ASTM D3161; and/or Chapters 2 and 15 (High-Velocity Hurricane Zones) of the *Florida Building Code, Building.* 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 E380.

**4. Types of Roof System Assemblies**

4.1 Asphalt shingles are of two types:

4.1.1 *Type I* - Shingles with a factory-applied adhesive (self-sealing shingles).

4.1.2 *Type II* - Shingles of the lock-type, with mechanically interlocking tabs or ears.

4.2 Metal shingles or other non-rigid, discontinuous Roof System Assemblies shall be tested under this Protocol at the direction of the Authority Having Jurisdiction.

**5. Significance and Use**

5.1 Asphalt shingles, metal shingles or other non-rigid, discontinuous Roof System Assemblies that have demonstrated wind resistance by this test have also performed well in use. Local wind conditions may differ from the test conditions both in intensity and duration, and should be taken into consideration. This method is suitable for use in specifications and regulatory statutes. This method, assisted by experience and engineering judgment, will also prove useful for development work.

**6. Test Limitations and Precautions**

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

**7. Apparatus**

7.1 Test Machine

7.1.1 The “test machine” shall be capable of delivering a horizontal stream of air through a rectangular opening, 36 in. (914 mm) wide and 12 in. (305 mm) high, at a velocity of 110 mph (177 km/h) ± 5% as measured at the orifice.

7.1.2 The “test machine” shall be equipped with an adjustable stand on which a test panel is placed. The stand shall be adjustable to setting the test panel at any desired slope, at any horizontal distance from the lower edge of the duct opening, and at various angles incident to the wind direction.

7.2 Clock

7.3 Mechanical Circulation Conditioning Cell or Room

7.3.1 A mechanical circulation conditioning cell or room with a forced air circulation shall be utilized for self-sealing shingle conditioning. The cell or room shall be capable of receiving a minimum 50 in. (1.27 m) wide by 66 in. (1.68 m) long test panel at a slope of 2 in:12 in. and of maintaining a uniform temperature of 135 to 140°F (57 to 60°C).

**8. Test Specimen**

8.1 Deck

8.1.1 The wood test deck shall consist of APA 32/16 span rated sheathing of 15/32 in. thickness and not less than 50 in. by 66 in. (1.27 m by 1.68 m) in dimension. The wood test deck shall be of such rigidity that it will not twist or distort with normal handling, or vibrate from the wind velocity during the test.

8.2 Underlayment

8.2.1 Underlayment shall be either two layers of *approved* ~~15 lb~~ ASTM D226, Type I or one layer of *approved* ASTM D226, Type II asphalt saturated felt underlayment mechanically attached to the wood test deck, with 12 ga. roofing nails and 1 5/8 in. tin caps, in a 12 in. grid patter staggered in two rows in the field and 6 in. o.c. attachment at any laps.

8.3 Self-Sealing Asphalt Shingles

8.3.1 Apply self-sealing asphalt shingles with multiple tabs to duplicate test decks, parallel to the short dimension of the test deck, in compliance with the manufacturer’s instructions. Apply products with single tabs to duplicate test decks, parallel to the short dimension of the test deck, in such a manner that there is at least one full shingle in each course.

8.3.2 Secure the exposed portion of any partial product tab or shingle with face nailing or stapling such that the partial product tabs or partial shingles will remain in place for the entire duration of the test.

8.3.~~2~~3 Asphalt shingles shall be attached using 12 ga. roofing nails, properly positioned in compliance with the manufacturer’s instructions, to fasten each shingle. No cement, other than the factory-applied adhesive, shall be used to fasten down the tabs. Do not apply pressure to the shingle tabs either during or after application.

8.4 Lock-Type Asphalt Shingles

8.4.1 Apply lock-type asphalt shingles to not less than four test decks, parallel to the short dimension of the panel, in compliance with the manufacturer’s instructions. Secure the shingles at the outer edge of the test panel by exposed nailing to simulate anchoring at the rake edges of a roof deck.

8.5 Metal Shingles or Other

8.5.1 Apply metal shingles or other non-rigid, discontinuous components to duplicate test decks, parallel to the short dimension of the test deck, in compliance with the manufacturer’s instructions.

8.6 Control the temperature at 80 ± 15°F (27 ± 8°C) and maintain the slope of the panel at 2 in:12 in. (17% slope) during shingle application.

**9. Conditioning**

9.1 Maintain the test specimens at a slope of 2 in:12 in. and at a temperature of 80 ± 15°F (27 + 8°C) until the commencement of heat conditioning.

9.2 Place the test specimens in the conditioning cell or room at a slope of 2 in:12 in. and maintain at a temperature of 135 to 140°F (57 to 60°C) for a continuous 16 hour period.

9.3 After completion of the conditioning period, allow the test specimens to come to room temperature [80 ± 15°F (27 ± 8°C)] while at a slope of 2 in:12 in

9.4 Exercise care to avoid pressure on shingle tabs by any twisting or distortion of the test specimens during handling.

**10.** Procedure

10.1 Location of the Test Panel

10.1.1 Install the test specimen on the test carriage and adjust it in relation to the duct such that the exposed edge of the target course is on the same level as the lower edge of the duct orifice at a horizontal distance of 7 in. ± 1/16 in. (178 ± 1 mm). The target course shall be the third course up from the bot- tom of the test specimen. The test incline shall be 2:12 in. for self-sealing shingles, and at the lowest incline recommended by the manufacturer for lock-type asphalt and metal shingles and other non-rigid, discontinuous systems.

10.1.2 Since the design of lock-type shingle may make it difficult to determine the most critical angle of wind direction, conduct the test at a minimum of three different angles: 1) head-on; 2) with the bottom of the target course parallel to and 7 in. (178 mm) away from the machine orifice; and, 3) with the test specimen rotated 30 and 60 degrees from the head-on position, with the bottom corner of the third-course tab nearest to the duct being 7 in. (178 mm) away from and in the same horizontal plane as the bottom of the machine orifice. Test another panel at the position judged to be most critical on the basis of the first three tests.

10.2 Performing the Test

10.2.1 Maintain the ambient temperature at 75 ± 5°F (24 + 3°C) during the wind tests.

10.2.2 As soon as the test specimen is set in position, start the fan, adjust to produce a velocity of 110 mph (177 km/hr) ± 5% at the orifice, and maintain continuously for 2 hours, or until such lesser time as a failure occurs.

10.2.3 ~~During the test, an observer shall note any lifting of shingle tabs or non-rigid components and shall record any damage to a full shingle or non-rigid component or the disengaging of a locking ear or tab, or a shingle tab, including any failure of adhesive. The time at which any of these “failures” occurs should be noted.~~

Any steep slope roofing product assembly that fails to restrain full product tabs shall be considered as having failed this test.

10.2.4 If failure occurs during the test as defined in Section 10.2.3, stop the air flow and record the exposure time. ~~The end point for failure shall be taken as the time at which the sealing feature fails to restrain one or more full shingles or full shingle tabs, or a locking ear or tab of a lock shingle tears loose or disengages from its locking position or a non-rigid component is damaged so as to affect the performance of the system. In addition, no free portion of a shingle or non-rigid component shall lift so as to stand upright or bend back on itself during the test.~~

**11. Certification**

11.1 A test report will be provided to the Authority Having Jurisdiction confirming successful compliance with the test provisions of this Protocol. Completion of this test Protocol is one in a series of Testing Application Standards required by the Florida Building Code, Building for Product Approval of non-rigid, discontinuous Roof System Assemblies.

(S8284)

TAS-110

**TESTING APPLICATION STANDARD (TAS) No. 110-2000**

**TESTING REQUIREMENTS FOR PHYSICAL PROPERTIES OF ROOF**

**MEMBRANES, INSULATION, COATINGS AND OTHER ROOFING COMPONENTS**

Revise the following section as follows:

TAS 110 Section 1

Add Section 1.2

1.2   Manufacturing location of tested products shall be verified by the testing laboratory and be included in the report.

(R7299)

Revise the following sections as follows:

**TAS 110 Section 4**

Modify Table 4

|  |  |
| --- | --- |
| **PRODUCT TEST STANDARD** | |
| **Membrane Products** |  |
| Polyvinyl Chloride Sheet Roofing - PVC (Spec.) | D4434 |
| Vulcanized Rubber Sheet Roofing - EPDM (Spec.) | D4637 |
| Poly-isobutylene Sheet Roofing - PIB (Spec.) | D5019 |
| Polyethylene Chlorinated Polyethylene Sheet Roofing - CMS (Spec.) | D5019 |
| Hypalon Sheet Roofing | D5019 |
| Unreinforced Thermoplastic Olefin Elastomer Sheet Roofing - TPO | TAS 131 |
| Keytone Ethylene Ester Sheet Roofing - KEE (Spec.) | D6754 |
| Thermoplastic Olefin Elastomer Sheet Roofing – TPO (Internally Reinforced only) | |
| Standard Specification | D6878 |
| Static Puncture Resistance Report Results Only | D5602 |
| Dynamic Puncture Resistance Report Results Only | D5635 |
| Breaking Strength (after accelerated weathering) Report Results Only | D751 |
| Elongation at Reinforcement Break (after accelerated weathering)  Report Results Only | D751 |
|  |  |
| All Single-Ply Membranes | TAS 117(B) |
| **Other Components** |  |
| Sealants | TAS 132 |
| Insulation | See Section 7 of this Protocol |
| Fasteners, Stress Plates, etc. | See Section 12 of this Protocol |

**TAS 110 Section 8**

Modify Table 8

|  |  |  |
| --- | --- | --- |
| **Physical Property** | **Test Standard** | **Requirement** |
| **Expanded Polystyrene (EPS)** | | |
| Standard Specification | C578 | Minimum Type IX |
| Flame Spread | E84 | max. < 75 |
| **Extruded Polystyrene (XPS)** | | |
| Standard Specification | C578 | Minimum Type IV |
| Flame Spread | E84 | max. < 75 |
| **Fiberglass/Mineral Wool Fiber** | | |
| Standard Specification | C726 | Type I or Type II |
| **Wood Fiberboard** | | |
| Standard Specification | C208 | Grade 1 or 2 |
| Compressive Strength | C165 | nominal 30 psi |
| **Perlite** | | |
| Standard Specification | C728 | Type I or Type II |
| Compressive Strength | C165  Procedure "A" | min. 35 psi |
| Water Vapor Permeability | C355 | max. 25 perm-inch |
| Dimensional Stability | D2126 | max. 2% |
| Flame Spread | E84 | max. < 75 |
| **Polyisocyanurate** | | |
| Standard Specification | C1289 |  |
| Density | D1622 | nominal 2 pcf |
| Compressive Strength | D1621 | min. 18 psi |
| Water Absorption | C209 | max. 1.0% |
| Water Vapor Permeance | E96 | max. 1.0 perm |
| Dimensional Stability (7 Days) | D2116 | max. 2% |
| Flame Spread | E84 | max. < 75 |
| Spread of Flame  (with Roof Cover) | E108 | min. Class ‘B’ |
| **Gypsum** | | |
| Standard Specification | C1177 | Type X |
| **Cementitious** | | |
| Standard Specification | C1325 | Type A or Type B |
| **Lightweight Insulating Concrete** | | |
| Standard Specification | C869 | Cellular |
| Standard Specification | C332 | Aggregate |

**TAS 110 Section 9**

Modify Table 9 footnote only

**TABLE 9**

|  |  |  |
| --- | --- | --- |
| **Product** | **Test** | **Test Standard** |
| Fiber Cement Roof Assembly | Wind Driven Rain Resistance | TAS 100 |
| Fiber Cement Roofing Products | Physical Properties | TAS 135 |
| Mechanical Attached Fiber Cement Tile or Shake Roof Assemblies (Uplift Based  System) | Static Uplift Resistance | TAS 102(A) (See  TAS 135 for details) |
| Mechanically Attached, Clipped Fiber Cement Tile or Shake Roof Assemblies  (Uplift Based System) | Static Uplift Resistance | TAS 102(A) (See  TAS 135 for details) |
| Fiber Cement Panel Roof Assemblies | Uplift Pressure Resistance | E 330 (See TAS  135 for details) |
| **Underlayment** | | |
| Self-Adhered Underlayments | Physical Properties | TAS 103 |
| Nail-On Underlayments | Physical Properties | TAS 104 |
| Asphalt Based Underlayments | Physical Properties | See Section 2 of this Protocol |
| **Attachment Components** | | |
| Nails, Screws, Clips, etc. | Corrosion Resistance | Appendix E of TAS 114 |

All Underlayments (with the exception of TAS 103 or TAS 104 underlayments) with exposure limitation in excess of 30 days must submit enhanced Accelerated Weathering testing in conjunction with applicable Physical Properties testing. Exposure limitations up to a maximum of 180 days will be established through ASTM D4798 ~~as~~ ~~outlined in ASTM D5147~~ for 1000 hours (cycle A-1); pass /fail established by physical properties testing of the weathered samples. Physical property testing where specimen size will not fit into the accelerated weathering device may be omitted.

**TAS 110 Section 10**

Modify Table 10 footnote only

**TABLE 10**

|  |  |  |
| --- | --- | --- |
| **Product** | **Test** | **Test Standard** |
| Non-Rigid, Discontinuous Roof Assembly | Wind Driven Rain Resistance | TAS 100 |
| Non-Rigid, Discontinuous Roof Assembly | Wind Resistance | TAS 107 |
| Non-Rigid, Discontinuous Roof  Assembly | Fire Resistance min. Class 'B' | E 108 min. Class 'B' |
| Granule Surfaced, Glass Felt Asphalt Shingles | Physical Properties | D3462 |
| Granule Surfaced, Class 'A' Asphalt Shingles  Fiberglass Reinforced | Physical Properties | D3018 TAS 135 |
| Composite Shingles Fiber Cement Shingles | Physical Properties | TAS 135 |
| Metal Shingles | Salt Spray and Accelerated  Weathering | B117 and G23 |
| **Underlayment** | | |
| Self-Adhered Underlayments | Physical Properties | TAS 103 or ASTM D1970 |
| Nail-On Underlayments | Physical Properties | TAS 104 |
| Asphalt Based Underlayments | Physical Properties | See Section 2 of this Protocol |
| **Attachment Components** | | |
| Nails, Screws, Clips, etc | Corrosion Resistance | Appendix E of TAS 114 |

All Underlayments (with the exception of TAS 103 or TAS 104 underlayments) with exposure limitation in excess of 30 days must submit enhanced Accelerated Weathering testing in conjunction with applicable Physical Properties testing. Exposure limitations up to a maximum of 180 days will be established through ASTM D4798 ~~as~~ ~~outlined in ASTM D5147~~ for 1000 hours (cycle A-1); pass /fail established by physical properties testing of the weathered samples. Physical property testing where specimen size will not fit into the accelerated weathering device may be omitted.

**TAS 110 Section 11**

Modify Table 11(A) and 11(B) footnote 3 only

**TABLE 11(A)**

|  |  |  |
| --- | --- | --- |
| **Product** | **Test** | **Test Standard** |
| Mechanically Attached Rigid, Discontinuous Roof Assembly | Wind Driven Resistance | TAS 100 |
| Mechanically Attached Rigid, Discontinuous Roof Assembly | Static Uplift Resistance | TAS 102 |
| Mechanically Attached Clipped, Rigid, Discontinuous Roof Assembly | Static Uplift Resistance | TAS 102(A) |
| Mortar or Adhesive Set Tile Roof Assembly | Static Uplift Resistance | TAS 101 |
| Rigid, Discontinuous Roof Assembly | Wind Tunnel Performance | TAS 108 |
| Rigid, Discontinuous Roof Assembly | Air Permeability | TAS 116 |
| Concrete Roof Tile | Physical Properties | TAS 112 |
| Clay Roof Tile | Physical Properties | C 1167 |
| Fiberglass Reinforced Composite Tile | Physical Properties | TAS 135 |
| **Underlayment** | | |
| Self-Adhered Underlayments | Physical Properties | TAS 103 |
| Nail-On Underlayments | Physical Properties | TAS 104 |
| Asphalt Based Underlayments | Physical Properties | See Section 2 of this  Protocol |
| **Attachment Components** | | |
| Nails, Screws, Clips, etc. | Corrosion Resistance | Appendix E of  TAS 114 |
| Mortar (for use in mortar set tile Roof System Assemblies) | Physical Properties | TAS 123 |
| Adhesive (for use as a repair or supplemental  attachment component) | Physical Properties | TAS 123(A) |

**TABLE 11(B)**

|  |  |  |
| --- | --- | --- |
| **Product** | **Test** | **Test Standard** |
| Slate | Physical Properties | C406 |
| **Underlayment** | | |
| Self-Adhered Underlayments | Physical Properties | TAS 103 or ASTM D1970 |
| Nail-On Underlayments | Physical Properties | TAS 104 |
| Asphalt Based Underlayments | Physical Properties | See Section 2 of this Protocol |
| **Attachment Components** | | |
| Nails, Screws, Clips, etc. | Corrosion Resistance | Appendix E of TAS 114 |

Notes:

1. Wind tunnel testing of rigid, discontinuous roof assemblies is optional and is only applicable to systems having rigid components which meet the size constraints set forth in TAS 108.

2. Air permeability testing of rigid, discontinuous roof assemblies is only applicable to those systems which are to be tested in compliance with TAS 108 and is not required for those systems generally considered to be air permeable. This is a test to confirm the roof assembly would apply to wind tunnel testing.

**3.** All Underlayments (with the exception of TAS 103 or TAS 104 underlayments) with exposure limitation in excess of 30 days must submit enhanced Accelerated Weathering testing in conjunction with applicable Physical Properties testing. Exposure limitations up to a maximum of 180 days will be established through ASTM D4798 as outlined in ASTM D5147 for 1000 hours (cycle A-1); pass /fail established by physical properties testing of the weathered samples. Physical property testing where specimen size will not fit into the accelerated weathering device may be omitted.

**TAS 110 Section 17**

Modify Table 17 and footnote

**TABLE 17**

|  |  |  |
| --- | --- | --- |
| **Product** | **Test** | **Test Standard** |
| Non-Rigid, Discontinuous Roof Assembly | Wind Driven Rain Resistance | TAS 100 |
| Plastic Tile/Shake/Slate Systems | Uplift Performance | TAS 125 |
| Plastic Tile/Shake/Slate | Outdoor Exposure Xenon Arc | G26 (6500 watts) Test Method 1 or  G155 (4500 hours) |
| Tensile Test | D638  (+/- 10% allowable difference between exposed and non-exposed samples) |
| Flexural Test | C158  (+/- 10% allowable difference between exposed and non-exposed samples) |
| Plastic Tile/Shake/Slate | Self Ignition | D1929  (greater than 650oF) |
| Plastic Tile/Shake/Slate | Smoke Density Rating | E84 (rating less than 450) or  D2843 (rating less than 75) |
| Plastic Tile/Shake/Slate | Rate of Burning | D635  (Class ~~C1~~ CC-1 or ~~C2~~ CC-2) |
| **Underlayment** | | |
| Self-Adhered Underlayments | Physical Properties | TAS 103 or ASTM D1970 |
| Nail-On Underlayments | Physical Properties | TAS 104 |
| Asphalt Based Underlayments | Physical Properties | See Section 2 of this Protocol |
| **Attachment Components** | | |
| Nails, Screws, Clips, etc. | Corrosion Resistance | Appendix E of TAS 114 |

All Underlayments (with the exception of TAS 103 or TAS 104 underlayments) with exposure limitation in excess of 30 days must submit enhanced Accelerated Weathering testing in conjunction with applicable Physical Properties testing.

Exposure limitations up to a maximum of 180 days will be established through ASTM D4798 ~~as outlined in ASTM~~ ~~D5147~~ for 1000 hours (cycle A-1); pass /fail established by physical properties testing of the weathered samples. Physical property testing where specimen size will not fit into the accelerated weathering device may be omitted.

**TAS 110 Section 18**

ADD ALL ASTMs Specified in TAS 110

(S8299, R7304, R7305, R7303, S7301, S7300 and R706)

|  |  |  |  |
| --- | --- | --- | --- |
| **TAS 110 Table 15**  **Table 15** | | | |
| **Product** | | **Test** | **Test Standard** |
| Structural, Nonstructural Metal Panels and Metal Shingle Roof Assemblies | | Uplift Resistance | TAS 125 |
| Structural, Nonstructural Metal Panels and Metal Shingle Roof Assemblies | | Wind and Wind Driven Rain Resistance | TAS 100 |
| Structural, Nonstructural Metal Panels and Metal Shingle Roof Assemblies | | Fire Resistance | E108  (min. Class “B”) |
| Structural, Nonstructural Metal Panels and Metal Shingle Roof Assemblies | | Accelerated Weathering | G152 or G155  (2000 hours) |
| Structural, Nonstructural Metal Panels and Metal Shingle Roof Assemblies | | Salt Spray | B117  (1000 hours) |
| Insulated Metal Panels | | Thermal Value | C518 (report) |
| Nonstructural Standing Seam Metal Panels | | Static Water Leakage Test 1 | FM 4471 Appendix G or ASTM E2140-012 |
| 1 | Optional test to allow minimum slope of 1:12. | | |
| 2 | Standing seam metal roof panel systems that pass the requirements of FM 4471 Appendix G or ASTM E2140-01, shall be permitted to be installed to a minimum slope of 1:12 | | |

(R7439)

TAS-114

**TESTING APPLICATION STANDARD (TAS) No. 114-11**

**TEST PROCEDURES FOR ROOFING ASSEMBLIES**

**IN THE HIGH-VELOCITY HURRICANE ZONE JURISDICTION**

Revise the following sections as follows:

TAS 114 Appendix D Section 1

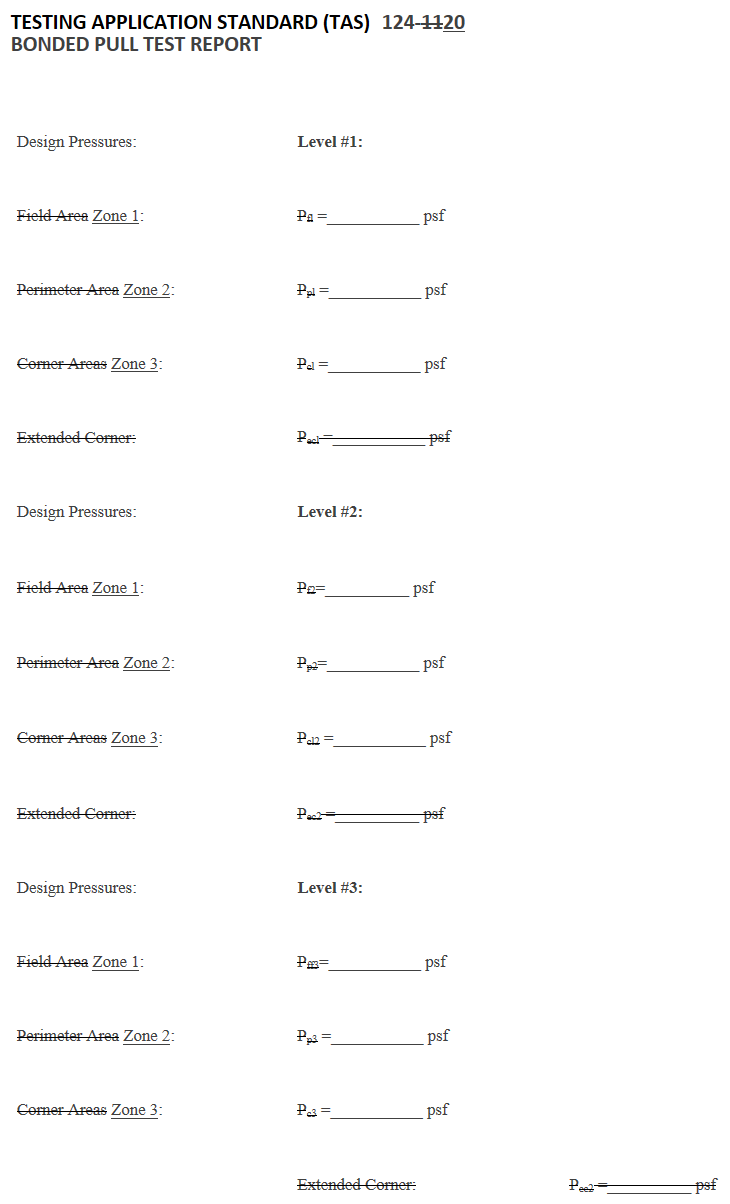
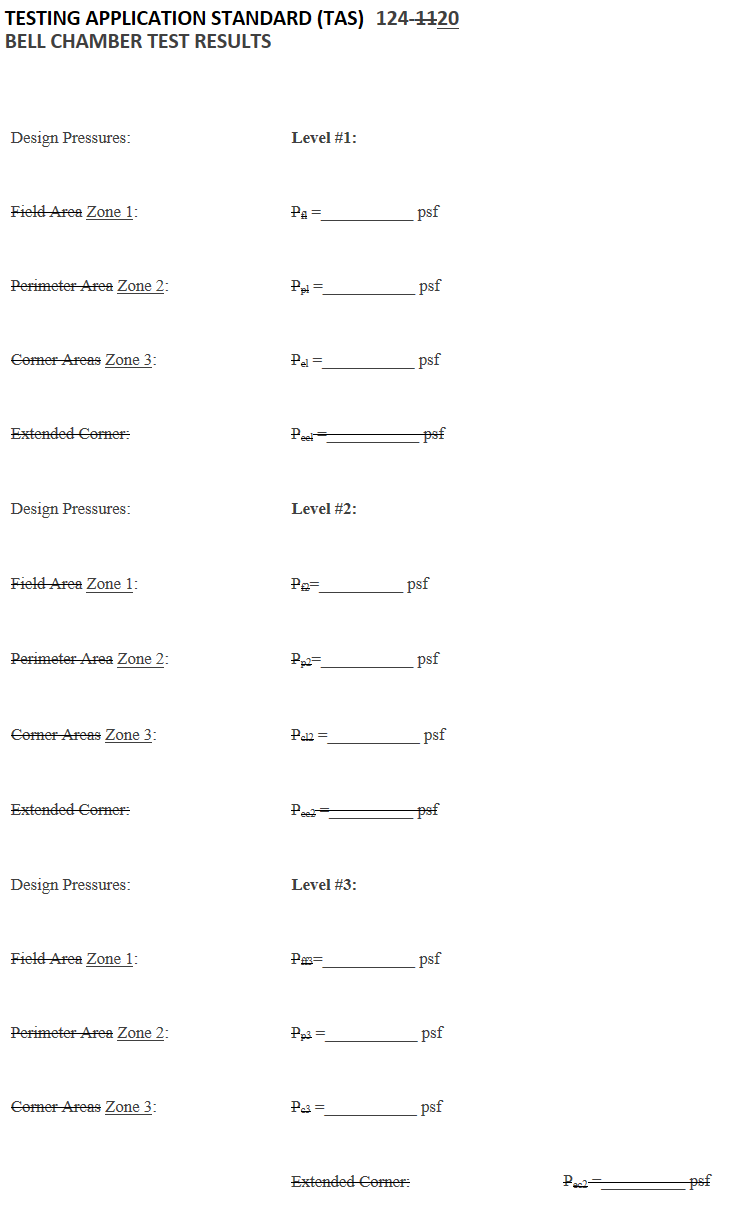
Add Section 1.2

1.2  This procedure is not applicable to roofing assemblies applied onto a steel deck substrate

(R7308)

TAS-124

|  |
| --- |
|  |
| **TESTING APPLICATION STANDARD (TAS) 124-~~11~~20**  **TEST PROCEDURE FOR FIELD UPLIFT RESISTANCE OF EXISTING MEMBRANE ROOF SYSTEMS AND IN SITU TESTING FOR REROOF ANDNEW CONSTRUCTIONAPPLICATIONS**      Revise the following sections as follows:  1.1 This protocol covers the determination of the resistance to uplift pressure of newly installed, adhered, single-ply, built-up, bituminous roofing systems over mechanically attached or adhered rigid board insulation over various deck types.    1.2 The test procedures outlined herein are intended as quality control to ~~determine~~ confirm the performance of a new roof system assembly or when determining the wind resistance of  ~~installed ove~~r an existing roof system assembly where a bonded recover roof system is to be installed ~~or directly over a roofing substrate~~.      4.1 The field test procedures specified herein provide a means for determining the uplift resistance of a new, adhered, single-ply, built-up, bituminous roof systems ~~assembly~~, ~~as stated in applicable specification bid documents,~~ installed on a building within the high-velocity hurricane zone. The test procedures are intended to confirm and supplement the uplift resistance performance of roofing systems as determined under laboratory conditions and confirm that a given installation meets the design pressure requirements under ASCE 7, as required in the Florida Building Code, Building.    6.2.4 Testing under this protocol shall be conducted on mechanically attached roof system assemblies, with fastener spacing of no more than two (2) feet in any direction or may be conducted on fully adhered system assemblies. When testing mechanically attached roof system assemblies, deflection measurement shall not be required.    7.1 The total number of tests to be conducted when testing over an existing roof assembly is listed in Table 1, on the following page. Of these tests, half shall be conducted at selected locations within the Zone 2 and Zone 3 ~~perimeter~~ areas of the roof and half shall be conducted at selected locations within the Zone 1 ~~field~~ area of the roof.    ~~7.2 Three test samples are required for all assemblies tested on any size roof deck when the test assembly is applied directly to the substrate for confirmation of design pressure performance. (See Section 4.1.1.)~~    **9. Procedure:**  9.1 Bell chamber tests over an existing roof system assembly:    9.1.1 The test area’s membrane surface shall be clean, smooth and dry to provide a continuous contact surface for the edges of the pressure chamber. For roof surfaces which contain surfacing such as gravel, slag or granules, the test areas shall be prepared as follows:     * Remove the loose gravel surfacing; sweeping a 12 inch (300 mm) wide square in which the chamber perimeter will be placed.      * Apply a heavy pouring of hot asphalt over the swept area and allow to completely cool. The use of other approved compatible sealants or adhesives shall not be prohibited.      * This test area preparation is intended to provide a continuous, smooth surface to which the edges of the test chamber make contact such that accurate pressure measurements are taken.      * Deflection measurement shall not be required when testing mechanically attached roof    system assemblies.       9.1.8 At the end of the first one minute interval, increase the pressure within the chamber in increments of 15 + 0.5 lbf/ft2 (720 + 20 Pa), holding each pressure level for a period of one minute, until:     * the roof system assembly fails, as noted in Section 10.1; or,      * the pressure within the chamber is held at the design pressure for the particular roof area (i.e., Zone 1, Zone 2 or Zone 3 ~~field, perimeter or corner~~ areas) for a period of one minute. These design pressures are determined in compliance with ASCE 7, as specified in the *Florida Building* *Code, Building* and are listed on Section II of the Uniform Building Permit.       9.3.4 Apply a flood coat of hot steep asphalt coal tar pitch over the marked test area at an application rate of 4 lb/ft2 and float the test panel into place. Allow a curing time of 24 hours for hot asphalt and 48 hours for coal tar pitch applications. Curing time may vary due to atmospheric conditions. The use of other approved compatible sealants shall not be prohibited.    11.2.8 Field uplift resistance testing shall be performed in the preceding three (3) months, unless otherwise authorized by the *building official.* |



(R7183)

**TESTING APPLICATION STANDARD (TAS)131-~~95~~20**

**STANDARD REQUIREMENTS FOR UNREINFORCED THERMOPLASTIC OLEFIN**

**ELASTOMER BASED SHEET USED IN SINGLE-PLY ROOF ~~MEMBRANE~~SYSTEMS**

Revise the following sections as follows:

1.            Scope:

1.1          This Protocol covers unreinforced ~~and reinforced~~ thermoplastic olefin elastomer sheet made from blends of polypropylene and ethylene-propylene rubber (TPO), intended for use as a roof membrane exposed to the weather.

1.2          The test and property limits are used to characterize the membrane and are minimum values. In-place roof system design criteria, such as fire resistance, field seaming strength, material compatibility, and up-lift resistance, in situ shrinkage, among others, are factors which must be considered but are beyond the scope of this specification.

1.3          The following precautionary caveat pertains to the test methods portion only, Section 8, of this specification: This Standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

1.4          All testing shall be conducted by an approved testing agency, and all test reports shall be signed by an authorized signer of the testing/listing agency. Manufacturing location of tested products shall be verified by the testing laboratory and be included in the report.

2.            Referenced Documents:

2.1          ASTM Standards

D412 Test Method for Rubber Properties in Tension

D471 Test Method for Rubber Property - Effect of Liquids

D573 Test method for Rubber-Deterioration in an Air Oven

D624 Test Method for Rubber Property - Tear Resistance

D751 Method of Testing Coated Fabrics

D816 Methods of Testing Rubber Cements

D1149 Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber (Flat Specimens)

D1204 Test Method for Linear Dimensional Changes of Non-rigid Thermoplastic Sheeting or Film at Elevated Temperature

~~D1822 Tensile Impact Testing~~

D2137 Test Method for Rubber Property - Brittleness Point of Flexible Polymers and Coated Fabrics

E 96 Water Vapor Permeability, Method BW

E380 Excerpts from Use of the International System of Units (SI) (The Modernized Metric System)

~~G 154 Standard Practice for Operating Fluorescent Light Apparatus for UV-Condensation (QUV) Exposure of Nonmetallic Material~~

G 155 Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Nonmetallic Materials

2.2          The Florida Building Code, Building

2.3          Application Standards

TAS 114 Test Procedures for Roof System Assemblies in the High Velocity Hurricane Zone

Jurisdiction

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. 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 E380.

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 the user to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

5.            Classification:

5.1          Types are used to identify the principal polymer component of the sheet.

5.1.1      Ethylene-Propylene based elastomer (TPO)

~~5.2          Grades indicate the mass percentage of the polymer (TPO) in relation to the total sheet:~~

~~5.2.1      Grade 1 - Greater than 95%.~~

~~5.2.2      Grade 2 - 50 to 95%.~~

~~5.3          Class describes sheet construction.~~

~~5.3.1      Class U - Unreinforced.~~

~~5.3.2      Class SR - Reinforced, internally or externally.~~

6.            Materials and Manufacture:

6.1          The sheet shall be formulated from the appropriate polymers and other compounding ingredients. The principal polymer used in the sheet shall be one of those listed in Section 5.1.1 ~~in accordance with the percentages listed in Sections 5.2.1 and 5.2.2.~~

6.2          The sheet shall be capable of being bonded to itself for making watertight field splices and repairs, and the supplier or fabricator shall recommend suitable bonding methods and materials.

7.            Physical Properties:

7.1          The test shall conform to the physical requirements prescribed in Table 1 of this Protocol.

8.            Dimensions and Permissible Variations:

8.1          The width and length of the sheet shall be as published and tested for physical property values. The sheet width shall be as tested for system performance in compliance with TAS 114.

8.1.1      The width and length tolerance shall be + 3%, - 0%.

8.2          The published sheet thickness tolerance shall be +15%, -10% of the specified thickness, but in no case shall the thickness be less than the minimum listed Table 1 of this Protocol.

**Remove this table and footnotes**

**~~TABLE 1~~**

**~~PHYSICAL REQUIREMENTS FOR TPO ELASTOMER SHEETS~~**

|  |  |  |
| --- | --- | --- |
| **~~Physical Property~~** | **~~Grade 1 or 2 Class SR~~** | **~~Grade 1 or 2 Class U Unreinforced~~** |
| ~~Thickness (over scrim) in. (mm)~~ | ~~min. 0.015 (0.385)~~ | ~~NA~~ |
| ~~Thickness (overall) in. (mm)~~ | ~~min. 0.039 (1.0)~~ | ~~min. 0.039 (1.0)~~ |
| ~~Tensile Strength psi (MPa)~~ | ~~NA~~ | ~~min. 1740 (12.0)~~ |
| ~~Breaking Strength lbf (kN)~~ | ~~min. 225 (1.0)~~ | ~~NA~~ |
| ~~Elongation (ultimate) %~~ | ~~NA~~ | ~~min. 500~~ |
| ~~Elongation (at break) %~~ | ~~min. 151~~ | ~~NA~~ |
| ~~Tensile set %~~ | ~~NA~~ | ~~max. 10~~ |
| ~~Tear Resistance lbf/in (kN/m)~~ |  | ~~min. 340 (60)~~ |
| ~~Tearing Strength lbf (N)~~ | ~~min. 55 (245)~~ | ~~NA~~ |
| ~~Brittleness Point °F(°C)~~ | ~~max. -49 (-45)~~ | ~~max. -30 (-34)~~ |
| ~~Ozone Resistance no cracks~~ | ~~pass~~ | ~~pass~~ |
| **~~After Heat Aging-(A.H.A.)~~** | | |
| ~~Tensile Strength-A.H.A. psi (MPa)~~ | ~~NA~~ | ~~min. 1740 (120)~~ |
| ~~Breaking Strength-A.H.A. lbf (kN)~~ | ~~min. 225 (1.0)~~ | ~~NA~~ |
| ~~Elongation (ultimate)-A.H.A. %~~ | ~~NA~~ | ~~min. 500~~ |
| ~~Elongation (at break)-A.H.A. %~~ | ~~min. 151~~ | ~~NA~~ |
| ~~Tear Resistance -A.H.A. lbf/in. (kN/m)~~ | ~~NA~~ | ~~min. 340 (60)~~ |
| ~~Linear Dimensional Change -A.H.A %~~    ~~Weight Change -A.H.A %~~ | ~~max. ± 2~~ | ~~max. ± 2~~    ~~max. ± 2~~ |
| ~~Water Absorption mass %~~ | ~~max. ± 42~~ | ~~max. ± 2~~ |
| ~~Factory Seam Strength lbf/in. (kN/m)~~ | ~~min. 51 (9) or Sheet Failure~~ | ~~min. 51 (9) or Sheet Failure~~ |
| ~~Weather Resistance no cracks or crazing~~ | ~~pass~~ | ~~pass~~ |
| **~~After Accelerated Weathering-A.A.W.~~** | | |
| ~~Tensile Strength-A.A.W. psi (MPa)~~ | ~~report~~ | ~~min. 1450 (10.0)~~ |
| ~~Elongation (ultimate)-A.A.W. %~~ | ~~report~~ | ~~min. 200 %~~ |
| ~~PRFSE-A.A.W. %~~ | ~~report~~ | ~~30.00~~ |
| ~~Static Puncture Resistance~~ | ~~report~~ | ~~report~~ |
| ~~Dynamic Puncture Resistance~~ | ~~report~~ | ~~report~~ |
| ~~Tensile Impact ft•lb/in2 (kJ/m2)~~ |  | ~~min. 21 (44)~~ |

~~1 For reinforcing fabric only.~~

~~2 Test performed on coating elastomer only.~~

**Add this table**

**TABLE 1**

**PHYSICAL REQUIREMENTS FOR UNREINFORCED TPO ELASTOMER SHEETS**

|  |  |
| --- | --- |
| **Physical Property** | **Requirement** |
| Thickness (overall) in. (mm) | min. 0.039 (1.0) |
| Tensile Strength psi (MPa) | min. 1740 (12.0) |
| Elongation (ultimate) % | min. 500 |
| Tear Resistance lbf/in (kN/m) | min. 340 (60) |
| Brittleness Point °F(°C) | max. -30 (-34) |
| Ozone Resistance no cracks | pass |
| **After Heat Aging-(A.H.A.)** | |
| Tensile Strength-A.H.A. psi (MPa) | min. 1740 (120) |
| Elongation (ultimate)-A.H.A. % | min. 500 |
| Tear Resistance -A.H.A. lbf/in. (kN/m) | min. 340 (60) |
| Linear Dimensional Change -A.H.A %    Weight Change -A.H.A % | max. ± 2    max. ± 2 |
| Water Absorption mass % | max. ± 2 |
| Factory Seam Strength lbf/in. (kN/m) | min. 51 (9) or Sheet Failure |
| Weather Resistance no cracks or crazing | pass |
| **After Accelerated Weathering-A.A.W.** | |
| Tensile Strength-A.A.W. psi (MPa) | min. 1450 (10.0) |
| Elongation (ultimate)-A.A.W. % | min. 200 % |
| PRFSE-A.A.W. % | 30.00 |
| Static Puncture Resistance | report |
| Dynamic Puncture Resistance | report |

9.            Workmanship, Finish, and Appearance:

9.1          The sheet, including factory seams, if present, shall be water tight and free of pinholes, particles of foreign matter, undisbursed raw material, or other manufacturing defects that might affect serviceability. Excessive irregularities on the sheet surface shall not be acceptable (or portion thereof), then its rejection should be negotiated between supplier and buyer.

9.2          Edges of the sheets shall be straight and flat so that they may be seamed to one another without fishmouthing.

10. Test Methods: **(Needs to be Re-numbered)**

~~10.1                        Thickness (over scrim) - Appendix A of this Protocol.~~

~~10.2                        Dimensions - Test Method D 751~~

~~10.2.1                    Testing shall be conducted after permitting the sheet to relax at 73°F (23°C) for 1 hour.~~

10.~~3~~1                     Thickness (overall) - Test Methods D 412 for Class U Sheet and D 751 for Class SR Sheet.

10.~~4~~2                     Tensile Strength - Test Method D 412, Die C for Class U Sheet.

~~10.5                        Breaking Strength - Test Method D 751, Grab Method for Class SR Sheet.~~

10.~~6~~3                     Elongation (ultimate) - Test Method D 412, Die C for Class U Sheet.

~~10.7                        Elongation (at break) - Test Method D 751, Grab method for Class SR Sheet.~~

~~10.8                        Tensile Set - Test Method D 412, Method A, Die C, 50% elongation for Class U Sheet.~~

10.~~9~~4                     Tear Resistance - Test Method D 624, Die C for Class U Sheet.

~~10.10                     Tearing Strength - Test Method D 751, Procedure B for Class SR Sheet.~~

10.~~11~~5                   Brittleness Point - Test Method D 746 or D 2137.

10.~~12~~6                   Ozone Resistance - Test Method D 1149.

10.~~12~~6.1               Inspect at 7x magnification on specimens exposed to 1 x 10-5 psi (100 MPa) ozone in air at 100°F (38°C). For Class U Sheet, wrap around 3" (76.2 mm) mandrel for 166 hour exposure. For Class SR Sheets, use Procedure B.

10.~~13~~7                   Heat Aging - Test Method D 573.

10.~~13~~7.1               Age sheet specimens at 240°F (115°C) for 670 hours.

10.~~14~~8                   Linear Dimensional Change - Test Method D 471.

10.~~14~~8.1               Conduct test at 158°F (70°C) for 166 hours.

10.~~15~~9   Water Absorption - Test Method D 471.

10.~~15~~9.1               Conduct test at 158°F (70°C) for 166 hours.

10.1~~6~~0                   Factory Seam Strength - Test Method D 816, Method B.

10.1~~6~~0.1               Modify procedure by cutting a 1 in. (25.4 mm) wide by 12 in. (304.8 mm) long sample across the lap seam. Place in jaws approximately 2 in. (50.8 mm) from edges of the overlap area and test at 2 in. per minute (50.8 mm/min.) claim for rehearing.

10.1~~7~~1                   Weather Resistance - Practice G 155

10.1~~7~~1.1               Xenon-Arc shall be operated to the following conditions:

Filter Type: borosilicate inner and outer

Exposure: 0.35 W/m2 at 340 nm

Cycle: 690 min light, 30 min. light and water spray Black Panel

Temperature: 80 ± 3°C

Relative Humidity: 50 ± 5%

Spray Water: deionized

Specimen Rotation: every 250 hours

Exposure Time: 4000 hours

10.1~~7~~1.2               Specimens for exposure shall be mounted under no strain. The recommended specimen size is 2.75 in. x 8.0 in. (70 mm x 203 mm). After exposure, remove the specimens and inspect immediately. Strain Class U specimens 10% and visually inspect for cracks and crazing under 7x magnification.

~~10.18                     Weather Resistance - Practice G 154~~

~~10.18.1                 Operate to the following conditions:~~

~~Lamp Type: Fluorescent UVB - 313 (UVB-B)~~

~~Test Cycle: 20 hours UV @ 80°C 4 hours condensate @50°C~~

~~Exposure: 2000 hours~~

~~10.19                     Tensile Impact - ASTM D1822 for Class U Sheet.~~

11.          Inspection and Special Testing:

11.1        The manufacturer shall inspect and test his production to assure compliance of the product with this Protocol.

11.2        If the results of any tests do not conform to the requirements of this specification, retesting to determine conformity shall be performed as required by the Authority Having Jurisdiction.

12.          Rejection and Resubmittal:

12.1        Failure to conform to any one of the requirements prescribed in this specification shall constitute grounds for suspension of a current Product Approval.

13.          Product Marking:

13.1        The sheet shall be identified on the labeling in compliance with Section 1517 of the Florida Building Code, Building.

14.          Certification:

14.1        Upon request of the Authority Having Jurisdiction, a manufacturer may be required to certify that the material was manufactured and tested in accordance with this Protocol. Additional testing for confirmation may be required by an approved testing agency.

15.          Packaging and Package Marking:

15.1        The material shall be rolled on a substantial core and packaged in a standard commercial manner.

15.2        Shipping containers shall be marked with the name of the material, the stock and lot number.

~~TESTING APPLICATION STANDARD (TAS) 131-95~~

~~Appendix A~~

~~TEST PROCEDURE FOR THICKNESS MEASUREMENT OF~~

~~COATING OVER CLASS SR OLEFIN ELASTOMER BASED SHEET ROOFING~~

~~1.            Scope:~~

~~1.1          The procedure outlined in this Protocol Appendix provides a method for measuring the thickness of the coating over fiber backing or reinforcing fabric.~~

~~2. Measurement Method:~~

~~2.1          Principal~~

~~2.1.1      The thickness of coating material over fiber, fabric, or scrim can be observed with a standard microscope. Measurement is made with a calibrated eyepiece.~~

~~2.2          Apparatus~~

~~2.2.1      Microscope, 60x with reticule.~~

~~2.2.2      Light Source - If light source on the microscope is not adequate, a small high-intensity lamp may also be used.~~

~~2.2.3      Stage Micrometer, 0.001 in. (0.0254 mm) divisions.~~

~~2.3          Calibration Procedure~~

~~2.3.1      Place a standard reflectance stage micrometer in place of the specimen.~~

~~2.3.2      Position the reticle eyepiece and the micrometer such that the scales are superimposed. Focus the reticle by turning the eyepiece. Focus the specimen and reticle by turning the vertical adjustment knob.~~

~~2.3.3      Locate a point at which both scales line up. Count the number of micrometer divisions away. Measure to the nearest 0.0005 in. or 0.5 mil (0.0125 mm). The calibration may be optimized by increasing the number of divisions measured.~~

~~2.3.4      Repeat the calibration three times and average the results. A calibration example is given below.~~

~~2.3.5      Calibration Example~~

~~2.3.5.1   If four reticle divisions (RD) are found equal to 4.5 micrometer divisions (MD), then 1 RD = 0.001125 in. or 1.125 mils (28.6 mm) or the calibration factor.~~

~~2.4          Specimen Analysis:~~

~~2.4.1      Carefully center a sharp single edge razor or equivalent over the fiber intersections along the x-x axis.~~

~~2.4.2      Make a clean bias cut completely through the sheet.~~

~~2.4.3      Remove the razor-cut section and mount in common putty with the cut surface facing upward.~~

~~2.4.4      Observe the cut surface with the eyepiece reticle. Measure the thickness of the coating on either side of the thread intersection by counting the number of reticle divisions (to the nearest one-half division).~~

~~2.4.5      Sample three areas of the coatings and average the results.~~

~~3. Calculation and Report:~~

~~3.1          Multiply the number or reticle divisions representing the thickness of the coating by calibration factor. Report the average results from the areas of the coating to the nearest 0.005” or 0.5 mils (12.7 mm).~~

~~4. Precision:~~

~~4.1          Precision - Measurements are accurate to ± -0.005 in. or 5.0 mils (12.7 mm) when the thickness is about 0.020 in. or 20 mils (0.5 mm).~~

(S7307)