ROOFING APPLICATION STANDARD (RAS) No. 137

STANDARD REQUIREMENTS FOR MECHANICAL ATTACHMENT OF SINGLE-PLY ROOF COVERINGS TO VARIOUS SUBSTRATES

1. Scope

1.1 The standards set forth herein provide a means of determining the mechanical attachment of single-ply roof covers to insulated or uninsulated roof decks in compliance with the requirements set forth in Chapter 16 (High-Velocity Hurricane Zones) of the *Florida Building Code, Building*; specifically Section 1619 covering wind loads. For the mechanical attachment or bonding of insulation panels, refer to RAS 117.

1.2 All testing shall be conducted by an approved testing agency. A Professional Engineer, Registered Architect, or Registered Roof Consultant shall sign all calculations.

2. Definitions

2.1 For definitions of terms used in this application standard, refer to ASTM D 1079 and the *Florida Building Code, Building*.

3. General

3.1 All single-ply roof covering fasteners, stress plates and/or fastener assemblies shall have Product Approval, and shall be listed in the single-ply roof assembly manufacturer's Product Approval.

3.2 All insulation products shall have Product Approval, and shall be listed in the single-ply roof assembly Product Approval.

3.3 Care shall be taken not to overdrive single-ply membrane fasteners. Overdriving can deform stress plates and/or tear the membrane, reducing the uplift resistance performance of the Roof System assembly. All damaged stress plates shall be removed and replaced.

3.4 All overdriven fasteners or fasteners driven at an angle, shall be removed and replaced. If the insulation facer has been broken, or membrane torn or punctured by a stress plate, that section of insulation panel or membrane shall be removed and replaced.

3.5 All fasteners shall be installed in compliance with the fastener manufacturer's published installation instructions and the limitations set forth in the Product Approval. Fasteners shall be installed with tooling as specified by the fastener manufacturer.

3.6 In steel deck applications membrane attachment shall be perpendicular to the flutes of the steel deck. Membrane attachment shall be to the top flute of the deck. Fasteners spacing shall not be less, than that of the metal deck flute spacing.

4. Fasteners and Spacing

4.1 All fasteners and stress plates shall be tested in compliance with Chapter 15 (High-Velocity Hurricane Zones) of the *Florida Building Code, Building.*

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 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.

4.3 In recover or reroof applications if testing in compliance with TAS 105 of the membrane fasteners results in a minimum characteristic resistance force less than 275 lbf (1224 N), a Professional Engineer, or Registered Architect shall perform a moisture survey, in compliance with TAS 126, and examine the deck's integrity. The moisture survey and examination results, along with the withdrawal resistance test results and a proposed deck repair/replacement specification, shall be submitted to the building official for review prior to issuance of a roofing permit.

4.3.1 Subsequent to repair or replacement of the deck, a withdrawal resistance test of the fasteners shall be conducted. The same criteria noted above shall apply.

5. Single-Ply Membrane Attachment

5.1 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:

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 design pressures are as follows:

Field Area: *- 43.0 psf*
Perimeter Area: *- 56.0 psf*
Corner Areas: *- 90.0 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.

$$X = \frac{(row\ spacing\ x\ fastener\ spacing)}{144}$$

For this case, this results in 2.25 ft^2 per fastener, as shown below.

$$X = \frac{(18\ in\ x\ 18\ in)}{144} = 2.25\ ft^2$$

6.1.2 Determine the "Fastener Value."

General Equation:

$$f_v = \left(\max.\ design\ \ pressure\right)\ x\ [square\ \ feet\ \ per\ \ fastener\ \left(X\right)]$$

For this case, this results in a fastener value of 101.25 lbf, as shown below.

$$f_v = \left(\frac{45\ lbf}{ft^2}\right) x \left(\frac{2.25\ ft^2}{fastener}\right) = 101.25\ lbf$$

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

General Equation:

$$FS = \frac{f_v\, x\, 144}{P\ x\ RS}$$

where:
FS = fastener spacing (in);
f_v = fastener value (lbf);
P = design pressure (psf); and,
RS = row spacing (in.)

Perimeter Area:

$$FS = \frac{(101.25)\ x \left(\frac{144\ in^2}{ft^2}\right)}{(56.0\ psf)\ x\ (18\ inches)} = 14.5\ inches$$

All fractions shall be rounded down to the next whole number. Therefore, a fastener spacing of 14 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.

Corner Area:

$$FS = \frac{(101.25\ x \left(\frac{144\ in^2}{ft^2}\right)}{(90.0\ psf)\ x\ (18\ inches)} = 9.0\ inches$$

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.