**TEST PROTOCOLS FOR HIGH-VELOCITY HURRICANE ZONES, 6th Edition (2017)**

**ICC EDIT VERSION**

**[NOTE: The base document is the 5th Edition (2014) Florida Building Code, Test Protocols for High-Velocity Hurricane Zones]**

**PREFACE**

**History**

The State of Florida first mandated statewide building codes during the 1970s at the beginning of the modern construction boom. The first law required all municipalities and counties to adopt and enforce one of the four state-recognized model codes known as the “state minimum building codes.” During the early 1990s a series of natural disasters, together with the increasing complexity of building construction regulation in vastly changed markets, led to a comprehensive review of the state building code system. The study revealed that building code adoption and enforcement was inconsistent throughout the state and those local codes thought to be the strongest proved inadequate when tested by major hurricane events. The consequences of the building codes system failure were devastation to lives and economies and a statewide property insurance crisis. The response was a reform of the state building construction regulatory system that placed emphasis on uniformity and accountability.

The 1998 Florida Legislature amended Chapter 553, *Florida Statutes* (FS), Building Construction Standards, to create a single state building code that is enforced by local governments. As of March 1, 2002, the *Florida Building Code*, which is developed and maintained by the Florida Building Commission, supersedes all local building codes. The *Florida Building Code* is updated every three years and may be amended annually to incorporate interpretations and clarifications.

**Scope**

The *Florida Building Code* is based on national model building codes and national consensus standards which are amended where necessary for Florida’s specific needs. ~~However, code requirements that address snow loads and earthquake protection are pervasive; they are left in place but should not be utilized or enforced because Florida has no snow load or earthquake threat.~~ The code incorporates all building construction-related regulations for public and private buildings in the State of Florida other than those specifically exempted by Section 553.73, *Florida Statutes*. It has been harmonized with the *Florida Fire Prevention Code*, which is developed and maintained by the Department of Financial Services, Office of the State Fire Marshal, to establish unified and consistent standards.

The base codes for the 6th edition (2017) of the *Florida Building Code* include: the International Building Code®, 2015 edition; the International Plumbing Code®, 2015 edition; the International Mechanical Code®, 2015 edition; the International Fuel Gas Code®, 2015 edition; the International Residential Code®, 2015 edition; the International Existing Building Code®, 2015 edition; the International Energy Conservation Code, 2015; the National Electrical Code, 2014 edition; substantive criteria from the American Society of Heating, Refrigerating and Air-conditioning Engineers’ (ASHRAE) Standard 90.1-2013. State and local codes adopted and incorporated into the code include the *Florida Building Code, Accessibility,* and special hurricane protection standards for the High-Velocity Hurricane Zone.

The code is composed of nine main volumes: the *Florida Building Code, Building*, which also includes state regulations for licensed facilities; the *Florida Building Code, Plumbing*; the *Florida Building Code, Mechanical;* the *Florida Building Code, Fuel Gas*; the *Florida Building Code, Existing Building*; the *Florida Building Code, Residential;* the *Florida Building Code, Energy Conservation*; the *Florida Building Code, Accessibility* and the *Florida Building Code, Test Protocols for High-Velocity Hurricane Zones*. Chapter 27 of the *Florida Building Code, Building*, adopts the *National Electrical Code*, NFPA 70, by reference.

Under certain strictly defined conditions, local governments may amend requirements to be more stringent than the code. All local amendments to the *Florida Building Code* must be adopted by local ordinance and reported to the Florida Building Commission then posted on [www.floridabuilding.org](http://www.floridabuilding.org/) in Legislative format for a month before being enforced. Local amendments to the *Florida Building Code* and the *Florida Fire Prevention Code* may be obtained from the Florida Building Commission web site, or from the Florida Department of Business and Professional Regulation or the Florida Department of Financial Services, Office of the State Fire Marshal, respectively.

**Adoption and Maintenance**

The *Florida Building Code* is adopted and updated with new editions triennially by the Florida Building Commission. It is amended annually to incorporate interpretations, clarifications and to update standards. Minimum requirements for permitting, plans review and inspections are established by the code, and local jurisdictions may adopt additional administrative requirements that are more stringent. Local technical amendments are subject to strict criteria established by Section 553.73, *F.S.* They are subject to Commission review and adoption into the code or repeal when the code is updated triennially and are subject to appeal to the Commission according to the procedures established by Section 553.73, *F.S*.

Eleven Technical Advisory Committees (TACs), which are constituted consistent with American National Standards Institute (ANSI) Guidelines, review proposed code changes and clarifications of the code and make recommendations to the Commission. These TACs whose membership is constituted consistent with American National Standards Institute (ANSI) Guidelines include: Accessibility; Joint Building Fire (a joint committee of the Commission and the State Fire Marshal); Building Structural; Code Administration/ Enforcement; Electrical; Energy; Mechanical; Plumbing and Fuel Gas; Roofing; Swimming Pool; and Special Occupancy (state agency construction and facility licensing regulations).

The Commission may only issue official code clarifications using procedures of Chapter 120, *Florida Statutes*. To obtain such a clarification, a request for a Declaratory Statement (DEC) must be made to the Florida Building Commission in a manner that establishes a clear set of facts and circumstances and identifies the section of the code in question. Requests are analyzed by staff, reviewed by the appropriate Technical Advisory Committee, and sent to the Florida Building Commission for action. These interpretations establish precedents for situations having similar facts and circumstances and are typically incorporated into the code in the next code amendment cycle. Non-binding opinions are available from the Building Officials Association of Florida’s web site (www.BOAF.net) and a Binding Opinion process is available online at www.floridabuilding.org.

**Marginal Markings**

Dotted vertical lines in the margins within the body of the Florida Test Protocols for High-Velocity Hurricane Zones indicate a change from the requirements of the base codes to the Florida Test Protocols for High-Velocity Hurricane Zones, 6th Edition (2017), effective ???.

Sections deleted from the base code are designated “Reserved”.

**Acknowledgments**

The *Florida Building Code* is produced through the efforts and contributions of building designers, contractors, product manufacturers, regulators and other interested parties who participate in the Florida Building Commission’s consensus processes, Commission staff and the participants in the national model code development processes.

***ROOFING APPLICATION STANDARD (RAS) No. 109***

***Standard RAS 109. Add or modify to read as follows:***

**1.Scope**

1.1 This Roofing Application Standard sets the requirements to determine whether a substrate and surrounding environmental conditions are appropriate for the application of a spray applied polyurethane foam Roof Assembly; whether the final application is in compliance with the requirements of the *Florida Building Code, Building* and, whether proposed details are in compliance with industry standards.

**2. Referenced Documents**

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

**3. Significance and Use**

3.1 The test procedures outlined herein provide a means for establishing the use of industry accepted details of spray applied polyurethane foam Roof Assemblies, proper substrate and environmental conditions at the time of application, and methods of quality control during and after application of the Roof Assembly.

3.2 Quality control test methods are intended to confirm compliance with the wind load requirements of Chapter 16 (High-Velocity Hurricane Zones) of the *Florida Building Code, Building* and compliance with the spray applied polyurethane foam Roof Assembly manufacturer's Product Approval.

**4. General Requirements**

4.1 All spray applied polyurethane foam (PUF) Roof Assemblies shall have Product Approval. Spray applied polyurethane manufacturers' Product Approval shall include all components used in accepted

systems, and manufacturer's installation instructions, including environmental constraints concerning application temperatures and relative humidity.

4.2 All spray applied polyurethane foam (PUF), and coatings applied over spray applied polyurethane foam shall comply with ~~Section 1521 of~~ the *Florida Building Code, Building*.

4.3 All spray applied polyurethane foam applications shall have a minimum slope of 1/4 in.:12 in. The application shall be applied to eliminate ponding. Ponding, for the purposes of this Roofing

Application Standard, shall be defined as any roof area of 100 ft2 more which holds 1/2 in. or more of water as measured 24 hours after a rain fall.

4.4 ~~Certification~~ *A Certificate of Compliance* of a completed spray applied polyurethane foam Roof System Assembly shall be provided to the building official within 30 days of job completion as detailed in Section 1521 of the Florida Building Code, Building.

4.5 The minimum finished thickness of all spray applied polyurethane foam applications shall be not less than 1 in. A foam pass (or lift) shall not be less than 0.50 in. in thickness.

4.6 The spray polyurethane foam shall be uniformly terminated a minimum of four inches above the roof line at all penetrations (except drains, parapet walls or building junctions). Foamed in place

cants shall be smooth and uniform to allow for positive drainage.

4.7 The spray polyurethane foam shall be terminated below existing weep holes at through wall flashings. Weep holes shall not be covered with foam or coatings.

**5. Details**

5.1 Model details for spray applied polyurethane foam applications are provided in Appendix "A,” herein.

**6. General Practices** - The following general practices shall be observed prior to and during the application of spray applied polyurethane foam:

6.1 A Job Log shall be maintained on the job site in a ring binder, including but not limited to:

· Roof Assembly Product Approval

· Section 11 of the Uniform Building Permit Application

· All pre-job testing

· All job testing detailed in this Roofing Application Standard

· Daily weather conditions

· All written or verbal communications with spray applied polyurethane foam roof assembly

manufacturer relating to the application

· A list of all accessory products used within the Roof Assembly; and,

· All material safety data sheets

6.2 The building official shall have access to the Job Log during site inspections.

6.3 The roof deck shall be securely fastened to the building structure in compliance with the requirements set forth in the relevant decking chapter of the Florida Building Code, Building.

6.4 Surface preparation of the roof decking shall be in compliance with the Guide Specifications of the Polyurethane Foam Contractors Division, Section 3.02.

6.5 For spray applied polyurethane foam applications over an existing built-up Roof Assembly, the existing Assembly shall be tested for uplift resistance in compliance with TAS 124 to confirm compliance with design pressures determined in compliance with Chapter 16 (High-Velocity Hurricane Zones) of the *Florida Building Code, Building.*

6.6 Should the existing roof assembly fail to meet the required design pressures, additional mechanical attachment consisting of approved insulation fasteners and stress plate assemblies at a density calculated in compliance with RAS 117 and Chapter 16 (High-Velocity Hurricane Zones) of the *Florida Building Code, Building* ~~may~~ shall be permitted to be provided. Alternatively the removal of the existing roof assembly, including any insulation substrate, ~~may be removed~~ to the structural deck shall be permitted.

**7. Adhesion to Substrate**

7.1 Spray-applied polyurethane foam shall be permitted to ~~may~~ be applied to ~~a large variety of~~ substrate materials including but not limited to concrete, painted steel, galvanized steel, gravel- surfaced built-up roofing, smooth surface built-up roofing, synthetic membranes, and coatings. If

an adhesion of the spray applied polyurethane foam to the specific existing substrate is not listed in the manufacturer's Product Approval, adhesion testing conducted in compliance with TAS 124 ~~may~~ shall be permitted ~~be conducted in compliance with TAS 124.~~

7.1.1 A minimum of three adhesion tests shall be conducted in each roof area (i.e. field, perimeter and corner areas). The test report shall include results from each adhesion test as well as a mean value of the sample.

7.1.2 Average adhesion test results in each respective roof area shall meet or exceed 1.45 times the design pressure for that respective roof area, calculated in compliance with Chapter 16 (High- Velocity Hurricane Zones) of the *Florida Building Code, Building.*

7.1.3 If primer is used in the test specimen construction, then primer shall be required as a part of the application. The spray applied polyurethane foam manufacturer shall provide primer application instructions together with material safety data sheets and acceptable environmental conditions for application.

7.1.4 The adhesion test report shall be attached to Section 11 of the Uniform Building Permit Application, and submitted to the building official for review.

7.2 Prior to application of any spray applied polyurethane foam, the substrate surface shall be clean; dry; free from loose dirt or any contaminants that ~~may~~ interfere with proper adhesion of any

of the Roof Assembly components. Any deteriorated sections of deck or membrane shall be removed and replaced in compliance with this code.

7.2.1 Deck contaminants and debris shall be removed by methods approved by the spray applied polyurethane foam manufacturer. The application substrate shall be in similar condition to the

substrate tested for adhesion performance.

7.3 Areas to receive spray-applied polyurethane foam shall be thoroughly examined and tested for moisture immediately prior to foam application, particularly early in the morning and late in the afternoon, when condensation is most likely to be present. Testing shall be carried out on all areas, including those areas that appear dry to sight and touch.

7.3.1 Moisture detection shall be conducted using moisture detection paper or other moisture detection device that is sensitive to small quantities of surface moisture.

7.3.2 Results of all moisture testing shall be recorded in the job log including: 1) the type of testing; 2) the area(s) tested; 3) the time; and 4) the results.

7.3.3 A minimum of six moisture tests shall be conducted. All test results shall be recorded in the Job Log.

7.3.4 Moisture test shall be conducted: 1) not less than three more for every additional 100 squares of roof area; 2) not less than every twelve feet in the direction of the deck slope; and 3) within five feet of each drain.

7.3.5 The building official ~~may, at his/her discretion,~~ is permitted to request additional moisture tests in areas to be foamed and/or may-require examination of foam already in place to examine cell structure.

7.3.6 Where testing is carried out at areas already foamed, a minimum of 3 to 4 inches in diameter core sample of foam shall be removed to the substrate level. Where the foam has been applied to a monolithic substrate, the sample shall be scraped from the substrate, bagging all pieces of the sample and labeling the bag with: 1) the date of application; 2) the date of sampling; 3) the person taking the sample; and 4) a general description of material bagged.

7.3.6.1 Samples shall be forwarded to an approved testing agency for cell analysis. If inferior or irregular cell structure is observed, a "Bonded Pull Test," in compliance with TAS 124, shall be carried out in areas of inferior or irregular cell structure or as directed by the building official.

7.3.6.2 Results of all testing shall be submitted to building official for review.

**8. Moisture at Application Nozzles**

8.1 Functional air dryers shall be installed on all air inlets to spray equipment to eliminate moisture contamination. The building official ~~may, at his/her discretion~~ is permitted to test the spray gun assembly for moisture using moisture detection paper or some other type of moisture

detection to verify dry purge air.

8.2 The roofing contractor shall test nozzles not less than twice each day and record the results in the Job Log.

**9. Humidity**

~~9.1 Water vapor in humid air can react with a curing foam surface resulting in a weakened bond with the ensuing layer of foam. Humidity can create a weakness in the bond lines of multiple foam~~

~~passes~~

9.2 Care shall be taken to monitor humidity conditions during applications. Application shall cease when humidity levels are above the acceptable levels described in the foam manufacturer's Product

Approval.

9.3 The building official ~~may~~ shall be permitted to require ~~direct~~ testing of areas installed during high humidity conditions.

9.4 All spray-applied polyurethane foam Roof Assemblies Product Approval shall include a chart of ambient temperature and humidity application limits. Ambient humidity shall be monitored in all

projects with a sling or self-contained psychrometer. Readings shall be taken before spray applications commence and every two hours while spraying. All readings shall be recorded in the Job Log.

**10. Visual Inspections**

10.1 Slit test samples of a minimum 1/2 in. wide, 2 in. to 3 in. long and least 3/4 in. deep shall be cut at a minimum of one sample every 2,500 ft2 for visual observation and testing. In addition, one slit sample within ten feet of each drain shall be taken.

10.2 Samples shall be marked and bagged in an air tight polyurethane bags and stored until project completion. Bags shall be identified with date and location of core sampling.

10.3 A list of all stored samples shall be maintained in the Job Log. The building official ~~may~~ is permitted to request laboratory testing of samples during the period of construction or prior to final inspection.

10.4 Applied foam shall be visually examined for cell structure and uniformity of color. Bond lines shall also be examined for adhesion. Results of the visual examination shall be recorded in the Job

Log.

**11. Laboratory Examination**

11.1 Round core samples having a diameter not less than 3 inches shall be taken at a minimum of one sample every 10,000 ft2 at the thickest application of foam.

11.2 Samples shall be taken by approved testing agency, and shall provide a written report of the visual examination of color, cell structure and adhesion at bond lines. Copies of the reports shall be kept in the Job Log for reference by the building official.

11.3 Final inspection shall not be complete without satisfactory test reports on file at job completion.

**12. Remedial Repairs**

12.1 Should irregularities be found during visual or laboratory examination of slit or core samples, the surrounding area shall be examined by removing additional slit or core samples working outward from the initial sample location until the foam is determined to be satisfactory by an

approved testing agency. All inferior foam shall be removed and replaced.

12.2 If areas requiring remedial repair have been determined to be inferior by the designated testing agency, core samples on all sides of the repair area shall be taken and forwarded to the approved testing agency for examination. If the repair area is coated prior to the return of the

results, the area shall be delineated for identification purposes.

**13. Wood Decks and Surfaces**

13.1 Wood deck application shall comply with Section 1521.5 of the Florida Building Code, Building.

**14. Steel Decks and Surfaces**

14.1 All structural steel decks shall be not lighter than 22 ga. unless examined by a professional structural engineer, prior to application, confirming the suitability of application. In addition, a letter shall be provided by the spray applied polyurethane foam manufacturer confirming the specific application is in compliance manufacturer's guidelines. A copy of the structural report and manufacturers letter shall be attached to Section 11 of the Uniform Building Permit application and submitted to the building official for review.

14.2 Nonstructural metal panels forming the substrate for a spray applied polyurethane foam Roof Assembly shall be not lighter than 24 ga.

14.3 All steel deck joints shall be correctly lapped, fastened and sealed prior to application of spray applied polyurethane foam.

14.4 If an approved insulation board is applied to a fluted deck, the board shall be attached in compliance with RAS 117 and the wind load requirements set forth in Chapter 16 (High-Velocity Hurricane Zones) of the *Florida Building Code, Building*. Insulation boards shall be of sufficient

dimension to span deck flutes.

**15. Concrete Decks and Surfaces**

15.1 All concrete shall be free of contaminants and chemical release agents.

15.2 Priming of all concrete surfaces is required. New concrete decks shall have a cure period of not less than 28 days prior to the application of spray applied polyurethane foam.

15.3 All joints greater than 1/8 in. shall be filled or bridged with an acceptable product to the spray applied polyurethane foam manufacturer.

15.4 Spray-applied polyurethane foam shall not be applied to lightweight insulating concrete.

**16. Wind Speeds**

16.1 Spray-applied polyurethane foam ~~may~~ shall be applied ~~up to~~ at wind speeds of 25 mph or less. ~~If e~~Effective wind screens, tenting, or robotic equipment, ~~are~~ shall be used to prevent over spray damage and unacceptable surface texture.

**17. Coatings**

17.1 All coatings shall be approved for use with the spray-applied polyurethane foam Roof Assembly and shall be noted as such in the coating manufacturer's Product Approval and the spray applied

polyurethane foam manufacturer's roof assembly Product Approval.

17.2 Coating shall ~~may~~ be one of the following:

· Acrylics

· Butyls

· Chlorinated synthetic rubbers

· Silicones

· Polyurethanes

· Modified asphalts.

Other approved coatings.

17.3 All coatings shall be in compliance with applicable physical properties noted in Chapter 15 (High-Velocity Hurricane Zone) of the *Florida Building Code, Building* and TAS 110. Additionally, coatings shall be tested for peel strength of the coatings to foam in compliance with TAS 114(H)

and RAS 109(A).

17.4 The coatings shall be applied in compliance with coating manufacturer's Product Approval, and spray applied polyurethane foam manufactures Product Approval.

17.5 The base coat, if necessary, shall be applied the same day as the spray applied polyurethane foam. The base coats shall be ~~allowed to~~ cured as specified by the coating manufacturer prior to the application of the final top coat.

17.6 After application of top coating, the surface shall be ~~allowed to~~ fully cured prior to inspection for pin holes, thin coated areas and other defects.

18. Coating Testing

18.1 Slit test samples of a minimum 1/2 in. wide, 2 in. to 3 in. long and least 3/4 in. deep shall be cut at a minimum of one sample every 2,500 ft2 for visual observation and testing. In addition, one slit sample within ten feet of each drain shall be taken.

18.2 Four thickness measurements shall be taken from each sample.

18.3 Results of the tests shall be provided in the Job Log for review by the building official.

18.4.1 If any samples in the random sampling are determined to be inferior, additional test samples shall be taken at an interval of one sample every 2,500 ft2 to determine the extent of inferior application.

18.4.2 Any areas found to be inferior shall be recoated following methods published by the component manufacturer and maintained in the Job Log.

**19. Walkways**

19.1 Walkways, when installed, shall be breathable walk pads approved by the coating manufacturer, and shall be installed and bonded to the coating surface.

**20. Perimeter Metal**

20.1 All perimeter metal shall be in compliance with RAS 111 for retrofit, reroof and new applications.

**21. Final Inspection**

21.1 A final inspection of the completed Roof Assembly shall be conducted by the building official to confirm compliance with the requirements of this Application Standard and the requirements set

forth in the *Florida Building Code, Building.*

21.2 A final inspection shall also be conducted by the Roof Assembly manufacturer, or an inspection service designated by the manufacturer, confirming the application is in compliance with the material requirements and application standards established by the manufacturer.

~~21.3 The Roof Assembly manufacturer shall complete a final inspection certification not later than 30 days after completion of the application, as required in Section 1521.18.2 of the Florida~~

~~Building Code, Building.~~

**(R7084 AS)**

***RAS No. 115. Add or modify to read as follows:***

***ROOFING APPLICATION STANDARD (RAS) No. 115 STANDARD PROCEDURES FOR ASPHALT~~IC~~  SHINGLE INSTALLATION***

**1.Scope**

1.1This roofing application standard has been developed to provide a responsive method of complying with the requirements of Chapters 15 and 16 (High-Velocity Hurricane Zones) of the *Florida Building Code, Building* while providing a prescriptive method of installing asphalt~~ic~~ shingles.

**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 Asphalt~~ic~~ shingles shall not be installed on roof mean heights greater than 33 feet, unless specifically specified in the roof assembly’s Product Approval. Roof slope criteria shall be in accordance with Table 1515.2.

3.2 Where asphalt~~ic~~ shingles are to be installed over insulated roof deck, a suitable nailable substrate, in accordance with Section 1520.5.7 must be installed over the insulation prior to the installation of approved underlayment and shingles.

3.3 Asphalt~~ic~~ shingles shall be installed in compliance with the Product Approval installation specifications, but in no case with less than six approved roofing nails (12 ga. by 11/4 in. corrosion- resistant annular ring shank roofing nails) or approved fastening devices which penetrate through the sheathing or wood plank a minimum of 3/16 in. or penetrate a 1 in. 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.

**4. Underlayment**

4.1 Minimum prescriptive underlayments shall be one of the following, unless otherwise specifically noted in roofing assembly Product Approval:

* A double layer of an ASTM D 226, Type 1,with a 19-inch headlap; or
* A single layer of an ASTM D 226, type 11 with a 4-inch headlap; or
* A single layer of an ASTM D 2626 coated base sheet with a 4-inch headlap.
* All endlaps shall be a minimum of 6 inches.
* All valleys shall be woven.

4.2 All underlayments shall be fastened with approved minimum 12 gage by 1 ¼ in. corrosion- resistant annular ring shank roofing nails fastened through minimum 32 gage by 15/8 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. 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.

4.3 If the underlayment is a self-adhering membrane, the membrane shall be applied over a mechanically attached anchor/base sheet attached in compliance with this section above.

**5. Metal Accessories**

5.1 All metal accessories shall be in compliance with Section 1517.6 of the Florida Building Code,

Building and RAS 111.

5.2 Eave and gable drip metal vertical face shall be a minimum of 1- 1/2 inches and shall extend down

not less than 1/2 inch below the sheathing or other member immediately contiguous thereto. In all cases, the deck flange shall be not less than 2 inches in width. Where required, a continuous clip (hook strip) shall be installed in compliance with RAS 111.

5.3 Eave and gable drip metal shall be joined by a lapped 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 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.

5.4 Valley metal shall be a minimum 16 in. wide rolled or preformed material of thickness' in compliance with Section 1517.6 of the Florida Building Code, Building. Valley metal shall be set over the underlayment, or over an optional 18 in. sweat sheet. Fasten valley metal with minimum 12 gage by 1-1/4 in. annular ring shank roofing nails of similar materials 12 in. o.c. 1 in. in from each exterior edge, except where architectural appearance is to be preserved, in which case a min 3/4 in. nail may be used. The entire edge of the flange shall be sealed, covering all nail penetrations with flashing cement and membrane. All horizontal laps shall be a minimum of 6 in. and shall be fully embedded with approved flashing cement. No nails shall be permitted in the center of the valley.

**6. Shingle Installation**

6.1 At all intersections, eaves, rakes, valleys, and gable ends the shingles and starter strips shall be set in a minimum 8-in. wide strip of approved flashing cement. Maximum thickness of flashing cement shall be 1/8 in. as excessive use of the cement may cause blistering, or bleed through. Shingles shall not extend more than 1/4 in. beyond the eave and rake drip.

6.2 The starter strip may be either a row of nonlaminated shingles trimmed to the shingle manufacturer's recommendations or a strip of mineral-surfaced roll roofing not less than 7 in. wide.

6.3 If self-sealing shingles are used for the starter strip, remove the tab portion of each shingle and position the remaining strip with the factory-applied adhesive face up along the eaves. Trim

material from the end of the first shingle in the starter strip according to manufacturer's specifications to ensure that the cutouts of the first course of shingles are not placed over the

starter strip joints. Fasten starter strips parallel to the eaves along a line above the eave line according to manufacturer's specifications. Position fasteners to insure they will not be exposed under the cutouts in the first course.

6.4 For shingles without a self-sealing strip the tabs shall be removed and approved flashing cement shall be applied in spots approximately the size of a quarter at the corner of each tab of the first course. Starter shingles shall be nailed along a line not greater than 4 in. above the eave line nailing not greater than 6 in. o.c. Ensure that the cutouts of the first course are not placed over the starter strip joints. 6.5 If roll roofing is used for the starter strip, nail along a line not greater than 4 inches above the eave line nailing not greater than 12 inches o.c. Approved flashing cement shall be applied as noted above for nonsealing shingle starter. If more than one piece of roll roofing must be used, the end joint shall be butted. Joints shall be staggered with succeeding shingle joints, and the number of starter joints shall be kept to a minimum.

6.6 First course shall be laid straight, checking it regularly during application against a horizontal chalk line. A few vertical chalk lines aligned with the ends of shingles in the first

course will ensure proper alignment of cutouts. A shingle hatchet is an acceptable alternative to the use of succeeding chalk lines. The first course starts with a full shingle, while succeeding courses shall be installed in strict compliance with the shingle manufacturers' Product Approval course layout detail.

6.7 Valley courses shall be terminated with shingles not less than 12 in. in length. Rake courses shall terminate with shingles not less than 6 in. length. To obtain the correct exposure for square-tab strip shingles, align the butts with the top of the cutouts in the course below. Install no-cutout

shingles and those with variable butt lines according to the manufacturer’s installation instructions~~directions~~ to obtain correct exposure.

NOTE: Follow manufacturer's instructions concerning shingle alignment. See "Exposure, Course

Layout, and Fastening Detail" in shingle manufacturer's Product Approval.

***-RAS No. 115. RAS No 115 (12.) Add or modify to read as follows:***

**12. Hips and Ridges**

12.1 Apply pre-manufactured hip and ridge shingle components or cut hip and ridge shingles from

manufacturer’s strip shingles. Lay hip and ridge away from prevailing wind. Insure all fasteners are covered. Exposure shall not exceed 5 inches~~.~~ unless specified in the roof assembly’ s product approval. Taper the lap portion of each cap shingle slightly so that it is narrower than the exposed

portion.

**(R7085 AS)**

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

**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. A Professional Engineer, or Registered Architect, shall sign and seal all calculations.

**2. Anchor and Base Sheets, General**

2.1 All damaged stress plates shall be removed and replaced.

2.2 Insulation shall only be attached with approved insulation fasteners.

**3. Insulation, General**

3.1 Insulation, General All insulation fasteners shall be installed in compliance with the fastener manufacturer's published installation instructions and the limitations set forth in the Product Approval. Insulation attachment for panels in the field area of the roof shall use a fastener spacing in compliance with Figures 1 through 4 of this Application Standard, as referenced in the Roof Assembly Product Approval. Fastener placement guidelines shall be as follows-:

* Fasteners installed at insulation panel edges shall be spaced not greater than 13 ½ inches nor less than 4 ½ inches from the edge of the panel unless otherwise specified in the product approval.
* ~~Fasteners shall be evenly distributed over the panel area.~~

3.2 All insulation fasteners and stress plates shall be tested in compliance with Chapter 15 (High- Velocity Hurricane Zone) of the Florida Building Code, Building. Minimum withdrawal resistance for insulation fasteners shall be 275 Ibf.

3.3 For recover or reroof applications over an existing steel deck, having a thickness less than 22 gage, insulation fasteners shall be tested for withdrawal resistance in compliance with TAS 105.

3.4 Insulation fasteners and stress plates, and minimum acceptable insulation panel size and thickness shall be as listed in the roof assembly Product Approval.

3.5 Installation of more than one insulation layer using a single fastener shall utilize the fastening pattern and fastener designated for the top insulation panel.

3.6 Mixing of insulation panels (e.g., different manufacturer's, insulation types) shall not be acceptable when applied in the same layer.

3.7 Only as much insulation as can be roofed shall be installed each working day. Water shall not be allowed to run in the flutes of steel deck ribs under completed roof sections.

3.8 Insulation panels shall be installed with minimum joint dimensions and shall be tightly butted. Maximum joint widths shall be 3/8 in.

3.9 All insulation joints shall be staggered. Tapered insulation shall be installed in accordance with manufacturer's recommendations.

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. Polyisocyanurate tapered insulation systems shall have a minimum average thickness per panel of 1 in.

3.11 Insulation pieces that are cut from larger panels and are smaller than one square foot shall not be acceptable.

3.12 All insulated decks containing interior drains shall be sumped at the drains. Sump area insulation shall be tapered at a minimum slope of 1/8 of an inch per foot to the drain. The drain sump area shall be a minimum of (24 in. by 24 in.) 576 square inches, unless restricted by a wall or any other obstruction.

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

3.14 Attachment of any low density insulation panel, fiberglass or mineral wool, shall be with self- locking fasteners.

3.15 Insulation fasteners and stress plates shall be installed with tooling specified by the fastener manufacturer.

3.16 Predrilling, if any, shall be with the diameter bit listed in the withdrawal resistance test report. The drill bit tolerance range noted in the test report shall be maintained throughout the project. Should a change in bit size be required due to varying density of the deck material, an additional withdrawal resistance test shall be conducted to confirm fastener performance. Drill holes shall not spalled.

3.17 When installing "hammer-in" concrete fasteners, all deformed stress plates shall be removed and replaced.

3.18 Concrete dust shall be removed by brushing or forced air from the insulation top surface prior to the application of hot asphalt or adhesive.

3.19 Roof insulation and roll goods, either on the ground or on the roof top, shall be kept dry. The building official shall instruct the removal of the insulation or roll goods from the job when elevated moisture levels are found.

**4. Insulation Attachment Over Steel Decks**

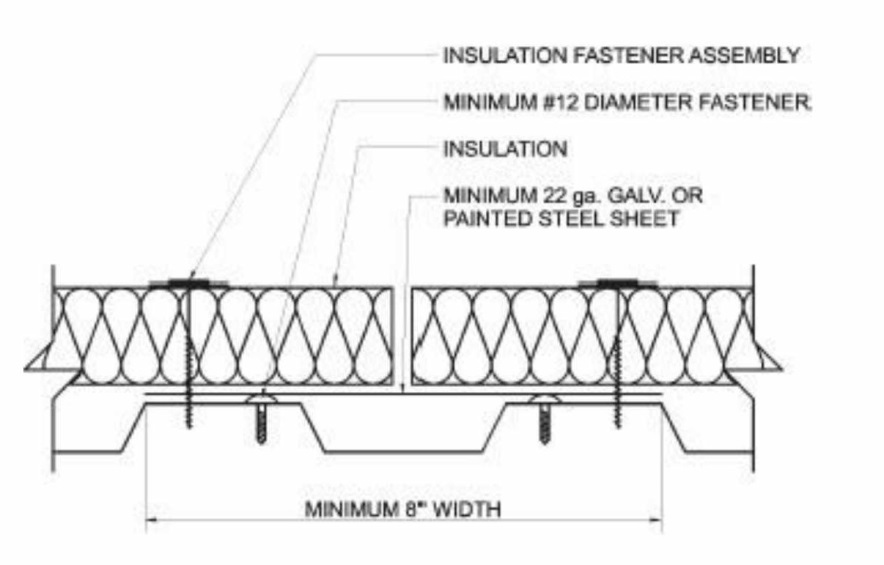
4.1 Steel deck insulation fasteners shall penetrate the top flange of a steel deck not less than 1/2 in.

4.2 The two opposite edges of any insulation panel shall be supported on the top flanges of the steel deck, and shall have a minimum bearing width of 1-1/2 in. unless restricted by top flange width. Alternatively, minimum 22 gage galvanized or painted sheet steel may be placed over the deck ribs and secured with minimum #12 diameter fasteners spaced 18 in. o.c. (see Figure 5).

4.3 Steel deck sections shall properly "nest," allowing insulation panels to have full contact with the top flanges. If any deck sections do not "nest" properly, the sections shall be repaired prior to the application of the roof insulation. Cutting, scoring or hollowing of the insulation panels is not acceptable.

**5. Insulation Attachment Over Concrete Decks**

5.1 Threaded concrete fasteners shall be a minimum of a #14 diameter. "Hammer-in" concrete fasteners having a length less than or equal to 8 in. shall have a minimum diameter of 3/16 in. "Hammer-in" concrete fasteners having a length in excess of 8 in. shall have a minimum diameter of 1/4 in.

****

**FIGURE 5 USE OF STEEL SHEET TO ENSURE SUPPORT OF INSULATION PANEL GAGES**

5.2 Insulation fasteners shall penetrate the concrete deck a minimum of 1-1/4 in.

**6. Lightweight Insulating Concrete**

6.1 New pours of lightweight insulating concrete shall be tested for fastener withdrawal in compliance with Section 1917 of the Florida Building Code, Building.

6.2 Rigid roof insulation panels shall not be applied directly over lightweight concrete decks unless specified in the product approval.

6.3 For recover or reroof applications where the proposed mechanical attachment is through the lightweight insulating concrete and to the structural deck, a TAS 105 withdrawal resistance test of the proposed fastener shall be conducted. Calculations based on the TAS 105 shall be submitted to the building official for evaluation of the proposed fastening method.

**7. Wood Decks**

7.1 Approved insulation fasteners shall be used for insulation attachment to wood decks. Nails are not acceptable for insulation attachment.

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 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 except as noted in Section 9.2.
* The minimum fastener separation shall not be less than 4 in. o.c.
* 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 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.

8.1.1 In recover or reroof applications, if testing in compliance with TAS 105 of the insulation fasteners results in a minimum characteristic resistance force less than 275 Ibf (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.

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

8.2 As an alternate to data extrapolation, or in the event data extrapolation is not allowed, in-situ (on- site) field uplift resistance testing of the in place roof assembly may be conducted in elevated pressure zones to confirm uplift resistance performance. Testing shall be conducted in compliance with TAS 124. Such Field uplift resistance testing shall be conducted to 1.45 times the design pressure for the tested pressure zone, and submitted to the building official for review.

**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:

Field Area: - 43.0 psf

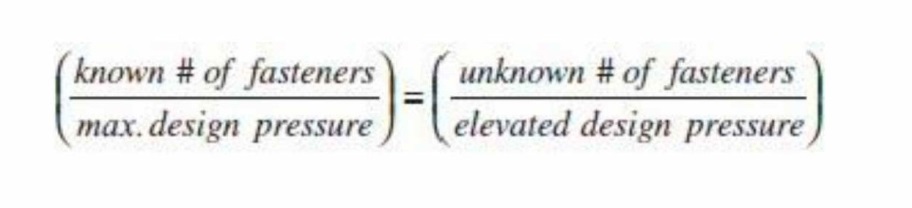
Perimeter Area: - 56.0 psf

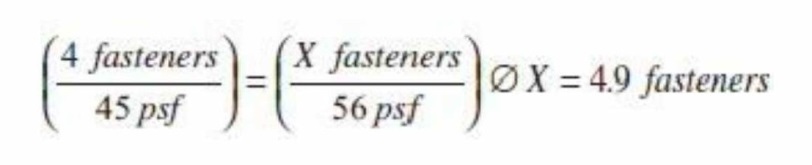
Corner Areas: - 90.0 psf

Consider a Roof Assembly Product Approval, which includes a system having 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.

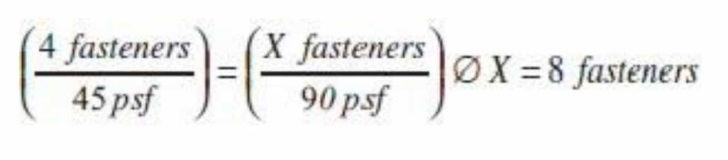
**General Equation:**

Perimeter Area:



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

**Corner Areas:**



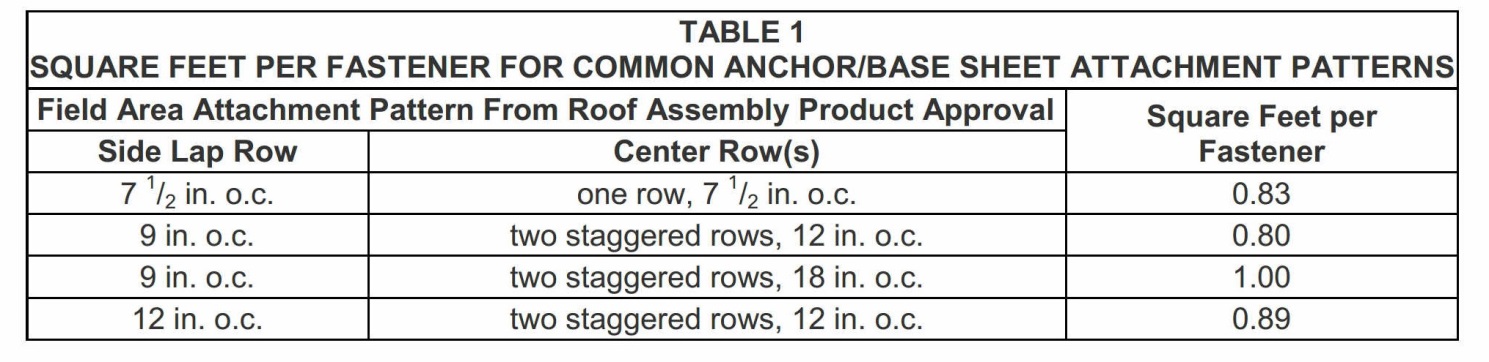
Therefore, corner panels shall be attached with eight fasteners per 4-ft by 4-ft panel. Fastener locations shall be in compliance with Figure 3, herein.

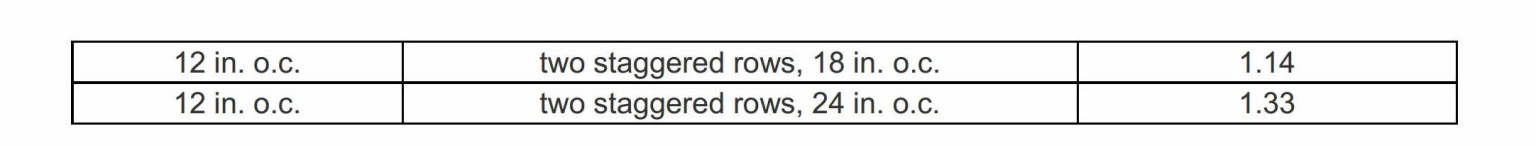
9.2 If the data extrapolation results in a number of fasteners for an elevated pressure zone which exceeds 280 percent of that for the field area, additional testing, as determined by the building official, may be required to confirm the performance of the Roof System Assembly.

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. Anchor or Base Sheet Attachment - New Construction/Reroof Applications

10.1 This section covers determination of anchor/ base sheet fastener applications. Anchor/base sheet attachment for elevated pressure zones may be determined through extrapolation of the data for field area attachment. Data extrapolation outlined in Section 10.4.4 utilizes field area attachment

data currently found in roof assembly Product Approval.

* For steel deck applications, fastener spacing shall be in increments of 6 in. o.c.

10.2 The following calculations have been performed for several common anchor/base sheet attachment patterns, the results of which are noted in Table 1 of this Roofing Application Standard. The values listed in Table 1 apply solely to anchor/base sheets having a width less than or equal to 36 inches and applications having a side lap equal to or greater than 4 in.

10.3 If the field area attachment pattern from the roof assembly Product Approval is not listed in Table 1, or the anchor/base sheet has a width in excess of 36 inches, or the side lap is less than 4 in. wide, then the following calculations shall be conducted to determine the number of square

feet per fastener.

**10. 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:

Field Area: - 43.0 psf

Perimeter Area: - 56.0 psf

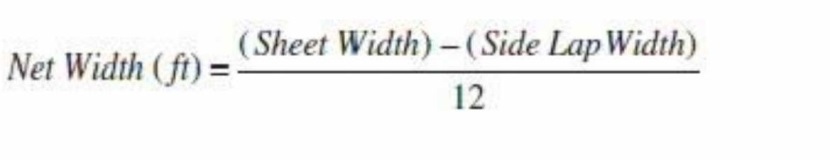
Corner Areas: - 90.0 psf

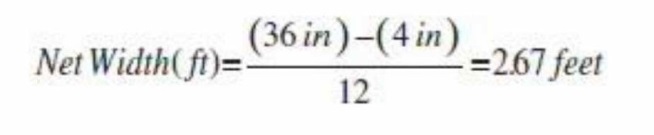
Consider a roof assembly Product Approval, which includes a system having a maximum design pressure of -45 psf (2155 Pa). The Product Approval specifies an anchor/base sheet, having a width of 36 in. attached with approved fasteners and bearing plates at a spacing of 12 in. o.c. at a 4 in. side lap and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

10.4.2 Determine the number of square feet per fastener.

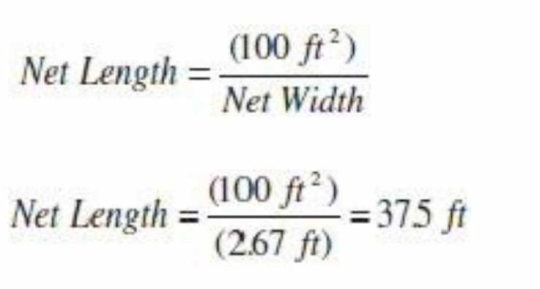
To determine the number of square feet per fastener, first determine the length of anchor/base sheet, which will yield one net square (i.e., 100 ft.2).

**Net Width of Sheet (ft):**





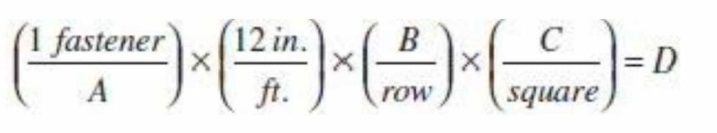
**Net Length to Make One Square (100 ft):**

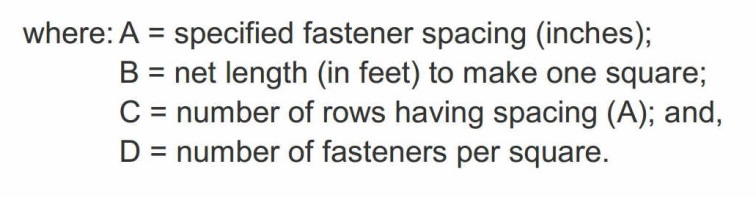


Determine the total number of fasteners per square.

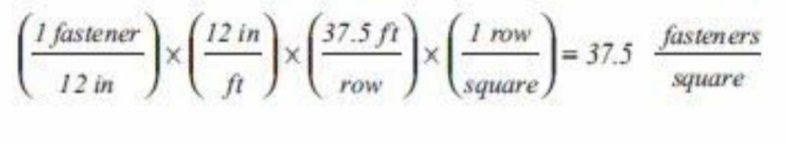
General Equation:

General Equation:

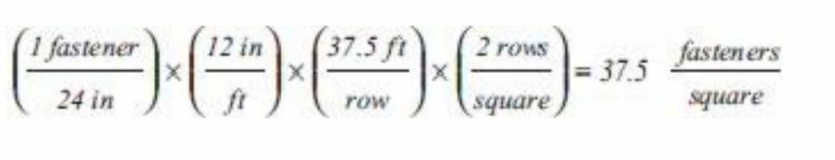




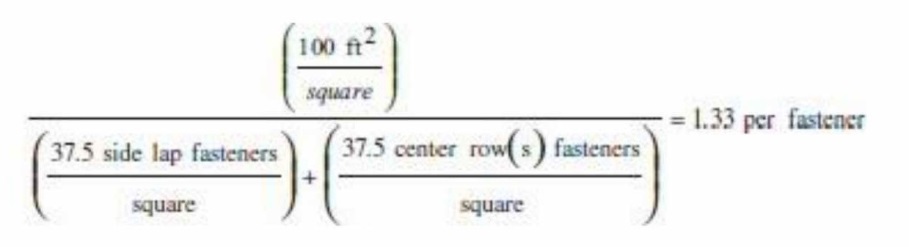
Side Lap Row:



Center Rows:



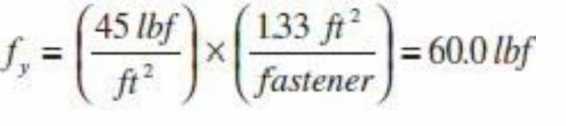
Combining these values leads to a total of 75 fasteners per square, which equates to 1.33 square feet per fastener, as noted below.



10.4.3 Determine the "fastener value:"

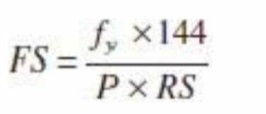
**General Equation:**

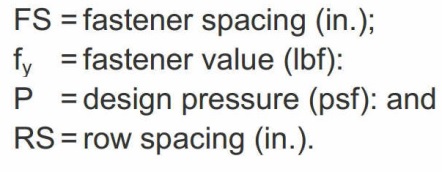
fy = (max. design pressure) x (ft2 per fastener)



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

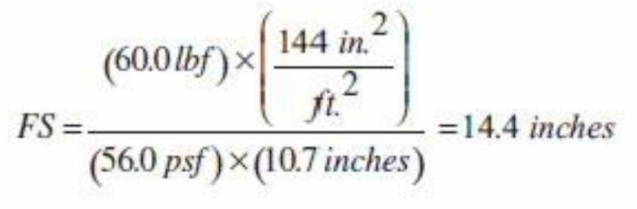
10.4.5 **General Equation:**





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.

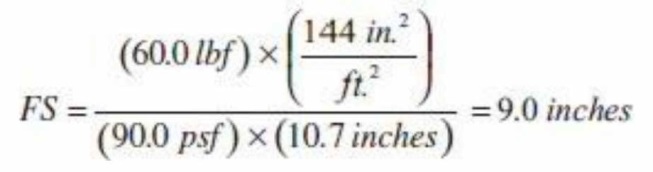
**Perimeter Area:**



All fractions shall be rounded down to the next whole number. Therefore, perimeter area

anchor/base sheet attachment could be with three rows spaced 10.7 in. apart, 14 in. o.c. Generally, side lap fastener spacing should not exceed 12 in. o.c.

**Corner Area:**



Therefore, a fastener spacing of 9 in. o.c. at a 4 in. side lap and two rows staggered in the center of the sheet, 9 in. o.c. would be an acceptable corner area anchor sheet fastener spacing.

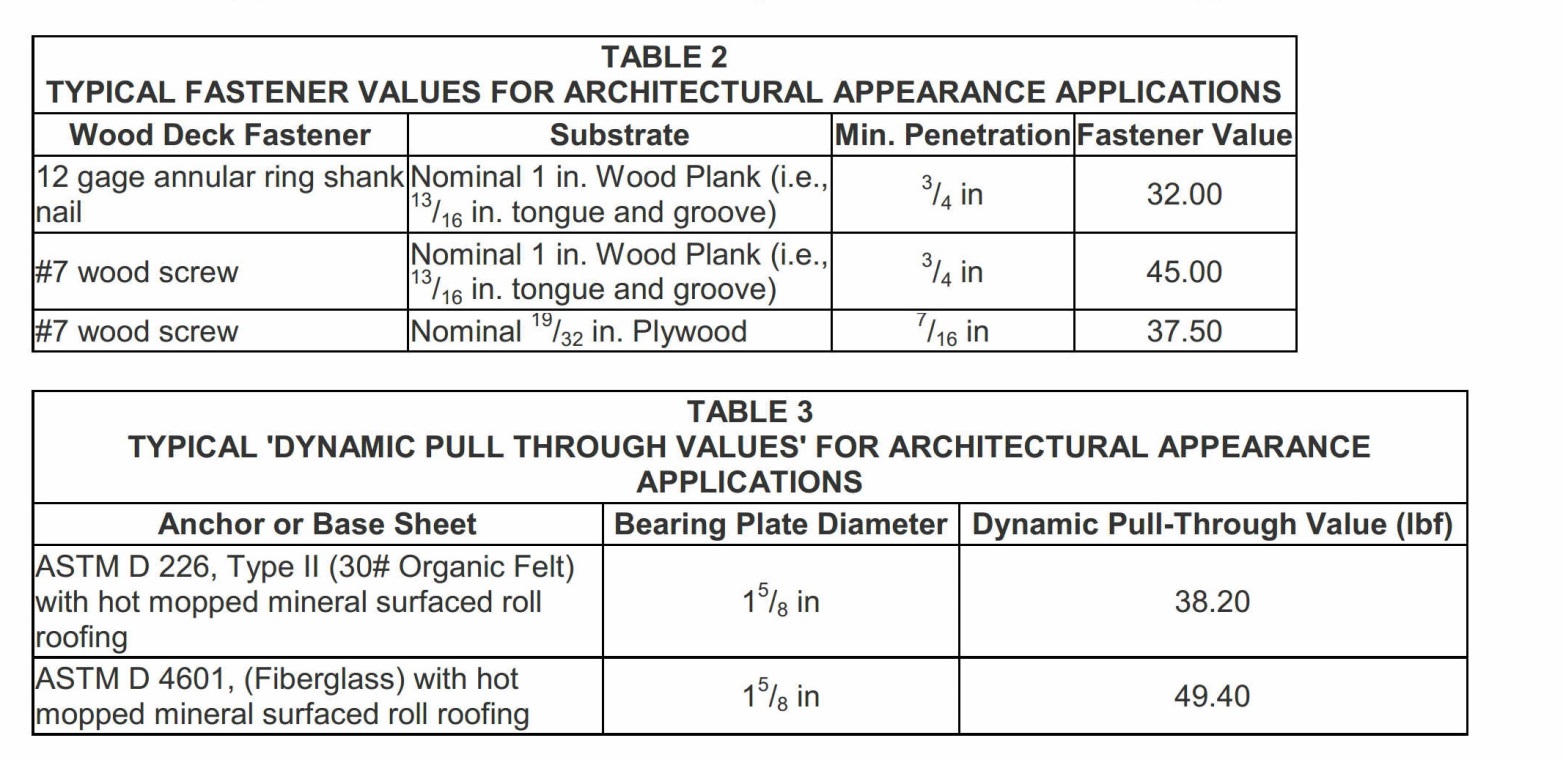
10.5 In recover applications anchor/base sheet attachment applications shall utilize approved insulation fasteners and bearing plates. Anchor or base sheet fasteners or nails shall not be utilized in such applications.

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

**11. Architectural Appearance Applications**

11.1 Design Values

11.1.1 The design value for architectural appearance applications shall be the lesser of either the "Fastener Value" of the fastener, determined in compliance with TAS 105 or the "dynamic pull- through value" of the anchor/base sheet over the proposed bearing plate, determined in compliance with TAS 117(B) Values shall be listed in fastener/plate manufacturer's Product Approval.



11.1.2 Tables 2 and 3, below, list typical "Fastener Values" and "Dynamic Pull-through Values," which may be used to determine anchor/base sheet fastener spacing in compliance with this section. Any wood deck fasteners, anchor/base sheets, which are proposed for use in an architectural appearance application and are not listed in Tables 2 and 3 shall be tested in compliance with TAS 117(A) and/or TAS 117(B) to determine necessary design values.

11.1.3 If a proposed fastener is "larger" than those noted in Table 2, the "Fastener Value" noted in Table 2 may be utilized. If a proposed bearing plate is larger than those noted in Table 3, the "Dynamic Pull-through Value" of the anchor/base over the smallest bearing plate may be utilized.

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:

Field Area: - 43.0 psf

Perimeter Area: - 56.0 psf

Corner Areas: - 90.0 psf

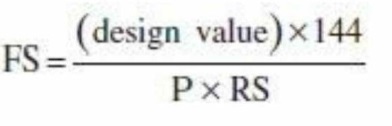
Consider an architectural appearance application in which an ASTM D 226, Type 11 base sheet, having a width of 36 in., is to be mechanically attached with a 3-in. side lap, to nominal 1-in. wood plank 13/16-in. tongue and groove) using #8 wood screws and 15/8-inch diameter tin caps. One ply of approved mineral surfaced roll roofing is to be applied over the mechanically attached base sheet in a full mopping of hot asphalt.

11.2.2 Determine the design value to be used in data extrapolation.

From Table 2, the "Fastener Value" for this application is 45.0 Ibf. From Table 3, the "Dynamic Pull- through Value" for this application is 38.2 Ibf. Taking the lesser of the two values, the design value for this case would be 38.2 Ibf.

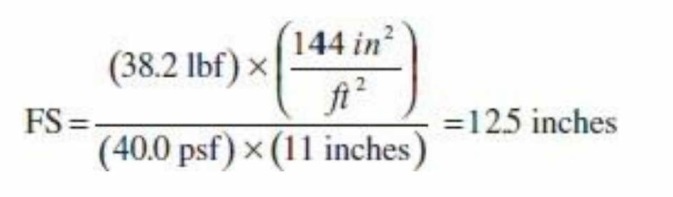
11.2.3 Determine a base sheet fastener spacing (FS) to meet the design pressures in each pressure zone of the roof.

**General Equation:**



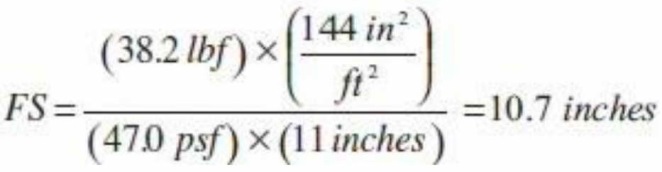
Note: The side lap, for this case is specified at 3 in. Therefore, the row spacing (RS) in the above noted equation shall be 11 inch [i.e., sheet width (36 inch) minus side lap width (3 inch) divided by the number of fastener rows (3)].

**Field Area:**



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

**Perimeter Area:**



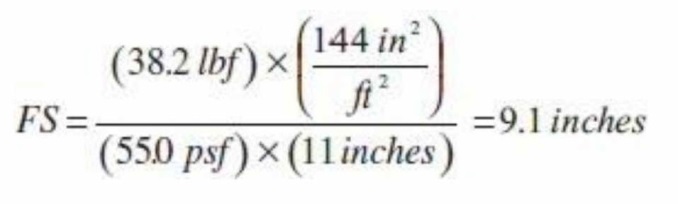
All fractions shall be rounded down to the next whole number. Therefore, a fastener spacing of 10 in. o.c. at a 3-in. side lap and two rows staggered in the center of the sheet, 10 in. o.c. would be an acceptable perimeter area base sheet fastener spacing.

**Corner Areas:**

All fractions shall be rounded down to the next whole number. Therefore, a fastener spacing of 9 in. o.c. at a 3-in. side lap and two rows staggered in the center of the sheet, 9 in. o.c. would be an acceptable perimeter area base sheet fastener spacing.

**12. Bitumen or Adhesive Application, General**

12.1 Insulation panel sizes listed in the Product Approval are the minimum approved sizes and thickness. Panels up to 4 ft. by 4 ft. may be installed in hot asphalt or approved cold adhesive, as specified in roof assembly Product Approval.



12.2 Not less than 85 percent of each insulation panel shall be in contact with the substrate and bonded with asphalt or adhesive, unless a specific intermittent adhesive attachment pattern is detailed in the roof assembly manufacturer's Product Approval.

12.3 Insulation panels set in hot asphalt shall be "walked in" to ensure complete adhesion to the substrate. Multiple "walk-in" procedures may be required for foam adhesive products that expand during the curing process.

12.4 For recover applications where the insulation panels are to be bonded to an existing roof membrane, all loose gravel shall be completely removed and the substrate shall be fully primed with ASTM D 41 primer. For applications where the insulation panels are to be bonded to a structural concrete deck, the deck shall be fully primed with ASTM D 41 primer. Primer shall be allowed to completely dry prior to asphalt applications.

12.5 Approved foam adhesive applications of insulation panels shall be applied in strict compliance with the foam adhesive manufacturer's Product Approval.

12.6 No extrapolation for the elevated pressure zones, as defined by ASCE 7, shall be allowed in adhered roof assemblies.

12.6.1 Bonded roof assembly may be tested in accordance with TAS 124 to verify attachment in the elevated pressure zones. The number of tests required shall comply with this Section. A minimum of four test specimens shall be conducted on each roof level with not less than two tests being conducted in each elevated pressure zone (perimeters and corners). One additional test shall be conducted for every 25 roofing squares of the elevated pressure zone area. A 1.45:1 margin of safety shall be applied to the test results.

13. Bitumen or Adhesive Application, Structural Concrete

13.1 A "Deck Dryness Test" shall be performed on structural concrete decks prior to asphalt application. The following procedures are specified for testing the dryness of the roof deck.

13.1.1 Heat not less than one pint of the specified asphalt to 400°F. Pour into a container.

13.1.2 Pour the asphalt on the primed deck surface. If the asphalt foams, the deck contains too much moisture for the asphalt to bond.

13.1.3 After the asphalt has cooled, pull the asphalt patch from the deck surface. If the asphalt patch strips clean, the deck is not dry enough for Roof System Assembly application. Wait a further period for the deck to dry and a sufficient asphalt bond can be achieved. Repeat the test procedure.

13.2 Structural concrete decks shall be primed with ASTM D 41 primer and allowed to dry prior to asphalt application, as noted in Section 12.4.

13.3 If applied directly to the deck, insulation shall be adhered in a full mopping of hot asphalt at an application rate of between 20 and 40 pounds per square, depending on the asphalt EVT. Asphalt types and temperature ranges shall be in compliance with Chapter 15 (High-Velocity Hurricane Zones) of the Florida Building Code, Building.

No change to Figure 1 and 2

**(R7086 AS)**

**ROOFING APPLICATION STANDARD (RAS) No. 150 PRESCRIPTIVE BUR REQUIREMENTS**

***Standard RAS 150. Add or modify to read as follows:***

**1.Scope**

1.1 This application standard shall be used where the authority having jurisdiction has adopted its use, and in accordance with the provisions of this code.

**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. Built-up and Prepared Roof Covering Application**

**3.0 General**

3.1 DECK PREPARATION: Before starting the roof covering:

3.1.1 All roof decks shall be broom-cleaned and dry.

3.1.2 Where practicable, eaves; parapet walls; vertical walls; penthouses and similar structures above the roof level shall have been completed.

3.1.3 Cant strips, where provided, shall extend at least three inches (3 in.) up vertical surfaces.

3.1.4 All eaves shall provide firm, nailable backing for the secure attachment of gravel stops and eave and gable drip.

3.1.5 All precast and prestressed concrete roof components shall be provided with insulation, or other leveling fill, where such component edges are more than one-half inch (1/2 in.) from being flush.

3.2 ATTACHMENT: All roof coverings shall be attached to the various types of decks by mopped-on adhesives or by mechanical fastening as set forth herein, or by other approved materials or methods.

3.3 ADHESIVES:

3.3.1 Bituminous compounds shall be asphalt (ASTM D 312), coal tar pitch (ASTM D 450), modified bitumen, or cold-applied roofing cement (ASTM D 4586 or ASTM D 3019, Type 111).

3.3.2 Hot asphalt shall be applied in a quantity not less than 25 pounds plus or minus 15 percent per roofing square per ply and 60 pounds plus or minus 20 percent per square for flood coats and at a temperature recommended by the manufacturer for the system being installed. However, kettle or tanker temperatures should not exceed the following:

Type I Asphalt: 475 °F

Type 111 & IV Asphalt: 525 °F

NOTE : Asphalt can be heated to within 25°F below the actual flash point, but this temperature limitation should never be exceeded.

3.3.3 Coal tar pitch shall be applied in a quantity not less than 25 pounds plus or minus 15 percent per roofing square per ply and 70 pounds plus or minus 20 percent per square for flood coats and at a temperature of not less than 275 nor more than 350 °F (350 to 400 °F in the kettle).

3.3.4 Where roof incline exceeds two inches (2 in.) per foot, bituminous compounds shall be steep asphalt Type 111 or Type IV.

NOTE : Coal tar pitch not to exceed a slope of one-half inch (1/2 in.) per foot with organic felts, if using glass felts or tar coated felts, slope not to exceed one-quarter inch (1/4 in.) per foot.

3.3.5 Adhesive compounds other than bitumen may be applied subject to manufacturer's

specifications.

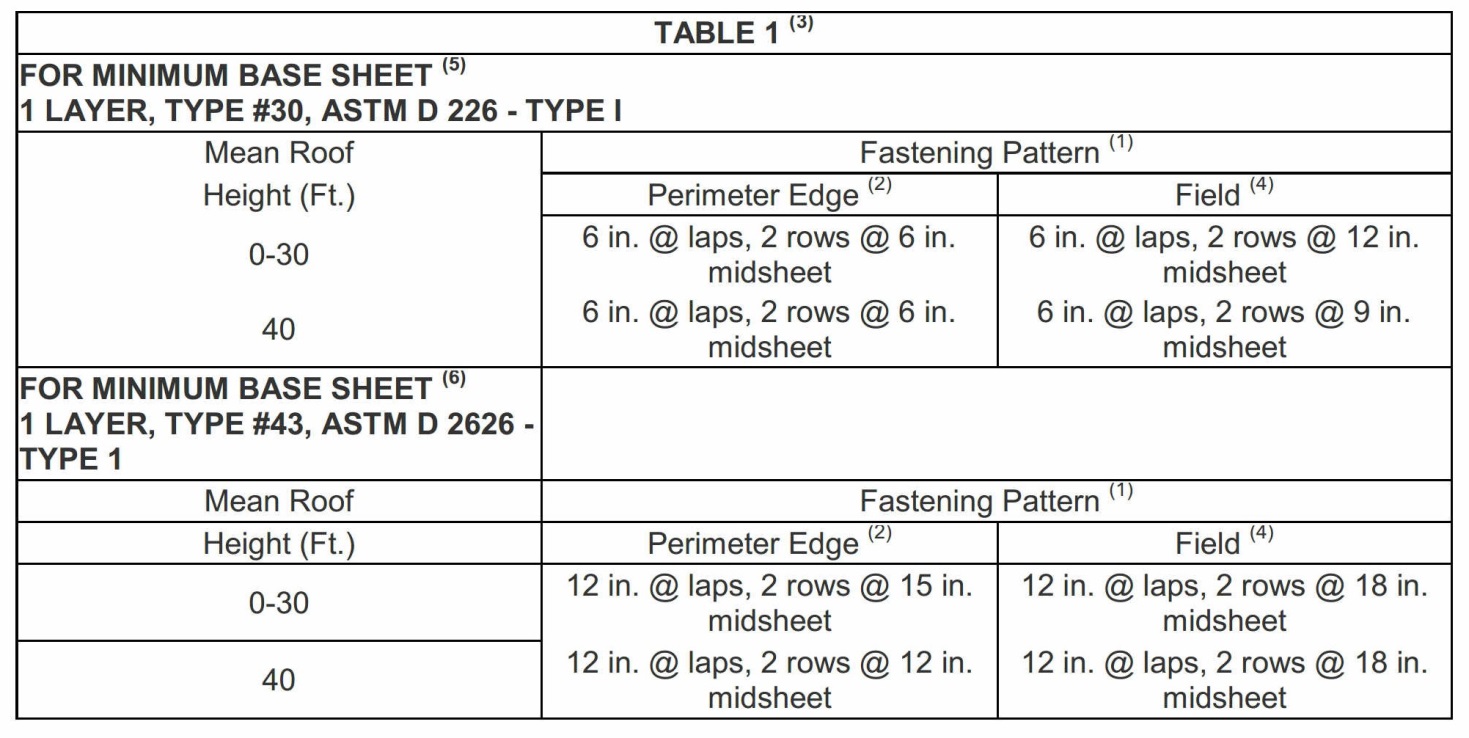
**4. BUILT-UP ROOF COVERING:**

4.1 Materials: All materials used in the assembly of fire-retardant and ordinary built-up coverings shall bear the label of an approved agency ~~the Underwriter's Laboratories, Inc.,~~ and be compatible with Class A, Class B, or Class C roofing. Material shall be delivered in original packaging bearing the manufacturer's labels.

4.2 ANCHOR SHEET: The anchor sheet, as defined herein, shall be a minimum one #30 felt lapped two inches (2 in.) and turned up vertical surfaces a minimum of four inches (4 in.) and secured as set forth herein.

4.3 WOOD DECKS:

4.3.1 Fasteners securing the anchor sheet to nominal one inch (1 in.) lumber or to wood based structural-use panels three-quarters inch (3/4 in.) or more in thickness shall be noncorrosive smooth shank nails with a shank diameter of a minimum of 0.118 inches or 11 gage, heads not less than three-eighths inches (3/8 in.) (0.375) diameter and not less than one inch (1 in.) in length; or non-corrosive 12 gage wire ring-shanked nails having not less than 20 rings per inch, not less than one inch (1 in.) in length with heads not less than three-eighths inch (3/8 in.) in diameter.



FOOTNOTES:

(1) See section 4 for fasteners.

(2) Perimeter edge is measured from all roof edges and each side of ridge as follows:

The smaller of 0.10 x minimum building width or 0.40 x mean roof height, gut not less than 0.04 x minimum building width or 3 feet.

(3) This table applies to roof slopes up to three inches (3 in.) per twelve inches (12 in.) (Maximum)

(4) Rows of fasteners, midsheet, shall be evenly spaced across width of sheet and staggered along length of sheet.

(5) Patterns shown require a minimum withdrawal capacity of 34 Ib per fastener (unfactored).

(6) Patterns shown require a minimum withdrawal capacity of 67 Ib per fastener (unfactored).

4.3.2 Fasteners securing the anchor sheet to wood based structural-use panels less than three- quarters inch (3/4 in.) in thickness shall be non corrosive smooth shank nails with a shank diameter of a minimum of 0.118 inches or eleven (11) gage, heads not less than three-eighths inch (3/8 in.) (0.375 in.) diameter and not less in length than will penetrate such wood based structural-use panels plus three-sixteenths inch (3/16 in.); or noncorrosive 12 gage wire ring-shanked nails having not less than 20 rings per inch, heads not less than three-eighths inch (3/8 in.) diameter and not less in length than will penetrate such wood based structural-use panels plus three-sixteenths inch (3/16 in.)

4.3.3 Such fasteners shall be applied through tin-caps not less than one and five-eighths inches (1 5/8 in.) nor more than two inches (2 in.) in diameter and of not less than 32-gage sheet metal.

4.3.4 Spacing of such fasteners along the laps of sheets and both ways in the field between laps shall comply with Table 1, based upon height above grade.

4.3.5 Where the architectural appearance is to be preserved from below, anchor sheet shall be secured in accordance with Section 1519.5.2

4.3.6 Other sub-deck systems may use the spacing shown in Table 1 provided each fastener has the required withdrawal load in the particular substrate for which the fastener is designed.

4.3.7 Sheathing paper shall be applied on such decks where anchor sheets are pitch-tarred felts only and shall not be required under asphalt felts.

4.4 OTHER NAILABLE DECKS: Poured gypsum, precast gypsum planks, poured Vermiculite and Perlite (light-weight, insulating concrete), as well as foamed cellular concrete and structural wood- fiber used as roof decking are considered nailable and anchor sheets shall be attached as follows:

4.4.1 Poured gypsum and pre-cast gypsum planks: Use mechanical fasteners providing equal withdrawal resistance when spaced as set forth in Table 1 of this Code.

4.4.2 Poured Vermiculite, Perlite, foamed cellular concrete, and other light-weight, insulating concrete: Use only mechanical fasteners providing resistance to uplift not less than those shown in Table 1.

4.4.3 Structural wood fiber units: Use mechanical fasteners specified by the deck manufacturer, or after all joints have been stripped with six inch (6 in.) wide felt applied with approved cold adhesive, the anchor sheet may be solid mopped to such decks.

4.5 NON-NAILABLE DECKS: Poured concrete and precast deck units are considered non-nailable and anchor sheets shall be fastened as follows:

4.5.1 Such decks shall be primed with an approved asphalt primer applied at the rate of one and one third (11/3) gallons per roofing square, solidly on poured decks but held back four inches (4 in.) from precast unit joints.

4.5.2 Strip or solid mop, holding back four inches (4 in.) from precast unit joints, using dead level asphalt or coal tar pitch as the adhesive unless otherwise specified on the plans and permit and embed anchor sheet firmly in the hot bitumen lapping each sheet four inches (4 in.).

4.5.3 Where the incline of such decks exceeds three inches (3 in.) per foot, anchor sheets shall, in addition to mopping, be mechanically fastened to wood strips spaced not more than 24 inches apart, cast into such decks.

4.5.4 Such wood strips shall be not less than a nominal one by two inches (1 in. x 2 in.), pressure treated with approved preservative, chamfered or otherwise secured flush with the deck surface.

4.5.5 Anchor sheets shall be attached to such wood strips with three-quarter inch ( 3/4 in.) long fasteners applied through tin caps and spaced as set forth herein.

4.5.6 Anchor sheet attachment shall satisfy the resistance to uplift requirements of Section 4.3.6 herein.

4.6 METAL DECKS: Metal decks shall be covered with mechanically fastened roof insulation.

4.7 OTHER DECKS: Attachment of the anchor sheet to decks other than those specifically provided for herein shall be as approved by the building official.

4.8 ADDITIONAL SHEETS:

4.8.1 Each additional sheet above the anchor sheet shall be lapped a minimum of two inches (2 in.) over the preceding sheet and shall be thoroughly mopped between sheets with a bituminous compound, or other approved adhesive providing equivalent bond, so that in no place felt touches felt.

4.8.2 Sheets shall be embedded without wrinkles or buckles.

4.8.3 Each sheet, like the anchor sheet, shall be turned up vertical surfaces a minimum of four inches (4 in.).

4.8.4 (aa) Polymer modified bitumen membranes shall be permitted to~~may~~ be applied as a single ply over a mechanically fastened anchor sheet without additional plies where slopes exceed one eighth inch (1/8 in.) per foot. An additional ply is required for slopes less than 1/8 in. per foot. Slope requirement applies to new roofs, recover roofs and reroofs.

4.8.5 Polymer modified bitumen membranes shall not be applied to slopes exceeding three inches (3 in.) per foot. At slopes exceeding one inch (1 in.) per foot, they shall be backnailed four inches (4 in.) from the upper edge at maximum twenty-four inches (24 in.) on center.

4.8.6 Polymer modified bitumen shall ~~must~~ be applied utilizing hot or cold adhesives as specified in Section 3.2.

4.9 FELT FLASHINGS:

4.9.1 Flashing used in the construction of built-up roof coverings shall be carried over cant strips, where provided, and turned up all walls and other vertical surfaces a minimum of eight inches (8 in.) and maximum of twenty four inches (24 in.).

4.9.2 Each layer of flashing shall be uniformly mopped with hot asphalt applied in a quantity not less than 25 pounds plus or minus 15 percent per roofing square for each mopping, or attached with approved cold adhesive providing equivalent bond.

4.9.3 Flashing turned up vertical surfaces shall be not less than one #30 felt starting four inches (4 in.) out from the cant strip and carried up such vertical surfaces not less than six inches (6 in.), and one mineral surfaced felt starting six inches (6 in.) out from the cant strip and carried up a minimum of eight inches (8 in.) above the top of the cant.

4.9.4 Such flashing shall be fastened to the wall one and one-half inches (1-1/2 in.) down from the upper edge every six inches (6 in.) after which the top edge shall be finished with a three inch (3 in.) strip of membrane set in roofing cement (ASTM D 4586).

4.10 VALLEYS:

4.10.1 Valleys shall be metal, as set forth in Section 1517.6, Florida Building Code, Building.

4.11 PARAPET WALLS: Built-up roof covering felts shall not wrap over walls more than 24 in. in height above the deck and, where wrapped, shall be applied as follows:

4.11.1 Flashing turned up vertical surfaces shall be not less than one #30 felt starting four inches (4 in.) out from the cant strip and carried up the face over the top of the parapet, and one mineral surfaced rolled roofing (ASTM D 249) starting six inches (6 in.) out from the cant strip and carried up and over the parapet to within three inches (3 in.) of the outside edge and fastened six inches (6 in.) on center.

4.11.2 The resulting edge shall then be finished with either a three inch (3 in.) strip of membrane set in roofing cement (ASTM D 4586) and painted with aluminum paint or coping installed in accordance with Section 1517.6 of the Florida Building Code, Building.

4.12 INSULATION: Roof insulation may be applied under or over an anchor sheet and, where provided shall be attached as set forth in Section 5 herein.

4.13 SURFACING:

4.13.1 Mineral surfaced roofing shall ~~not~~ be applied on inclines greater-than one-half inch (1/2 in.) ~~or less~~ per foot \_and~~, where used~~, shall be applied only over anchor sheets and mopped in as provided in Section 4.8 herein., ~~and on~~ On inclines five inches (5 in.) or more per foot, such caps shall be backnailed 18 inches on center.

4.13.2 Cap-surfacing with smooth or mineral surfaced felts of glass, or modified bitumen of SBS shall not be limited to slope requirements and shall be permitted to consist of one layer of mineral surfaced fiberglass felt. ~~may be:~~

~~4.13.2.1 One layer of mineral surfaced fiberglass felt.~~

4.13.3 COATINGS

4.13.3.1 Coatings shall be applied no later than 60 days after installation of membrane. Surface shall be clean and dry when coating is applied. Roof to be coated shall not be glaze coated. Coatings shall be applied in a uniform coverage with no asphalt showing through.

4.13.3.2 Aluminum pigmented coatings conforming to ASTM D 2824, Type I or 111 shall be applied at a minimum rate of 1.5 gallons per 100 square feet.

4.13.3.3 Emulsion coatings conforming to ASTM D 1227, Type 111 or IV shall be applied at the minimum rate of 3 gallons per 100 square feet.

4.13.3.4 Acrylic coatings conforming to ASTM D6083, shall not be applied on slopes less than 1/4 in. per foot, and when used, shall be applied at the rate recommended by the coating manufacturer.

5. ROOF INSULATION

5.1 Application: Roof insulation shall provide an acceptable base for built-up or~~,~~ polymer-modified bitumen, ~~or single ply~~ roof coverings, or shall become a part of such roof coverings as follows:

5.1.1 Over Wood Decks: Roof insulation shall be mechanically fastened directly to wood decks or shall be solidly mopped over an anchor sheet as set forth in Section 4.2 herein.

5.1.2 Over Other Nailable Decks: To reduce moisture absorption from the deck and preserve the insulating effectiveness, roof insulation shall be applied over an anchor sheet.

5.1.3 Insulation may be fully mopped to an anchor sheet on a nailable deck without any fasteners in the insulation.

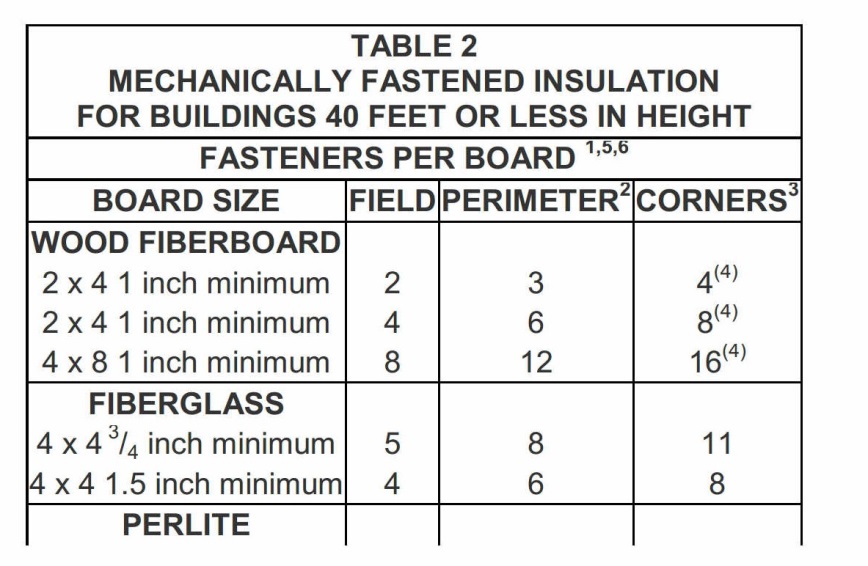
5.1.4 Over Nonnailable Decks:

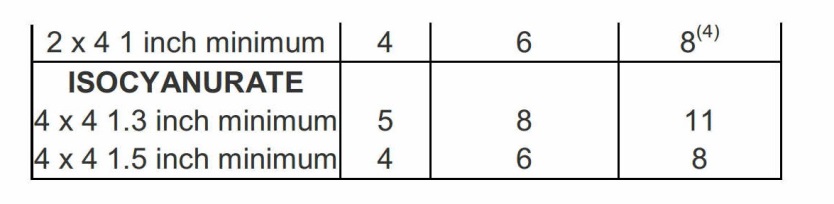
5.1.4.1 Roof insulation shall be solid-mopped as provided in Sections 4.5 and 4.6 herein for anchor sheet attachment to nonnailable roof decks.

5.1.4.2 Insulation used over structural or precast concrete deck shall be a maximum of 4' x 4' and fully mopped to the deck.

5.1.4.3 Over metal decks, roof insulation shall be mechanically attached per Table 2.

5.1.5 Over Anchor Sheet: Roof insulation applied over anchor sheets, attached as set forth in Section 4 herein shall be solid-mopped in as provided in Section 8 herein.





**FOOTNOTES**

(1) Minimum 3-inch plates must be used.

(2) Perimeter: Defined as the first board or a minimum of 4 feet from the roof edge.

(3) Corners: Defined as 8 feet in from each side.

(4) If the building has parapet walls 36 inches or higher around the entire roof perimeter, use the number of fasteners for the perimeter.

(5) Wood and Steel decks use a minimum #12 screw and penetrate through the deck a minimum of ½ inch.

(6) The installation of Polymer Modified Bitumen as a single-ply directly applied over mechanically fastened insulation requires DOUBLE the amount of fasteners in the field, perimeter and corners.

5.1.6 Under Anchor Sheet:

5.1.6.1 Where more than one layer of roof insulation is provided, each successive layer shall be solid-mopped in and all joints shall be staggered.

5.1.6.2 Anchor sheets applied over such insulation shall be solid-mopped thereto, or mechanically fastened through the insulation to nailable decks with approved fasteners spaced as set forth in Table 1 and the mechanical fastening of the insulation may be omitted.

5.1.6.3 Additional built-up roofing above the anchor sheet shall be mopped in place as provided in Section 4.8 herein.

5.1.6.4 Attachment of other roof coverings over roof insulation shall comply with the specific provisions set forth in this RAS.

6. Roof Incline:

6.1 Roof insulation applied to roof with inclines of 3 or more inches per foot (1 inch per foot on steel decks) shall be nailed, screwed or bolted through tin-caps spaced not more than 12 inches on centers both ways.

6.2 Only ASTM D 312 Type 111 or IV asphalt shall be used on such applications.

7. Vapor Retarders: Where vapor retarders are specified, they shall be as follows:

7.1 Over wood and other nailable decks, vapor retarders shall be not less than two #15 felts lapped 19 inches, or one #30 felt lapped 4 inches, solidly mopped to anchor sheet.

7.2 Over nonnailable decks, vapor retarders shall be not less than two #15 pound felts, lapped 19 inches, shingled in and solidly mopped with hot bitumen.

8. Mopping: Solid mopping shall be hot bitumen applied in a quantity of not less than 25 pounds per roofing square at temperatures as set forth in Section 3.3 and roof insulation shall be laid with staggered joints and pressed firmly into position while such mopping is hot.

**(R7087 AS)**

**TESTING APPLICATION STANDARD (TAS) No. 100-95 TEST PROCEDURE FOR WIND AND WIND DRIVEN RAIN RESISTANCE OF DISCONTINUOUS ROOF SYSTEMS**

***Standard TAS No. 100-95. Add or modify to read as follows:***

**1. Scope**   
  
1.1 This Protocol covers the determination of the water infiltration resistance of all discontinuous roof systems, consisting of a prepared roof covering and underlayment, when applied at slopes of 2 in:12 in. or greater over a nailable deck.   
  
1.2 The test procedures outlined in this Protocol determine whether a discontinuous roof system, consisting of an underlayment and a prepared roof covering, provides sufficient wind driven rain resistance to allow no water infiltration through the deck sheathing during a predetermined test period.   
  
1.3 All testing and calculations shall be conducted by an approved testing agency and all test reports, including calculations, shall be signed by a Registered Design Professional ~~per F.S., Section 471 or 481.~~  **2. Referenced Documents**   
  
2.1 *ASTM Standards:*

|  |  |
| --- | --- |
| D 1079 | Standard Definitions and Terms Relating to Roofing, Waterproofing and Bituminous Materials |
| E 380 | Excerpts from the Standard Practice for Use of the International System of Units (SI) (the Modernized Metric System) |

~~2.2~~ *~~International Conference of Building Officials~~* ~~Acceptance Criteria for Special Roofing Systems   
  
2.3~~ *~~The Florida Building Code, Building~~*~~.   
  
2.4~~ *~~The American Plywood Association~~* ~~Performance Standards and Polices for Structural-Use Panels   
  
2.5~~ *~~Roof Consultants Institute~~* ~~Glossary of Terms~~  **3. Terminology & Units**   
  
3.1 Definitions - For definitions of terms used in this specification, refer to ASTM D 1079~~,~~and Chapters 2 and 15 (High-Velocity Hurricane Zones) *Florida Building Code, Building*~~;~~. ~~and/or the RCI Glossary of Terms. The~~ In the event of a conflict, 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~~ This test procedure provides a means for establishing the resistance to wind driven rain of the discontinuous roof system, consisting of underlayment and a prepared roof covering. This test procedure has not been contemplated to measure the performance of the prepared roof covering and underlayment to maximum winds and/or uplift forces anticipated in Chapter 15, High-Velocity Hurricane Zone, of the *Florida Building Code, Building*.  **5. Apparatus**   
  
5.1 The Test Frame   
  
5.1.1 The test frame shall consist of a 10′ long x 8′ wide base structure, constructed from wood or steel framing, and a wood deck, constructed from plywood sheathing. Deck support joists shall be placed at 24 in. centers (See Figure 1, attached). The deck slope shall be adjustable or multiple interchangeable decks shall be available to test specimens at slopes of 2 in., 3 in., 31/2 in., 4 in., 5 in. and 6 in. in 12 in. The deck support assembly shall be capable of supporting not less than 55 lb per square foot of dead load.   
  
5.1.2 The test frame shall not be constructed against the side of a wall or other structure which is taller than the frame.   
  
5.1.3 The test frame shall be rigidly supported during the test period.   
  
5.2 The Wind Generator(s)   
  
5.2.1 The wind generator(s) shall provide a constant wind profile over the entire width of the test specimens for the specified time period to a maximum wind speed of 110 mph.   
  
5.2.2 If the wind generator(s) is unable to provide the required constant profile, as determined by windstream calibration (Section 7.1), airflow from the wind generator(s) shall be directed and smoothed by suitably shaped baffles (see Figure 2, attached).   
  
5.3 Water Supply   
  
5.3.1 Water shall be supplied to the wind stream using a sprinkle-pipe system mounted on a movable frame capable of simulating a uniform 8.8 in. per hour of rainfall over the test specimen. The simulated rainfall and flow meters shall be calibrated and the water distribution shall be checked as noted in Sections 7.2 and 7.3 , respectively.  **6. Test Limitations and Precautions**   
  
6.1 During the test, all testing agency representatives and other test observers shall wear ear and eye protection and hard hats to prevent injury.   
  
6.2 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.  **7. Calibration**   
  
7.1 Windstream Calibration:   
  
7.1.1 Prior to conducting the test, the windstream velocity shall be measured on a vertical plane grid, having dimensions of 8′ wide by 4′ high and grid dimensions of 24 in. x 24 in., located two feet in front of the test frame with the lower eight foot dimension in line with the front edge of the test frame (see Figure 2, attached).   
  
7.1.2 The measured windstream velocity within each grid square shall be within ± 10% of the required axial velocity for each wind speed. The windspeed shall be measured using a pitot tube connected directly to a U-tube or calibrated pressure sensing device such as a magna helix gauge. Convert the reading of inches of water to miles per hour (MPH). Pressure sensing device shall be capable of reading to the nearest 0.1 inch of water.   
  
7.1.3 Calibration of the wind stream velocity shall be conducted every six months or whenever any change is made to any wind tunnel component.   
  
7.2 Simulated Rainfall and Flow Meter Calibration - A maximum of three months prior to conducting the test, the flow meter(s) shall be calibrated using the following method:   
  
7.2.1 Capture water from the exit of the flow meters in a five gallon bucket which has been weighed.   
  
7.2.2 Allow water to flow through the flow meter into the tared 5 gallon bucket for a period of 1 minute. Set the flow meters to deliver 8.8 inches of water per hour and record the flow meter reading in gallons per minute during the process.   
  
7.2.3 Convert the flow meter reading (gallons/minute) to rainfall simulation (inches/hour) using the following formula:

|  |
| --- |
| http://floridabuilding2.iccsafe.org/app/book/content/2014_Florida/Test%20Protocols%20Code/Images/_724D52E8C7DBDB1_5265x1440.jpg |

7.2.4 The quantity of rainfall simulation determined in 7.2.3 shall be within ± 5% of the desired rainfall simulation of 8.8 inches/hour.   
  
7.2.5 Measure the volume of water (in3) captured and convert this to rainfall simulation (inches/hour) using the following formula:

|  |
| --- |
| http://floridabuilding2.iccsafe.org/app/book/content/2014_Florida/Test%20Protocols%20Code/Images/_73050198C7DBDB1_4665x1500.jpg |

7.2.6 The rainfall simulation determined in 7.2.3 (x) shall be within ± 5% of the rainfall simulation determined in 7.2.5 (y).   
  
7.3 Water Distribution Check - The water distribution check over the (8 ft. x 10 ft.) flat test deck (without valley) shall be checked and calibrated every six months using the method outlined herein. Water distribution system must be adjusted so that the water introduced into the wind stream strikes the deck.   
  
7.3.1 Prepare ten (10) 24 in. squares of thick absorptive material and weigh each sample. From this data, determine the average weight of the samples.   
  
7.3.2 Prepare twenty (20) numbered squares of absorptive material and lay out on deck four horizontally across the deck and five vertically up the deck. Place a hold-down frame over the test deck and squares of absorptive material.   
  
7.3.3 Set the test frame to 2 inches per foot of slope.   
  
7.3.4 Set the wind speed to 35 mph and add water to the windstream at a constant rate, as indicated on the flow meter, until the absorptive material is wet but not saturated, at which time the wind and water flow shall be terminated. Record the duration of time required to ‘wet’ the material.   
  
7.3.5 Remove the hold-down frame from the deck and rapidly weigh the squares of wet absorptive material. Determine the weight of water striking each square sample at the particular wind speed and flow meter setting.   
  
7.3.6 No one particular square sample shall exhibit rainfall simulation, measured in weight, greater than or less than 25% of the average weight of all twenty squares.   
  
7.3.7 Repeat steps 7.3.2 through 7.3.5 at a wind speed of 70 mph.   
  
7.3.7.1 No one particular square sample shall exhibit a rainfall simulation, measured in weight, greater than or less than 25% of the average weight of all 20 squares.  **8. Test Specimens**   
  
8.1 Deck   
  
8.1.1 The wood test deck shall consist of APA 32/16 span rated sheathing of 15/32 in. thickness installed over 2 in. x 6 in. perimeter supports and 2 in. x 6 in. intermediate supports spaced 24 in. apart. The sheathing shall be attached with 8d common nails at 6 in. o.c. at panel edges and 12 in. o.c. at intermediate supports. One valley shall be constructed into the test deck, located at the deck’s front edge, as noted on Figure 1, attached.

8.1.1.1. Other *approved* test deck configurations shall be permitted to be used.

8.1.2 The wood test deck shall be positioned at the minimum slope, as applicable in the High-Velocity Hurricane Zone jurisdiction, for the type of discontinuous roof system being tested, but not less than 2 in:12 in.   
  
8.2 Underlayment and Prepared Roof Covering.   
  
8.2.1 Underlayment and prepared roof covering shall be installed in ~~strict~~ compliance with the manufacturer’s ~~published~~ installation instructions and the minimum installation requirements set forth in Section 1518 of the *Florida Building Code, Building*. ~~The requirements of the~~ *~~Florida Building Code, Building~~* ~~shall take precedence.~~  
8.3 The areas subject to the test criteria shall consist of the field area of the test deck, the eave, the valley, one rake section.   
  
8.4 The test specimen shall be inspected by a Registered Design Professional per F.S., Section 471 or 481 or Registered Roof Consultant who shall confirm in the final report that the method of construction is in compliance with the specifications of this protocol.   
  
**9. Conditioning** - conditioning need not be performed on mechanically attached, rigid, discontinuous roof systems.  
  
9.1 Conditioning shall consist of three days of exposure to outside environmental conditions during which time the surface temperature of the prepared roof covering shall reach not less than 135°F for a period of six hours in each day. The surface temperature shall be measured with a surface mounted thermocouple and recorded to confirm that the specified surface temperature is attained for the specified period of time on each day.   
  
9.2 Should the surface temperature fail to reach the specified temperature for the specified time period on each of three days, the test deck shall be conditioned for one additional day or until the surface temperature has been at 135°F for a total of 18 hours.   
  
9.3 As an alternative, conditioning may consist of 16 continuous hours of deck exposure to minimum relative humidity of 80% ± 5% and a minimum temperature of 135°F to 140°F in a closed cell or room.   
  
9.4 Care must be taken not to damage, twist or distort the test specimen during handling as this may affect the test specimen’s performance.   
  
9.5 After the conditioning procedure is complete, the test deck shall be allowed to come to ambient temperature prior to testing.  **10. Test Procedure**   
  
10.1 The test specimen shall be positioned on the test frame at the minimum slope proposed for installation but not less than 2 in:12 in.   
  
10.2 The test specimen shall be positioned so that the exposed edge of the 8 foot eave is facing the wind generator(s) and to accommodate an observer under the deck for the duration of the test period.   
  
10.3 The topside and underside of the test specimen shall be photographed immediately prior to starting the test.   
  
10.4 The wind speed intervals shall be conducted as noted below.

|  |  |  |
| --- | --- | --- |
| Interval # | Wind speed (mph) | Time (min.) |
| 1 | 35 | 15 |
| 2 | 0 | 10 |
| 3 | 70 | 15 |
| 4 | 0 | 10 |
| 5 | 90 | 15 |
| 6 | 0 | 10 |
| 7 | 110 | 5 |
| 8 | 0 | 10 |

The test shall terminate at the end of the final ten (10) minute 0 mph interval.   
  
10.5 Water shall be added to the windstream upon commencement of the initial wind speed, upwind from the test deck, in an even spray, at a rate to simulate 8.8 in. per hour of rainfall over the test specimen. The flow of water shall be measured with a calibrated flow meter during the test procedure to confirm water flow. Water flow shall be stopped and started in conjunction with the air flow intervals noted in 10.4. Photographs shall be taken of the top side and underside of the test specimen 30 seconds prior to the completion of each interval noted in Section 10.4.   
  
10.6 The observer shall monitor any water infiltration from the underside of the test specimen, recording approximate quantities penetrating the deck structure during the test period. Should the volume of water increase to a steady dripping in three or more places during the test period, the test shall be terminated prior to maximum wind speed. Water penetrating the test shall be contained and measured. The observer shall also monitor any damage to the test specimen or any component thereof.   
  
10.7 The top side and underside of the test specimen shall be photographed immediately subsequent to test termination.  **11. Report**   
  
11.1 The final test report shall include the following:   
  
11.1.1 A description of the discontinuous roof system, including the manufacturer and type of underlayment; the manufacturer and type of prepared roof covering; the slope(s) at which the system was tested.   
  
11.1.2 A detailed report of the method of construction, including a sketch of the test specimen; certification by a Registered Design Professional per F.S., Section 471 or 481 or Registered Roof Consultant that the test specimen was constructed in compliance with the specifications of this Protocol; and, a copy of the published application instructions provided by the prepared roof covering manufacturer.   
  
11.1.3 A description of the method of conditioning used.   
  
11.1.4 A description of the absorptive material used during the water distribution check.   
  
11.1.5 Photographs of the top side and underside of the test specimen immediately prior and subsequent to commencement and termination of testing, respectively.   
  
11.1.6 Photographs of the top side and underside of the test specimen 30 seconds prior to completion of each interval noted in Section 10.4.   
  
11.1.7 All windstream calibration data (from Section 7.1); simulated rainfall and flow meter calibration data and calculations (from Section 7.2); and water distribution data and calculations (from Section 7.3).   
  
11.1.8 Detailed observations of water infiltration through the sheathing and the times and locations of water infiltration.   
  
~~11.1.9 The volume of water (if any) which infiltrated the sheathing in the area of the ridge vent on the second test specimen and was contained.~~

|  |
| --- |
| http://floridabuilding2.iccsafe.org/app/book/content/2014_Florida/Test%20Protocols%20Code/Images/Bitmap_172.jpg |

**FIGURE 1 WIND-DRIVEN RAIN TEST FRAME**

|  |
| --- |
| http://floridabuilding2.iccsafe.org/app/book/content/2014_Florida/Test%20Protocols%20Code/Images/Bitmap_173.jpg |

**FIGURE 2 WIND DRIVEN RAIN WIND TUNNEL**   
  
11.1.10 Any test specimen which exhibits water infiltration through the sheathing shall be considered as failing the wind driven rain test.   
  
11.1.11 Any test specimen which has the prepared roof covering or any portion thereof ‘blow off’, tear or blow upward without reseating during the test shall be considered as failing the wind driven rain test.

**(R7089 AS)**

**TESTING APPLICATION STANDARD (TAS) No. 100(A)-95 TEST PROCEDURE FOR WIND AND WIND DRIVEN RAIN RESISTANCE AND/OR INCREASED WINDSPEED RESISTANCE OF SOFFIT VENTILATION STRIP AND CONTINUOUS OR INTERMITTENT VENTILATION SYSTEM INSTALLED AT THE RIDGE AREA**

***Standard TAS 100(A)-95. Add or modify to read as follows:***

**1.Scope**

1.1 This Protocol covers the determination of the water infiltration resistance of a soffit ventilation and a continuous or intermittent ridge area ventilation system, including ~~(i.e.~~ ridge vents, hip and ridge shingles, static vents, turbines, and ~~or~~ powered vents~~)~~ installed on a test specimen consisting of an underlayment, prepared roof covering, the soffit ventilation, and the ridge area ventilation system, when applied at slopes of 2 in:12 in. or greater over a nailable deck.

1.2 The test procedures outlined in this Protocol determine whether a soffit ventilation and a continuous or intermittent ridge area ventilation system installed within a discontinuous roof system, consisting of an underlayment and a prepared roof covering, provides sufficient wind driven rain resistance to allow minimal water infiltration through the soffit and ridge area vent during a predetermined test period.

1.3 All testing and calculations shall be conducted by an approved testing agency and all test reports, including calculations, shall be signed by a Professional Engineer or Registered Roof Consultant.

**2. Referenced Documents**

D 1079 Standard Definitions and Terms

Relating to Roofing, Waterproofing and Bituminous

Materials

E 380 Excerpts from the Standard

Practice for Use of the International System of Units (SI) (the

Modernized Metric System)

~~2.2 International Conference of Building Officials Acceptance Criteria for Special Roofing Systems~~

~~2.3 The Florida Building Code, Building.~~

~~2.1 The American Plywood Association Performance Standards and Polices for Structural Use Panels~~

~~2.5 Roof Consultants Institute Glossary of Terms~~

**3. Terminology & Units**

3.1 Definitions - For definitions of terms used in this specification, refer to ASTM D 1079,

Chapters 2 and 15 (High-Velocity Hurricane Zones) of the Florida Building Code, Building.~~; and/or the RCl Glossary of Terms.~~ 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 procedure provides a means for establishing the resistance to wind driven rain of a continuous or intermittent ridge area ventilation system when installed in a discontinuous roof system, consisting of underlayment and a prepared roof covering. This test procedure has not been contemplated to measure the performance of the prepared roof covering and underlayment to maximum winds and/or uplift forces anticipated in the High-Velocity Hurricane Zone jurisdiction.

**5. Apparatus**

5.1 The Test Frame

5.1.1 The test frame shall consist of a base structure of sufficient dimensions to hold the test specimen noted in Section 8, constructed from wood or steel framing, and a wood deck, constructed from plywood sheathing. Deck support joists shall be placed at 24 in. centers. (See Figure 1, attached.) The deck slopes, on the windward and leeward side, shall be adjustable or multiple interchangeable decks shall be available to test assemblies at slopes of 2 in., 4 in. and 6 in. in 12 in. The deck support assembly shall be capable of supporting not less than 55 lbs per square foot of dead load. The windward end and each side of the test frame shall be covered with plywood to insure soffit to ridge airflow.

5.1.1 The test frame shall not be constructed against the side of a wall or other structure which is taller than the frame.

5.1.2 The test frame shall be rigidly supported during the test period.

5.2 The Wind Generator(s)

5.2.1 The wind generator(s) shall provide a constant wind profile over the entire width of the test deck for the specified time period to a maximum wind speed of 110 mph for ridge vent testing and 140 mph for other ventilation components.

5.2.2 If the wind generator(s) is unable to provide the required constant profile, as determined by windstream calibration (Section 7.1), airflow from the wind generator(s) shall be directed and smoothed by suitably shaped baffles. (See Figure 2, attached.)

5.3 Water Supply

5.3.1 Water shall be supplied to the wind stream using a sprinkle-pipe system mounted on a movable frame capable of simulating a uniform 8.8 in. per hour of rainfall over the test specimen. The simulated rainfall and flow meters shall be calibrated and the water distribution shall be checked as noted in Sections 7.2 and 7.3, respectively.

6. Test Limitations and Precautions

6.1 During the test, all testing agency representatives and other test observers shall wear ear and eye protection and hard hats to prevent injury.

6.2 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.

7. Calibration

7.1 Windstream Calibration

7.1.1 Prior to conducting the test, the windstream velocity shall be measured on an 8' wide vertical plane grid, of sufficient height to encompass the entire frontal profile of the test specimen placed at the test slope, having grid dimensions of 24 in. x 24 in., located two feet in front of the test frame with the lower eight foot dimension in line with the front edge of the test frame. (See Figure 2, attached.)

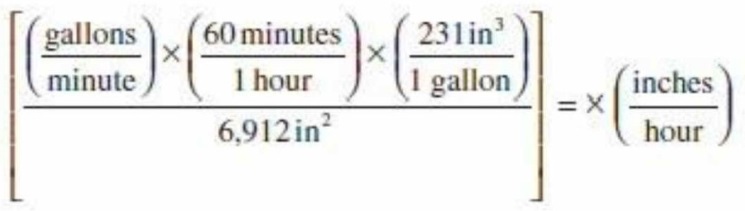
7.1.2 The measured windstream velocity within each grid square shall be within + 10% of the required axial velocity for each wind speed.

7.2 Simulated Rainfall and Flow Meter Calibration - A maximum of three months prior to conducting the test, the flow meter(s) shall be calibrated using the following method:

7.2.1 Prepare an apparatus to capture any water which would enter the windstream during an actual test.

7.2.2 Commence water insertion for a period of one (1) minute and capture the water. Record the flow meter reading ( gallons/minute) during this process.

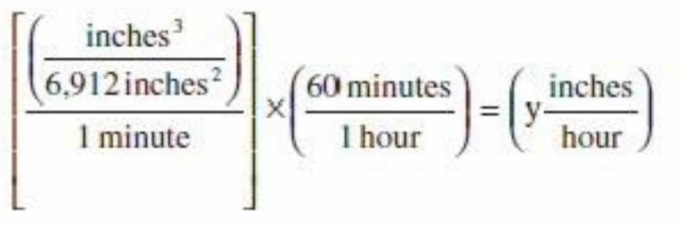
7.2.3 Convert the flow meter reading (gallons/minute) to rainfall simulation (inches/hour) using the following formula:



7.2.4 The quantity of rainfall simulation determined in 7.2.3 shall be within + 5% of the desired rainfall simulation of 8.8 inches/hour

7.2.5 Measure the volume of water (in3) captured and convert this to rainfall simulation

(inches/hour) using the following formula:



7.2.6 The rainfall simulation determined in 7.2.3 (x) shall be within + 5% of the rainfall simulation determined in 7.2.5 (y).

7.3 Water Distribution Check - Prior to conducting the test, the water distribution over the test frame shall be checked and calibrated using the method outlined herein.

7.3.1 Prepare ten (10) 24 in. squares of thick absorptive material and weigh each sample. From this data, determine the average weight of the samples.

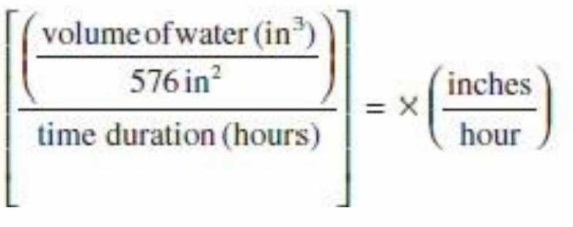
7.3.2 Prepare a 9' x 7' sheet of the absorptive material and mark the sheet with 12 24 in. squares centered on the sheet, leaving a 6 in. perimeter area unmarked.

7.3.3 Set the test frame to the desired slope and attach an 8' wide by 6' long sheathing panel, of the type specified in Section 8.1, to the test frame with the absorptive material centered on the sheathing. Fold the 6 in. material perimeter down over the test fame perimeter and clamp into place using 2 in. x 4 in. blocking and C-clamps.

7.3.4 Set the wind speed to 35 mph and add water to the windstream at a constant rate, as indicated on the flow meter, until the absorptive material is wet but not saturated, at which time the wind and water flow shall be terminated. Record the duration of time required to "wet" the material.

7.3.5 Remove the C-clamps and blocking and cut the material into the premarked 24 in. squares. Using the average dry weight of the material squares (determined in 7.3.1) and the weight after exposure, determine the volume of water (in3) striking each square sample at the particular wind speed and flow meter setting.

7.3.5.1 Determine the rain simulation (inches/hour ) absorbed into each square sample using the following formula:



7.3.6 No one particular square sample shall exhibit a rainfall simulation (determined in 7.3.5.1) greater than or less than 15% of any other square sample.

7.3.7 Repeat steps 7.3.2 through 7.3.5 at a wind speed of 70 mph.

7.3.7.1 No one particular square sample shall exhibit a rainfall simulation (determined in 7.3.5.1) greater than or less than 10% of any other square sample.

8. Test Specimens

8.1 Deck

8.1.1 The wood test deck shall consist of APA 32/16 span rated sheathing of 1532 in. thickness installed over 2 in. x 6 in. perimeter supports and 2 in. x 6 in. intermediate supports spaced 24 in. apart. The sheathing shall be attached with 8d common nails at 6 in. o.c. at panel edges and 12 in. o.c. at intermediate supports. The "windward deck" shall be 8' wide by 6' long and the leeward deck shall be 8' wide by 1'6 in. long and shall overhang the leeward end of the test frame.

8.1.2 Sheathing panels, which meet at the ridge, shall be installed such that a gap exists along the ridge. The gap size shall be specified by the ridge ventilation system manufacturer; but shall not exceed 3.5 in. in width.

8.1.3 The type of soffit ventilation shall be specified by the ridge ventilation system

manufacturer; but the net free area shall be equal to 72 + 5 in . The soffit ventilation assembly shall be installed beneath the windward eave of the test specimen. (See Figure 1, attached.)

8.1.3.1 The testing agency shall confirm that adequate soffit to ridge ventilation exists prior to conducting the wind driven rain test. Ventilation shall comply with the Florida Building Code. The net- free area of the ventilation products shall be recorded and reported in the test report.

8.1.4 A tray shall be installed on the underside of the ridge area to capture any water which infiltrates the ridge area ventilation system. The tray shall be sized and configured to insure that all water penetrating the ridge area ventilation system or the ventilation unit, is captured.

8.1.5 The wood test deck shall be positioned at the minimum slope, as applicable in the High- Velocity Hurricane Zones jurisdiction, for the type of ridge area ventilation system being tested, but not less than 2 in:12 in. (See Figure 1, attached.)

8.2 Underlayment, Prepared Roof Covering and Ridge Area Ventilation System

8.2.1 The underlayment, prepared roof covering, soffit ventilation and ridge area ventilation system (i.e., ridge vent, static vents, turbines or powered vents) shall be installed in strict compliance with the respective manufacturer's published installation instructions and the minimum installation requirements set forth in Section 1518 of the Florida Building Code, Building. The requirements of the Florida Building Code, Building shall take precedence.

8.3 The areas subject to the test criteria shall consist of the soffit ventilation installed at the windward eave and the ridge area ventilation system or the two ventilation units. All continuous ridge vents shall extend six feet across the ridge, leaving one foot of ridge waterproofing in place on each side of the ridge vent. The soffit ventilation shall extend the entire 8' width of the windward eave.

8.4 Static vents, turbines or power vents shall be installed 18 in. below the ridge measured to the closest point of the unit to the ridge.

8.4.1 Two units shall be installed on the test panel, equally spaced in the center of two support joists.

8.4.2 If units are manufactured for curb mounting, a curb shall be constructed or a preformed curb shall be secured to the test deck. The construction of the curb and its attachment shall be detailed in the test report.

8.4.3 The ventilation component shall be secured to the test deck with fasteners and/or nails in compliance with the component manufacturer's current, published installation instructions.

8.4.4 The method of application, including a detail drawing, shall be included in the test report.

8.4.5 Turbines shall be installed with the turbine component in place.

8.4.6 Turbine caps shall be available for installation at windspeeds greater than 70 mph during the test procedure.

8.5 The test specimen shall be inspected by a Professional Engineer or Registered Roof Consultant who shall confirm in the final report that the method of construction is in compliance with the specifications of this protocol.

9. Conditioning - conditioning need not be performed on ventilation systems designed for use with mechanically attached, rigid, discontinuous roof systems.

9.1 Conditioning shall consist of three days of exposure to outside environmental conditions during which time the surface temperature of the prepared roof covering shall reach not less than 135~~120~~°F for a period of six hours in each day. The surface temperature shall be measured with a surface mounted thermocouple and recorded on a chart recorder to confirm that the specified surface temperature is attained for the specified period of time on each day.

9.2 Should the surface temperature fail to reach the specified temperature for the specified time period on each of three days, the test deck shall be conditioned for one additional day or until the surface temperature has been at 135~~120~~°F for a total of 18 hours.

9.3 As an alternative, conditioning may consist of 16 continuous hours of test specimen exposure to a minimum relative humidity of 80% + 5% and a minimum temperature of 135~~120~~°F to ~~135~~140°F in a closed cell or room.

9.4 Care must be taken not to damage, twist or distort the deck during handling as this may affect the test specimen's performance.

9.5 After the conditioning procedure is complete, the test deck shall be allowed to come to ambient temperature for a period of not less than four hours prior to testing.

9.6 Additional fastener installation shall be permitted during testing to ensure roof covering performance does not interfere with the evaluation of ventilation materials. Such fasteners shall not contribute to the wind load resistance of the ventilation materials.

10. Test Procedures

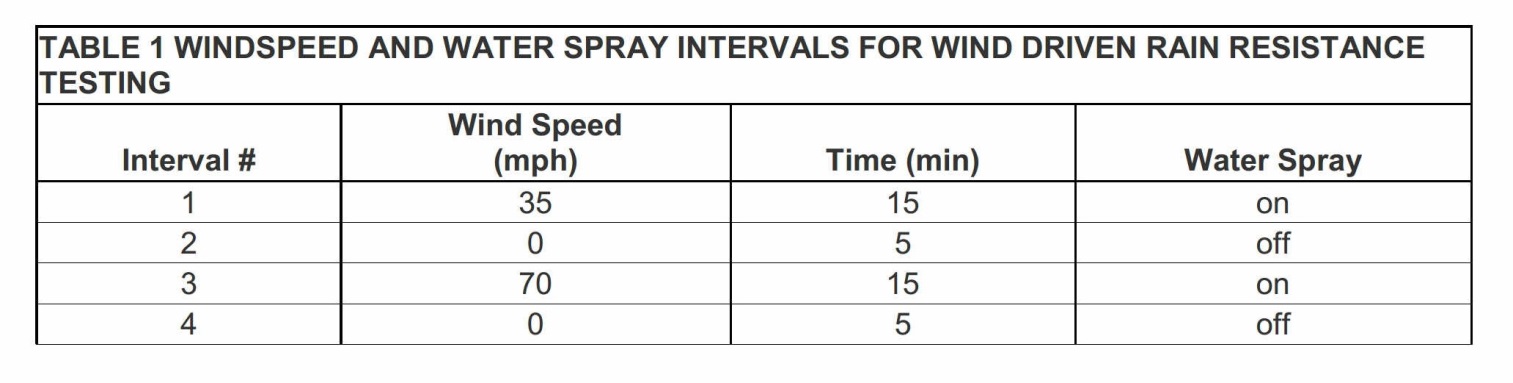
10.1 The test specimen shall be positioned on the test frame at the minimum slope proposed for installation, but not less than 2 in:12 in.

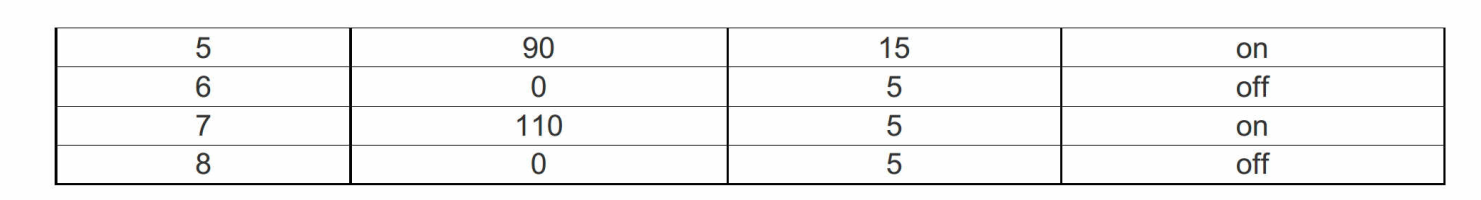
10.2 The test specimen shall be positioned so that the exposed edge of the 8 foot eave is facing the wind generator(s) and to accommodate an observer under the deck for the duration of the wind driven rain test period noted in Section 10.4.

10.3 Wind-Driven Rain Testing

10.3.1 The underside of the soffit ventilation, ridge vent or ventilation unit shall be photographed immediately prior to starting the wind driven rain test.

10.3.2 The wind speed intervals shall be conducted as noted in Table 1, below.





1 If the ventilator is a turbine vent, the turbine unit shall be removed at the conclusion of interval #3 and replaced with a "storm cap" for the duration of testing, including increased windspeed testing noted in Section 10.5.

10.3.3 Water shall be added to the windstream upon commencement of the initial wind speed, upwind from the test deck, in an even spray, at a rate equal to 8.8 in. per hour of rainfall over the test specimen. The flow of water shall be measured with a calibrated flow meter during the test procedure to confirm water flow. Water flow shall be stopped and started in conjunction with the air flow intervals noted in Table 1.

10.3.4 An observer shall monitor any water infiltration from the underside of the soffit ventilation strip or ventilation unit, recording approximate quantities penetrating the test deck during the test period. The observer shall also monitor any damage to the test specimen or any component thereof. Water penetrating the ridge area ventilation system or ventilation unit shall be gathered from the tray and measured.

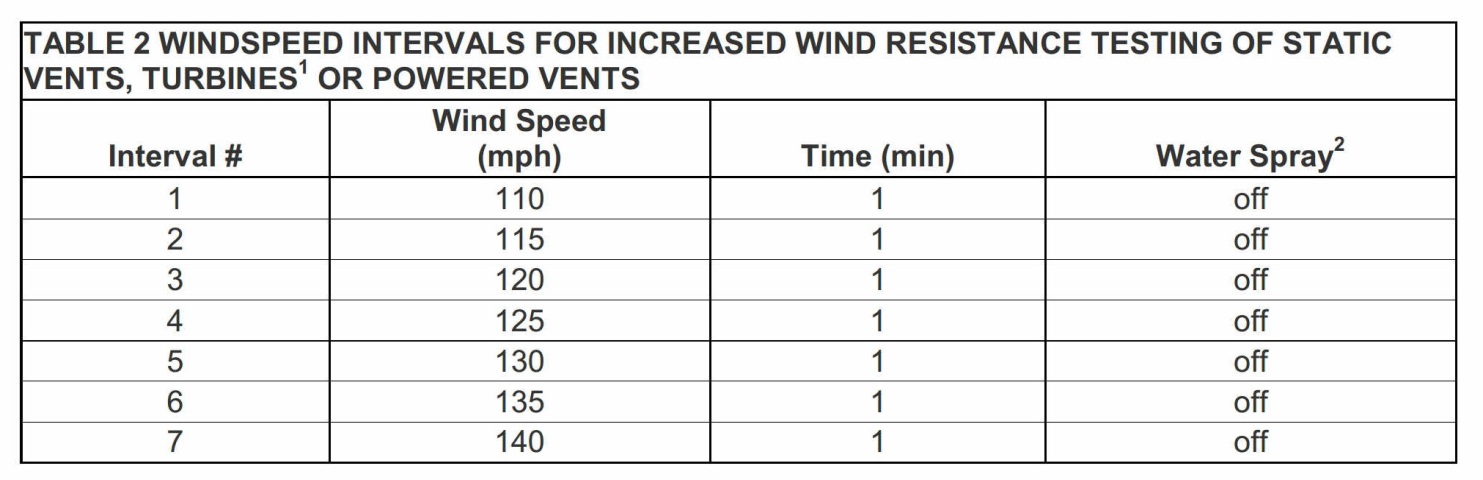
10.3.5 Any visible, unusual occurrences at the soffit or ridge ventilation areas or ventilation unit during the wind driven rain test shall be photographed.

10.3.6 If the ventilator is a turbine vent, the turbine unit shall be removed at the conclusion of interval #3 and replaced with the "storm cap" for the duration of testing, including increased windspeed testing noted in Section 10.4.

10.3.7 The underside of the soffit ventilation strip, ventilation unit and/or ridge vent shall be photographed immediately subsequent to test termination.

10.4 Increased Wind-Resistance Testing

10.4.1 Static vents, turbines, powered vents or other protruding roof top components, having a height less than or equal to 12 in. and any other dimension less than or equal to 18 in. may be tested for resistance to increased windspeeds following windspeed intervals noted in Table 2, below.



1 If the ventilator is a turbine vent, the turbine unit shall have been replaced with a storm cap

2 Water spray shall not form a portion of increased windspeed testing.   
  
10.4.2 The ventilation unit shall be photographed immediately prior to starting the increased wind resistance test.   
  
10.4.3 The increased windspeed resistance test procedure may be performed as a continuation of wind driven rain testing noted in Section 10.3 or may be performed as a separate test, provided the product being tested has previously passed the wind-driven rain testing noted in Section 10.3.   
  
10.4.4 This test procedure does not include water spray, therefore, no observer shall be present under the test deck. The observer shall remain a safe distance away from the test deck to monitor and document any damage occurring to the venting unit during increased windspeeds.   
  
10.4.5 Any visible, unusual occurrences at the ventilation unit during the increase windspeed test shall be photographed.   
  
10.4.6 Any damage to or loss of anchorage of either of the two ventilation units shall terminate the test; the observer noting the windspeed interval and time therein at which damage or anchorage loss occurs.   
  
10.4.7 The ventilation unit shall be photographed immediately subsequent to test termination, insuring any damage or loss of anchorage is completely documented.   
  
10.4.8 Manufacturers of static vents, turbines, powered vents or other protruding roof top components, having a height greater than 12 in. or any other dimension greater than 18 in. shall contact the authority having jurisdiction for additional testing requirements such as but not limited to resistance to wind induced pressures.

**(S7088 AS)**

**TESTING APPLICATION STANDARD (TAS) No. 103-95 TEST PROCEDURE FOR SELF-ADHERED UNDERLAYMENTS FOR USE IN DISCONTINUOUS ROOF SYSTEMS**

**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 Roof Systems to assist in the waterproofing to function in combination with a Prepared Roof Covering. These products may employ granular surfacing materials on one side ~~in which case the “Granular Adhesion” test, as specified herein, shall also be conducted~~. The ~~Granula~~r Granule 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 of an underlayment material; and Granular Adhesion of a mineral 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 |
| ~~Water Absorption~~ 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 | 20 |
| Peel Resistance | 21 |
| Granule Adhesion | 22 |

**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 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 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) *~~International Conference of Building Officials~~*~~Acceptance Criteria For Roof Underlayment For Use In Severe Climate Areas Acceptance Criteria For Concrete Tile Underlayment On Spaced Sheathing~~2.3 (Reserved) *~~American Plywood Association~~*~~Performance Standards and Policies for Structural-Use Panels~~2.4 (Reserved)  *~~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)  *~~Roof Consultants Institute~~* ~~Glossary of Terms~~  **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* ~~and/or the RCI Glossary of Terms~~. 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, ~~T~~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.~~Sampling~~ .  
  
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 ~~1938~~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 ~~3.5~~20 lbf (~~15.5~~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 ~~Q~~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~~ ~~Q~~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. ~~Testing shall be performed at 77°F for all tests.   
  
10.1.3.4 Specimens and testing grips shall be conditioned at 77°F for a minimum of one (1) hour prior to testing.~~   
  
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 aging ~~conditioning,~~ and ~~after Q~~UV exposure, as specified in 10.1.2.1 and 10.1.2.2 herein. These grouping 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 | ~~20~~25 lbf/inch of width (35 N/cm of width) |
| After Heat Aging | 25 lbf/inch of width (35 N/cm of width)~~85% of “as received”~~ |
| After ~~Q~~UV Exposure | 25 lbf/inch of width (35 N/cm of width)~~85% of “as received”~~ |

10.1.4.3 Elongation shall be reported, in (%), for all test specimens and shall be itemized in groupings of “as received,” after heat aging ~~conditioning,~~ and ~~after Q~~UV exposure as specified in 10.1.2.1 and 10.1.2.2 herein. 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** | |
| As Received | MD | 6% | MD | 3% | MD | 25% | MD | 225% |
| XMD | 6% | XMD | 3% | XMD | 25% | XMD | 225% |
| ~~Aster~~ After Heat Aging | 5%~~85% of “as received”~~ | | 2.5%~~85% of “as received”~~ | | 21%~~85% of “as received”~~ | | 191%~~85% of “as received”~~ | |
| After ~~Q~~UV Exposure | 5%~~85% of “as received”~~ | | 2.5%~~85% of “as received”~~ | | 21%~~85% of “as received”~~ | | 191%~~85% of “as received”~~ | |

**11.** (Reserved)  **~~Water Absorption~~**  ~~11.1 This test covers the determination of the water absorption of materials specified in Section 1 of this Protocol in accordance with ASTM Test Method D 570, except as noted below.   
  
11.1.1 Preparation   
  
11.1.1.1 Edges of membranes which include internal reinforcement as a component shall be sealed with wax to prevent water absorption through these edges. Wax shall cover not more than 0.25 in. at each edge.   
  
11.1.1 Conditioning   
  
11.1.1.1 Conditioning shall consist of 72 continuous hours of exposure to temperatures and relative humidity specified in Section 5 of this Protocol.   
  
11.1.2 Report   
  
11.1.2.1 Any test specimen which exhibits water absorption values greater than 3% shall be considered as failing the water absorption test.~~  **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 ~~(7.4),~~ 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 in. specimens are to be cut.   
  
13.1.2 Conditioning   
  
13.1.2.1 Ultraviolet light shall be produced by four 300 watt UV lamps in an enclosure in accordance with Figure 1. Recommended lamps are: Ultra-Vitalux, 300 W, 220-230 V, #E27; Osram 300 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 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.   
  
  
~~13.1 This test covers the determination of the ultraviolet resistance 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-H), except as noted below.   
  
13.1.1 Sampling - Two 18 in. x 18 in. specimens are to be cut.   
  
13.1.2 Conditioning   
  
13.1.2.1 Conditioning shall be in accordance with ICBO Acceptance Criteria For Roof Underlayment For Use In Severe Climate Areas (Section IV-H), except as noted below.   
  
13.1.2.2 Ultraviolet light shall be produced by four 300 watt UV lamps. Recommended lamps are Ultra-Vitalux, 300 W, 220-230 V, #E27, or oshram 300 W lamps.   
  
13.1.2.3 Specimens to be exposed for 200 hours (10 hours per day for 20 days).   
  
13.1.2.4 Specimen temperature to be maintained at 135-140°F throughout 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 13.1.2.1 of this Protocol shall be considered as failing the ultraviolet resistance test.   
  
13.1.3.4 Do no subject the ultraviolet exposed specimens to “tensile strength and peel-adhesion test” as noted in the ICBO Acceptance Criteria Document. The “breaking strength” shall be addressed as specified in Section 9 of this Protocol and “peel-adhesion” will not be a requirement of this Protocol.~~  **14. Accelerated Aging**   
  
14.1 This test covers the determination of the accelerated aging 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-G), except as noted below~~.   
 ~~14.1.1 Sampling~~  
14.2~~1.1.1 The six~~ Sampling - 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 (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 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).

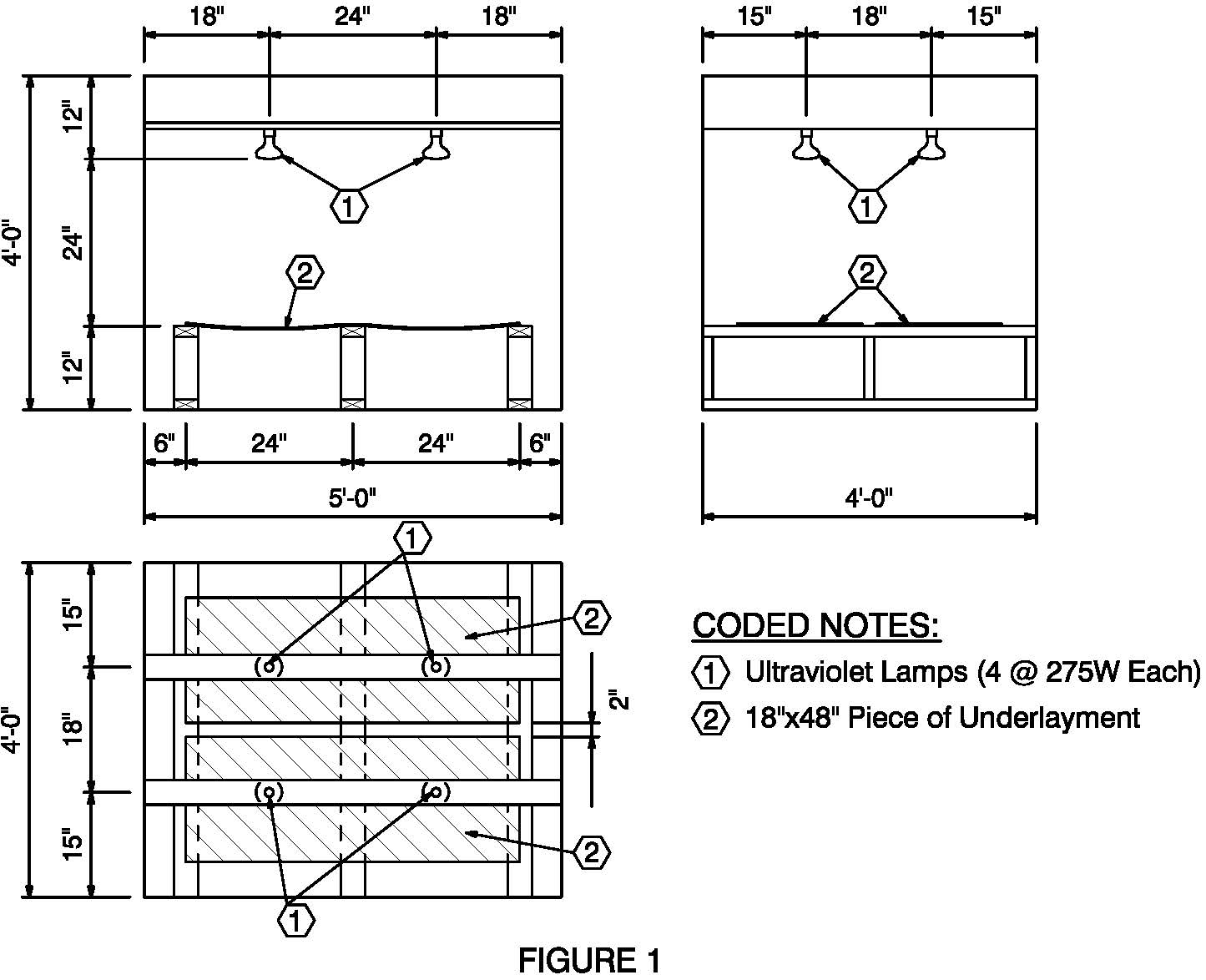
14.3.1 ~~1.2~~ Conditions of Acceptance – No visible damage to the specimens, such as chipping, cracking, or delamination.  
  
~~14.1.2.1 Do not subject the aged specimens to “tests in accordance with Section III A, D and E.” Water ponding tests (“Section III D”) and peel-adhesion tests (“Section III E”) are not requirements of this Protocol. The noted “Section III A” shall be addressed in Section 13.1.3 of this Protocol.~~   
  
14.3.1.1 ~~14.1.3~~ Breaking strength and elongation tests of aged specimens shall be conducted in accordance with Section 10 of this Protocol, except as noted below.   
  
14.3.1.2 ~~14.1.3.1~~ 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.   
  
14.3.1.3 ~~14.1.3.2~~ Conditioning - No further conditioning is to be incurred on the aged specimens.   
  
14.3.1.4 ~~14.1.3.3~~ Procedure - Each set of samples, as specified in 13.1.3.1 herein, shall be tested “as received” and after accelerated aging.   
  
14.3.1.5 ~~14.1.3.4~~ Report   
  
14.3.1.5.1 ~~14.1.3.4.1~~ 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 shall be itemized in subgroups of machine direction and cross-machine direction. Any aged specimen which exhibits a breaking strength less than ~~85%~~ ~~of the “as received”~~ the “after heat aging” value listed in Table 1 shall be considered as failing the accelerated aging test.

14.3.1.5.2 ~~14.1.3.4.2~~ Elongation shall be reported, in (%), for all test specimens and shall be itemized in grouping of ‘as received’ and after accelerated aging. These grouping shall be itemized in subgroups of machine direction and cross-machine direction. Any aged specimen which exhibits an elongation value less than ~~85% of the ‘as received’~~ the“after heat aging” 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 ~~in accordance with the ICBO Acceptance Criteria For Roof Underlayment For Use In Severe Climate Areas (Section IV F), except as noted below~~.   
  
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). Once 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 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.

~~Specimens shall be adhered over the two pieces of sheathing.~~  
~~15.1.2 The three specimens shall be prepared with 32/16~~ ~~15~~~~/~~~~32~~ ~~in. x 3 in. x 6 in. APA span rated plywood sheathing.~~15.1.2~~3~~ 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 ~~in accordance with the ICBO Acceptance Criteria For Concrete Tile Underlayment On Spaced Sheathing (Section 5.0, d,2), except~~ 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 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 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 32/16 15/32 in. APA span rated sheathing that has been reinforced on the back side with two angle irons.   
  
19.3 Adhere the underlayment to the substrate.   
  
19.4 Condition each test deck in an oven or under heat lamps maintained at ~~135~~ 165± 5°F for a minimum of four (4) hours. Thereafter, the deck shall be cooled for 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 hours while maintaining a controlled surface temperature of 165° ± 5°F. Temperature to be maintained by a surface mounted thermocouple.   
  
19.7 Report any 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.   
  
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. **20. Crack Cycling**   
  
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.~~4~~2 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 ~~(7.4), except~~ 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 15/32in. thickness.   
  
21.1.2 Conditioning   
  
21.1.2.1 One set of samples shall be conditioned at 75 ± 2°F for four (4) hours; a second and third set shall be conditioned per Sections 13 and 14 of this protocol ~~as specified in the ICBO Acceptance Criteria For Roof Underlayment For Use In Severe Climate Areas, Sections IV-G and IV-H~~ 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 75°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 ~~75% of the “conditioned at 75°F” value~~ 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 granular surfacing on one side, in accordance with ASTM Test Method D 5147~~, Section 14,~~ 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.



**(R7090 AM)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **TESTING APPLICATION STANDARD (TAS) No. 104-95 TEST PROCEDURE FOR NAIL-ON UNDERLAYMENT FOR USE IN DISCONTINUOUS ROOF SYSTEMS**  **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 Roof Systems to assist in the waterproofing to function in combination with a Prepared Roof Covering. These products may employ 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; and Granular Adhesion of a mineral 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 | | ~~Water Absorption~~ | ~~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 |   **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  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  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. ~~International Conference of Building Officials~~* ~~Acceptance~~ ~~Criteria For Roof Underlayment For Use In Severe Climate Areas Acceptance Criteria For Concrete~~ ~~Tile Underlayment On Spaced Sheathing~~  ~~2.3~~ *~~American Plywood Association~~* ~~Performance Standards and Policies for Structural-Use Panels~~  ~~2.4~~ *~~The Florida Building Code, Building.~~*  ~~2.5~~ *~~Roof Consultants Institute~~* ~~Glossary of Terms~~  **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*~~; and/or the RCI Glossary~~ ~~of Terms.~~ 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 Unless otherwise specified, condition test specimens for a minimum of four 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 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 bituminous test specimen which exhibits an average thickness less than sixty (60) mils shall be considered as failing the thickness test. Thickness measurements shall  be at the selvage edge, not at a granular surface.  6.5 Nonbituminous 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 ~~1938~~ 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 ~~3.5~~ 20 lbf (~~15.5~~ 88.5 N) in either the machine direction 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 ~~Q~~UV Exposure, shall consist of 460 hours of continuous ultraviolet light exposure in accordance with the apparatus and configuration in 12.1.2.2 herein.  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 Q~~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 ~~77°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 ~~after Q~~UV exposure as specified in  9.1.2.1 and 9.1.2.2 herein. These grouping 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 | ~~20~~25 lbf/inch of width (35 N/cm of width) | | After Heat Aging | 25 lbf/inch of width (35 N/cm of width) ~~85% of " as r ec ei ved"~~ | | After ~~Q~~UV Exposure | 25 lbf/inch of width (35 N/cm of width) ~~85% of " as r ec ei ved"~~ |   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 Q~~UV exposure as specified in 9.1.2.1 and 9.1.2.2 herein. 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.  **TABLE 2 MINIMUM ELONGATION VALUES (%)**   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **SPECIMEN** | **ORGANIC REINFORCEMENT** | | **FIBERGLASS REINFORCED** | | **POLYESTER OR POLYPROPYLENE REINFORCED** | | **SOLID THERMOPLASTIC SHEETING ~~SHEATHING~~** | | | As Received | MD | 6% | MD | 3% | MD | 25% | MD | 225% | | 6% | XMD | 3% | XMD | 25% | XMD | 225% |  | | After~~Aster~~ Heat  Aging | 5% ~~85% of " as~~  ~~r ec eiv ed"~~ | | 2.5% ~~8 5% of " as~~  ~~r ec eiv ed"~~ | | 21% ~~8 5% of " as~~  ~~r ec eiv ed"~~ | | 191% ~~85% of " as~~  ~~r ec eiv ed"~~ | | | After ~~Q~~UV Exposure | 5% ~~85% of " as~~  ~~r ec eiv ed"~~ | | 2.5% ~~8 5% of " as~~  ~~r ec eiv ed"~~ | | 21% ~~8 5% of " as~~  ~~r ec eiv ed"~~ | | 191% ~~85% of " as~~  ~~r ec eiv ed"~~ | |   **10. Reserved. ~~Water Absorption~~**  ~~10.1 This test covers the determination of the water absorption of materials specified in Section 1 of~~ ~~this Protocol in accordance with ASTM Test Method D 570, except as noted below.~~  ~~10.1.1 Specimen Preparation~~  ~~10.1.1.1 Edges of membranes which include internal reinforcement as a component shall be sealed~~ ~~with wax to prevent water absorption through these edges. Wax shall cover not more than 0.25 in. at~~ ~~each edge.~~  ~~10.1.2 Conditioning~~  ~~10.1.2.1 Conditioning shall consist of 72 continuous hours of exposure to temperatures and relative~~ ~~humidity specified in Section 5 of this Protocol.~~  ~~10.1.3 Report~~  ~~10.1.3.1 Any test specimen which exhibits water absorption values greater than 3% shall be~~ ~~considered as failing the water absorption test.~~  **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 ~~(7.7),~~ except as noted below. Membranes shall be tested at a maximum of -10 ~~5~~°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 ~~(7.7.2)~~.  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. Specimens exhibiting no cracking at -10°F shall be considered as passing the low temperature flexibility test.  **12. Ultraviolet Resistance**  12.1 This test covers the determination of the ultraviolet resistance 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-H), except as noted below~~.  12.1.1 Sampling - Two 18 in. x 18 in. specimens are to be cut.  12.1.2 Conditioning  12.1.2.1 Reserved ~~Conditioning shall be in accordance with ICBO Acceptance Criteria For Roof~~  ~~Underlayment For Use In Severe Climate Areas (Section IV-H), except as noted below.~~  12.1.2.2 Ultraviolet light shall be produced by four 300 watt UV lamps in an enclosure in accordance with Figure 1. Recommended lamps are: Ultra-Vitalux, 300 W, 220-230 V, #E27;~~, or~~ O~~o~~s~~h~~ram 300 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 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~~2~~.1 of this Protocol shall be considered as failing the ultraviolet resistance test.  ~~12.1.3.4 Do not subj ect the ul travi olet exposed specim ens to "tensil e strength and peel -adhesion~~  ~~test" as noted i n the IC B O A cceptance C ri teri a D ocum ent. Th e "breaking strength" shall be~~  ~~addressed as specif ied in S ection 9 of thi s P rotocol and "peel -adhesi on" wi ll not be a requi rem ent of~~  ~~this Protocol.~~  **13. Accelerated Aging**  13.1 This test covers the determination of the accelerated aging 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-G), except as noted below~~.  ~~13.1.1 Sampling~~  ~~13.1.1.1 The 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.~~  ~~13.1.2 Conditions of Acceptance~~  ~~13.1.2.1 Do not subj ect the aged specim ens to "tests i n accordance wi th S ection III A , D and E."~~  ~~W ater ponding tests ("S ecti on III D ") and peel -adhesi on tests ("S ecti on III E ") a re not requi rem ents of~~  ~~thi s P rotocol . The noted "S ection III A " shall be addressed i n Secti on 13.1.3 of thi s P rotocol .~~  ~~13.1.3 Breaking strength and elongation tests of aged specimens shall be conducted in accordance~~ ~~with Section 9 of this Protocol, except as noted below.~~  ~~13.1.3.1 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 recei ved" specim ens of the sam e dim ensi ons; f i ve i n the m achi ne di recti on and f i ve~~  ~~in the cross-machine direction of the roll.~~  ~~13.1.3.2 Conditioning - No further conditioning is to be incurred on the aged specimens.~~  ~~13.1.3.3 Procedure - E ach set of sam pl es, as specif ied i n 13.1.3.1 herei n, shall be tested "as~~  ~~recei ved" and af ter accel erated aging.~~  ~~13.1.3.4 Report~~  ~~13.1.3.4.1 Breaking strength shall be reported, in lbf/inch of width, for all test specimens and shall be~~ ~~itemized in grouping of "as recei ved" and af ter accel erated aging. These groupi ng shal l be i temi zed~~  ~~in subgroups of machine direction and cross-machine direction. Any aged specimen which exhibits a~~  ~~breaki ng strength l ess than 85% of the "as recei ved" val ue shal l be consi dered as failing the~~ ~~accelerated aging test.~~  ~~13.1.3.4.2 Elongation shall be reported, in (%), for all test specimens and shall be itemized in~~  ~~groupi ng of "as recei ved" and af ter accel erated agi ng. Th ese groupi ng shal l be i tem i zed in~~  ~~subgroups of machine direction and cross-machine direction. Any aged specimen which exhibits an~~  ~~el ongation val ue l ess than 85% of the "as recei ved" val ue shall be considered as f ai li ng the~~  ~~accelerated aging test.~~  13.2 Sampling - 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 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).  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 recei ved" specim ens of the sam e dim ensi ons; f i ve i n the m achi ne di recti on and f i ve  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 herei n, shall be tested "as  recei ved" and a fter 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  i tem i zed in grouping of "as recei ved" and af ter accel erated aging. These groupi ng shal l be i temi zed  in subgroups of machine direction and cross-machine direction. Any aged specimen which exhibits a breaking strength less than the "after heat aging" value listed in Table 1 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  groupi ng of ‘as recei ved’ and af ter accel erated aging. Th ese groupi ng shall be i tem i zed in subgroups of machine direction and cross-machine direction. Any aged specimen which exhibits an elongation value less than the "after heat aging" 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 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.  ~~14.1 This test covers the determination of the cyclic elongation 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.~~  ~~14.1.1 Specimens shall be nailed, using four (4) 10d roofing nails, with one nail in each exterior~~ ~~corner of the two pieces of plywood sheathing.~~  ~~14.1.2 The three specimens shall be prepared with~~ ~~32~~/~~16~~ ~~15~~/~~32 in. x 3 in. x 6 in. APA span rated~~ ~~sheathing.~~  ~~14.1.3 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.  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 ~~in accordance with the ICBO Acceptance Criteria For Concrete Tile Underlayment~~ ~~On Spaced Sheathing (Section 5.0, d,2), except~~ 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 12 and 13 of this Protocol, respectively.  16.1.2 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 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 32/16 15/32 in. x 4' x 8' APA span rated sheathing 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.  17.4 Condition each test deck in an oven maintained at 165 ± 5°F for a minimum of four (4) hours. Thereafter, the deck shall be cooled for 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 clay tiles equipped with "lugs," 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 hours while maintaining a controlled ambient temperature of 165° ± 5° F.  17.7 Report any tears, slippage or "tear drop" conditions which arise at fastener penetrations during the test. Report any tile sliding which has damaged any portion of the top surface of the underlayment.  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 stacking configurations shall be permitted to be approved as part of a Product  Approval.  **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 granular surfacing on one side, in accordance with ASTM Test Method D  5147, ~~Section 14,~~ 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.  Mod_7091_R1_Pages from Mod_7091_A1_Text_TAS 104-95 PC R7091  **(R7091 AM)** | |
|  |  |

**TESTING APPLICATION STANDARD (TAS) No. 107-95 TEST PROCEDURE FOR WIND RESISTANCE TESTING OF NON-RIGID, DISCONTINUOUS ROOF SYSTEM ASSEMBLIES (Modified from ASTM D 3161)**

***Standard TAS No. 107-95. Add or modify to read 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*

|  |  |
| --- | --- |
| D 3161 | Standard Test Method for Wind Resistance of Asphalt Shingles. |
| 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*.   
  
~~2.3~~ *~~Roof Consultants Institute~~* ~~Glossary of Terms~~   
  
3. Terminology & Units   
  
3.1 Definitions- For definitions of terms used in this specification refer to ASTM D 3161; and/or Chapters 2 and 15 (High-Velocity Hurricane Zones) 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 E 380.   
  
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 two layers of 15 lb ASTM D 226, type I asphalt saturated felt mechanically attached to the wood test deck, with 12 ga. roofing nails and 15/8 in. tin caps, in a 12 in. grid pattern 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 to duplicate test decks, parallel to the short dimension of the test deck, in compliance with the manufacturer’s instructions.   
  
8.3.2 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 bottom 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” occur shall be noted.   
  
10.2.4 If failure occurs during the test, 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 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.

**(R7092)**

**TESTING APPLICATION STANDARD (TAS) No. 110-2000 TESTING REQUIREMENTS FOR PHYSICAL PROPERTIES OF ROOF MEMBRANES, INSULATION, COATINGS AND OTHER ROOFING COMPONENTS**

**1. General**   
  
1.1 Approved roof assemblies and the Roofing Components therein shall be in compliance with the applicable ASTM Standards, and those outlined in this Testing Application Standards herein. Products not addressed herein shall be tested according to the authority having jurisdiction.  **2. Conventional Asphalt Built-up and Modified Bitumen Roof Assemblies**   
  
2.1 Conventional built-up and modified bitumen roof assemblies shall be tested in compliance with the requirements set forth in TAS 114.   
  
2.2 Roofing components within asphalt built-up and modified bitumen roof assemblies shall be in compliance with the following requirements, as applicable.

|  |  |
| --- | --- |
| **Table 2(A)** | |
| **PRODUCT** | **TEST STANDARD** |
| **Membrane or Roll Roofing Products** | |
| ~~Asphalt Cap Sheets~~ | ~~D 228~~ |
| Asphalt Coated Fiberglass Base Sheet | D 4601 |
| Asphalt Glass Felt for Roofing | D 2178 |
| Asphalt Coated Fiberglass Vented Base | D 4897 |
| Asphalt Coated Organic Base Sheet | D 2626 |
| Asphalt Organic Roll Roofing | ~~D 371~~D 6380 Class WS |
| ~~Asphalt Saturated Felt (Spec.)~~ | ~~D 250~~ |
| Asphalt Saturated Felt | D 226 |
| Roll Roofing, Glass Mat, Granule  Surface | D 3909 |
| Roll Roofing, Organic, Smooth Surface | ~~D 224~~D 6380 Class S |
| Roll Roofing, Organic, Granule Surface | D 6380 Class M |
| SBS Polyester & Glass Fiber Reinforced  ~~Modified Bitumen Membranes~~ | ~~D 5147~~ D 6162  ~~D6163 D6164~~ |
| SBS Glass Fiber Reinforced | D 6163 |
| SBS Polyester Reinforced | D 6164 |
| APP Polyester Reinforced | D 6222 |
| APP Polyester & Glass Fiber Reinforced | D 6223 |
| SBS with Metallic Laminate Surfacing | D 6298 |
| APP Base Sheet Glass Fiber Reinforced | D 6509 |
| Accelerated Weathering all membranes  Specified for use as capsheets.1 | D 5147 |
| Mechanically Attached Anchor or Base  Sheets | TAS 117(B) |

1Accelerated Weathering in compliance with ASTM D4798, Cycle A, as outlined in ASTM D5147 is to be performed on membranes identified as cap sheets wherever the applicable membrane specification standard has specified a property be tested after Heat Aging/Conditioning. The Pass/Fail criteria for accelerated weathering will be the same as that specified within the applicable membrane specification standard for after heat aging in the instances where the after heat aging requirement differs from the as received requirement. (NOTE: This Footnote is to Table 2A)

|  |  |
| --- | --- |
| **Table 2(B)** | |
| **PRODUCT** | **TEST STANDARD** |
| **~~Membrane or Roll Roofing Products~~ Other Products** | |
| Asphalt Used In Roofing | D 312 |
| Asphalt Roof Cement (Asbestos Free) | D 4586 |
| Asphalt Lap Cement1 | D ~~4022~~4586 |
| ~~Cement Wet/Underwater Application~~ | ~~Include D 3409~~ |
| Emulsified Asphalt Adhesive | D 3747 |
| Asphalt Primer | D 41 |
| Lap Cement Used in Asphalt Roll  Roofing1 | D 3019 |
| Mineral Aggregate | D 1863 |
| Insulation | See Section 8  herein |
| Fasteners, Stress Plates, etc. | See Section 13  herein |

**1. Asphalt lap cement used in wet cement or underwater applications shall also include testing in accordance with ASTM D 3409.  
  
3. Coal-Tar Pitch Built-up Roof Assemblies:**   
  
3.1 Coal-tar pitch built-up roof assemblies shall be tested in compliance with the requirements set forth in TAS 114.   
  
3.2 Roofing components within coal-tar pitch built-up roof assemblies shall be in compliance with the following requirements, as applicable.

|  |  |
| --- | --- |
| **Table 3** | |
| **PRODUCT** | **TEST STANDARD** |
| **Membrane or Roll Roofing Products** | |
| Coal-Tar Roofing Felts | D 4990 |
| Coal-Tar Saturated Felts | D 227 |
| Mechanically Attached Anchor or Base  Sheets | TAS 117(B) |
| **Other Components** | |
| Coal-Tar Pitch | D 450 |
| Coal-Tar Roof Cement | TAS 142 |
| Coal-Tar Primer | D 43 |
| Insulation | See Section 8  of this Protocol |
| Fasteners, Stress Plates, etc. | See Section 13  of this Protocol |

|  |
| --- |
| 1 Dynamic pull-over testing of all anchor or base sheets used in Approved roof assemblies shall be in compliance with TAS 117(B). |

**4. Single-Ply Roof Assemblies:**   
  
4.1 Single-ply roof assemblies shall be tested in compliance with the requirements set forth in Testing Application Standard TAS 114.   
  
4.2 Roofing components within single-ply roof assemblies shall be in compliance with the following requirements, as applicable.

|  |  |
| --- | --- |
| **Table 4** | |
| **PRODUCT** | **TEST STANDARD** |
| **Membrane Products** | |
| Polyvinyl Chloride Sheet Roofing - PVC (Spec.) ~~Thermoplastic Sheet Roofing (Spec.)~~ | D 4434 |
| Vulcanized Rubber Sheet Roofing -  EPDM (Spec.) | D 4637 |
| Poly-isobutylene Sheet Roofing -  PIB (Spec.) | D 5019 |
| Polyethylene Chlorinated Polyethylene  Sheet Roofing – CMS (Spec.) | D 5019 |
| Hypalon Sheet Roofing | D 5019 |
| Thermoplastic Olefin Elastomer Sheet  Roofing - TPO | TAS 131 |
| Keytone Ethylene Ester Sheet Roofing - KEE (Spec.) | D 6754 |
| 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 |

1 Dynamic pull-over testing of single-ply membranes TAS 117(B) is not required for those mechanically attached single-ply roof assemblies tested for uplift pressure resistance in compliance with Appendix‘B’ of TAS 114.

**5. Liquid ~~Polyethylene~~ Applied Roof Assemblies:**   
  
5.1 Liquid Applied Roof Assemblies ~~neoprene and chlorinated polyethylene membrane (CPM) roof assemblies~~ shall be tested in compliance with the requirements set forth in TAS 114.   
  
5.2 ~~Liquid Applied neoprene and chlorinated polyethylene membrane (CPM) shall be in compliance with ASTM D 3468~~ Roofing components within Liquid Applied roof assemblies shall comply with the physical properties requirements and standards in table 5, as applicable.

|  |  |
| --- | --- |
| **Table 5** | |
| **PRODUCT** | **TEST STANDARD** |
| **Liquid Applied Membranes** | |
| Liquid applied neoprene and chlorinated polyethylene membrane (CPM) | D 3468 |
| White Elastomeric Liquid Applied Membrane  (Water or Solvent Based) | ASTM D 6083 |
| Polyurethane Liquid Applied Membrane | ASTM D 6947 or  ASTM D 7311 |
| Silicone Liquid Applied Membrane | ASTM D 6694 |
| Rubberized Asphalt Liquid Applied Membrane | CGSB-37.50-M89 |
| **Other Components** | |
| Sealants | TAS 132 |
| Insulation | See Section 7 of  this Protocol |
| Fasteners, Stress Plates, etc. | See Section 12 of  this Protocol |

|  |  |
| --- | --- |
| **~~PRODUCT~~** | **~~TEST STANDARD~~** |
| **~~Membrane Products~~** | |
| ~~Thermoplastic Sheet Roofing (Spec.)~~ | ~~D 4434~~ |
| ~~Vulcanized Rubber Sheet Roofing -  EPDM (Spec.)~~ | ~~D 4637~~ |
| ~~Poly-isobutylene Sheet Roofing -  PIB (Spec.)~~ | ~~D 5019~~ |
| ~~Polyethylene Chlorinated Polyethylene  Sheet Roofing – CMS (Spec.)~~ | ~~D 5019~~ |
| ~~Hypalon Sheet Roofing~~ | ~~D 5019~~ |
| ~~Thermoplastic Olefin Elastomer Sheet  Roofing - TPO~~ | ~~TAS 131~~ |
| ~~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~~ |

|  |
| --- |
| ~~1~~ ~~Dynamic pull-over testing of single-ply membranes TAS 117(B) is not required for those mechanically attached single-ply roof assemblies tested for uplift pressure resistance in compliance with Appendix‘B’ of TAS 114.~~ |

**6. Spray-Applied Polyurethane Foam Roof Assemblies:**   
  
6.1 Spray-applied polyurethane foam roof assemblies shall be tested in compliance with the applicable requirements set forth in TAS 114. As an alternative to uplift pressure resistance tests noted in TAS 114, spray-applied polyurethane foam roof assemblies ~~may~~ shall be permitted to be tested for uplift pressure resistance in compliance with UL 1897.  
  
6.1.2 RAS 109 includes requirements regarding field uplift resistance testing in compliance with TAS 124 and small scale adhesion testing in compliance with TAS 109(A). These tests shall be performed based on requirements set forth in RAS 109.  
  
6.2 Spray-applied polyurethane foam shall be in compliance with the following physical property requirement.

|  |  |  |
| --- | --- | --- |
| **Table 6** | | |
| **Physical Property** | **Test**  **Standard** | **Requirement** |
| Water Absorption  (@ 73.4°F + 3.6°F for 96  hours @ 2 in. head) | D 2842 | max. 0.10 psf  (surface area) or  max. 1.0%  (by volume) |
| Dimensional Stability  (@160°F and 100%  relative humidity for 28  days) | D 2126 | max. 15% by volume |
| Water Vapor  Permeability (@ 74°F) | E 96 | max. 2.5 perm·inch |
| Compressive Strength  (@ yield parallel to rise) | D 1621 | min. 40 psi |
| Tensile Strength | D 1623 | min. 60 psi |
| Shear Strength | C 273 | min. 35 psi |
| Closed Cell Content | D 1940  D 2856 | min. 90% |
| Uplift Resistance | TAS 114  or  UL 1897 | min. -45 psf |

**7. Coatings:**   
  
7.1 Roof coatings shall be in compliance with the following requirements, as applicable.

|  |  |
| --- | --- |
| **Table 7** | |
| **Product** | **Test Standard** |
| ~~Liquid Applied Acrylic Roof Coating  Used in Polyurethane Foamed Roofing~~ | ~~ASTM D 6083~~ |
| White Elastomeric Roof Coating (Water or Solvent Based) | ASTM D 6083 |
| Polyurethane Roof Coating | ASTM D 6947 or  ASTM D 7311 |
| Rubberized Asphalt Roof Coating | CGSB-37.50-M89 |
| Silicone Roof Coating | ASTM D6694 |
| Coal-Tar (Cutback) Roof Coating | TAS 141 |
| Non-Fibered Roof and Foundation  Coating | TAS 140 |
| White Roof Patch | TAS 139 |
| Aluminum Pigmented Emulsified  Asphalt Roof Coating | TAS 138 |
| Aluminum Pigmented Asphalt  Roof Coating | ASTM D2824 |
| Asphalt Roof Coating (Asbestos Free) | D 4479 |
| Emulsified Bitumen Roof Coatings | D 1227 |

**8. Roofing Insulation:**   
  
8.1 Roofing insulation products shall be approved for use with specific roof assembly and shall be listed in such roof assembly Product Approval.   
  
8.2 Roof and sheathing insulation products used in approved roof assemblies shall be in compliance with the requirements listed in Table 8 ~~with the following requirements~~, as applicable.

|  |  |  |
| --- | --- | --- |
| **Table 8** | | |
| **Physical Property** | **Test Standard** | **Requirement** |
| **Expanded Polystyrene (EPS)** | | |
| Standard Specification | C 578 | Type IX |
| ~~Density~~ | ~~C 303~~ | ~~nom. 1.8 lbs/ft~~~~3~~ |
| ~~Compressive Strength~~ | ~~D 1621~~ | ~~min. 25 psi~~ |
| ~~Flexural Strength~~ | ~~C 203~~ | ~~min. 50 psi~~ |
| ~~Thermal Resistance~~ | ~~C 518~~ |  |
| ~~Water Absorption~~ | ~~C 272~~ | ~~max. 2.0%~~ |
| ~~Water Vapor  Permeance~~ | ~~E 96~~ | ~~max. 2.5 perm~~ |
| ~~Dimensional Stability~~ | ~~D 2126~~ | ~~max. -2%~~ |
| Flame Spread | E 84 | max. < 75 |
| **Extruded Polystyrene (XPS)** | | |
| Standard Specification | C 578 | Type IV |
| ~~Density~~ | ~~C 303~~ | ~~nom. 1.6 lbs~~ |
| ~~Compressive Strength~~ | ~~D 1621~~ | ~~min. 20 psi~~ |
| ~~Flexural Strength~~ | ~~C 203~~ | ~~min. 50 psi~~ |
| ~~Thermal Resistance~~ | ~~C 518~~ |  |
| ~~Water Absorption~~ | ~~C 272~~ | ~~max. 0.30%~~ |
| ~~Water Vapor Permeance~~ | ~~E 96~~ | ~~max. 1.0 perm~~ |
| ~~Dimensional Stability~~ | ~~D 2126~~ | ~~max. 2%~~ |
| Flame Spread | E 84 | max. < 75 |
| **Fiberglass/Mineral Wool ~~d~~fiber** | | |
| Standard Specification | C 726 | Type I or II |
| ~~Compressive Strength~~ | ~~C 165~~ | ~~min. 30 psi~~ |
| ~~Thermal Resistance~~ | ~~C 518~~ |  |
| ~~Water Absorption~~ | ~~C 209~~ | ~~max. 10%~~ |
| ~~Water Vapor  Permeance~~ | ~~E 96~~ | ~~max. 0.3 perm~~ |
| ~~Flame Spread~~ | ~~E 84~~ | ~~max. 20~~ |
| ~~Linear Expansion~~ | ~~C 208  Class C & E~~ | ~~max. 0.5%~~ |
| **Wood Fiberboard** | | |
| Standard Specification | C 208~~9~~ | Grade 1 or 2 |
| ~~Water Absorption~~ | ~~C 209~~ | ~~max. 10%~~ |
| Compressive Strength | C 165 | nominal 30 psi |
| ~~Thermal Resistance~~ | ~~C 518~~ |  |
| **Perlite** | | |
| Standard Specification | C 728 | Type 1 or 2 |
| Compressive Strength | C 165  Procedure "A" | min. 35 psi |
| ~~Flexural Strength~~ | ~~C 203~~ | ~~min. 40 psi~~ |
| ~~Tensile Strength~~ | ~~C 209~~ | ~~575 lb/ft~~~~2~~ |
| ~~Thermal Resistance~~ | ~~C 518~~ |  |
| ~~Water Absorption~~ | ~~C 209~~ | ~~max. 1.5%~~ |
| Water Vapor  Permeability | C 355 | max. 25 perm-inch |
| Dimensional Stability | D 2126 | max. 2% |
| Flame Spread | E 84 | max. < 75 |
| **Polyisocyanurate** | | |
| Standard Specification | C 1289 |  |
| Density | D 1622 | nominal 2 pcf |
| Compressive Strength | D 1621 | min. 18 psi |
| Water Absorption | C 209 | max. 1.0% |
| Water Vapor Permeance | E 96 | max. 1.0 perm |
| Dimensional Stability (7Days) | D 2116 | max. 2% |
| Flame Spread | E 84 | max. < 75 |
| Spread of Flame (with Roof Cover) | E 108 | min. Class‘B’ |

|  |  |  |
| --- | --- | --- |
| **~~Physical Property~~** | **~~Test Standard~~** | **~~Requirement~~** |
| **~~Polyisocyanurate~~** | | |
| ~~Density~~ | ~~D 1622~~ | ~~nominal 2 pcf~~ |
| ~~Compressive Strength~~ | ~~D 1621~~ | ~~min. 18 psi~~ |
| ~~Thermal Resistance~~ | ~~C 518  PIMA CP 101~~ | ~~report~~ |
| ~~Water Absorption~~ | ~~C 209~~ | ~~max. 1.0%~~ |
| ~~Water Vapor Permeance~~ | ~~E 96~~ | ~~max. 1.0 perm~~ |
| ~~Dimensional Stability (7Days)~~ | ~~D 2116~~ | ~~max. 2%~~ |
| ~~Flame Spread~~ | ~~E 84~~ | ~~max. < 75~~ |
| ~~Spread of Flame (with Roof Cover)~~ | ~~E 108~~ | ~~min. Class‘B’~~ |

**9. Fiber Cement, Discontinuous Roof Assemblies**   
  
9.1 Fiber cement, discontinuous roof assemblies shall be installed in compliance with the requirements set forth in the roof assembly Product Approval.

|  |  |  |
| --- | --- | --- |
| **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  TAS135 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 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 D 4798 as outlined in ASTM D 5147 for 1000 hours (cycle A); 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. |

9.2 All fiber cement, discontinuous roof assemblies, and the roofing components therein, shall be tested in compliance with the following requirements, as applicable. **10. Non-Rigid, Discontinuous (Shingle) Roof Assemblies:**   
  
10.1 Non-rigid, discontinuous roof assemblies shall be installed in compliance with the requirements set forth in the roof assembly Product Approval.   
  
10.2 All non-rigid, discontinuous roof assemblies, and the roofing components therein, shall be tested in compliance with the following requirements, as applicable.

|  |  |  |
| --- | --- | --- |
| **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 | D 3462 |
| Granule Surfaced, Class  'A' Asphalt Shingles  Fiberglass Reinforced | Physical  Properties | D 3018  TAS 135 |
| Composite Shingles  Fiber Cement Shingles | Physical  Properties | TAS 135 |
| Metal Shingles | Salt Spray and  Accelerated  Weathering | B 117 and G  23 |
| **Underlayment** | | |
| Self-Adhered  Underlayments | Physical  Properties | TAS 103 or ASTM D 1970 |
| 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 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 D 4798 as outlined in ASTM D 5147 for 1000 hours (cycle A); pass/fail established by physical properties testing of the weathered samples. Physical properties testing where specimen size will not fit into the accelerated weathering device may be omitted. |

**11. Rigid, Discontinuous (Tile) Roof Assemblies:**   
  
11.1 Rigid, discontinuous roof assemblies shall be applied in compliance with the requirements set forth in the roof assembly Product Approval.   
  
11.2 All rigid, discontinuous roof assemblies, and the roofing components therein, shall be tested in compliance with the following requirements, as applicable.

|  |  |  |
| --- | --- | --- |
| **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 | C 406 |
| **Underlayment** | | |
| Self-Adhered  Underlayments | Physical  Properties | TAS 103 or ASTM D 1970 |
| 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 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 D 4798 as outlined in ASTM D 5147 for 1000 hours (cycle A); pass/fail established by physical properties testing of the weathered samples. Physical properties testing where specimen size will not fit into the accelerated weathering device may be omitted. |

**12. Steel:**   
  
12.1 Galvanized steel shall be in compliance with Standard A 525.  **13. Mechanical Attachment Components:**   
  
13.1 All nails, metal fasteners, batten bars and stress distribution plates shall be tested for corrosion resistance in compliance with Appendix E of TAS 114.  
  
13.1.1 All roofing nails and tin-caps shall be tested for corrosion resistance in compliance with TAS 114 Appendix E, Section 2 (ASTM G 85).   
  
13.1.2 All roof tile nails or fasteners, except those made of copper, monel, aluminum, or stainless steel, shall be tested for corrosion resistance in compliance with TAS 114 Appendix E, Section 2 (ASTM G 85), for salt spray for 1000 hrs.   
  
13.2 Fasteners for attachment of anchor or base sheets, insulation products or single-ply membranes to various substrates shall be tested for withdrawal resistance in compliance with TAS 117(A).   
  
13.3 Metal stress plates, whether separate or integral to a particular fastener, shall be tested in compliance with TAS 117(B) with various anchor or base sheets or single-ply membranes (i.e. the type of product the plate is design to attach) to determine the dynamic pull-through performance of the particular membrane with the particular stress plate.

|  |  |  |
| --- | --- | --- |
| **~~Product~~** | **~~Test~~** | **~~Test Standard~~** |
| ~~Concrete Roof Tile~~ | ~~Physical  Properties~~ | ~~TAS 112~~ |
| ~~Clay Roof Tile~~ | ~~Physical  Properties~~ | ~~C 1167~~ |
| ~~Fiberglass Reinforced  Composite Tile~~ | ~~Physical  Properties~~ | ~~TAS 135~~ |
| ~~Fiber Cement Tile or  Shakes~~ | ~~Physical  Properties~~ | ~~TAS 135~~ |
| ~~Slate~~ | ~~Physical  Properties~~ | ~~C 406~~ |
| **~~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)~~ |

13.3.1 For single-ply membranes, if the mechanically attached, single-ply roof assembly is tested for dynamic uplift pressure resistance in compliance with Appendix B of TAS 114, then no dynamic pull-through testing is required for the metal stress plate/membrane combination used in the dynamic uplift pressure testing.   
  
13.4 Metal and plastic stress plates, whether separate or integral to a particular fastener, shall be tested in compliance with TAS 117(C) to determine the dynamic pull-off performance of the particular stress plate.   
  
13.4.1 For single-ply membranes, if the mechanically attached, single-ply roof assembly is tested for dynamic uplift pressure resistance in compliance with Appendix B of TAS 114, then no dynamic pull-off testing is required for the metal or plastic stress plate/membrane combination used in the dynamic uplift pressure testing.  **14. Attic Ventilation Products:**   
  
14.1 All approved attic ventilation products (i.e. soffit vent strips, ridge vents, static vents, louvers, turbines and/or powered vents) shall be sized and installed in compliance with the requirements set forth in the Product Approval.   
  
14.2 Approved attic ventilation products shall be in compliance with the following requirements, as applicable.

|  |  |  |
| --- | --- | --- |
| **Table 14** | | |
| **Product** | **Test** | **Test Standard** |
| Attic Ventilation  Products (*soffit vent*  *strips, ridge vents,  static vents, louvers,*  *turbines, powered  vents, etc.*) | Wind and  Wind-Driven Rain  Resistance | TAS 100(A) |
| 'Small' Protruding  Ridge Ventilation  Products (*static vents,*  *louvers, turbines,  powered vents, etc.*) | Increased Wind  Speed Resistance | TAS 100(A) |
| 'Large' Protruding  Ridge Ventilation  Products (*turbines,*  *powered vents, etc.*) | Pressure  Resistance | TAS 100(B) |
| Plastic Ridge Vents | Ultraviolet  Resistance | ASTM G155 |
| Plastic Ridge Vents | Burning  Resistance | D 635 or  D1929 |

**15. Non-Structural Metal Panel Roof Assemblies:**   
  
15.1 All structural metal panel, ~~and~~ nonstructural metal panel, and metal shingle ~~l~~ roof assemblies, and the roofing components therein, shall be tested in compliance with the following requirements, as applicable.

|  |  |  |
| --- | --- | --- |
| **~~Product~~** | **~~Test~~** | **~~Test Standard~~** |
| ~~Attic Ventilation  Products (~~*~~soffit vent~~**~~strips, ridge vents,  static vents, louvers,~~**~~turbines, powered  vents, etc.~~*~~)~~ | ~~Wind and  Wind-Driven Rain  Resistance~~ | ~~TAS 100(A)~~ |
| ~~'Small' Protruding  Ridge Ventilation  Products (~~*~~static vents,~~**~~louvers, turbines,  powered vents, etc.~~*~~)~~ | ~~Increased Wind  Speed Resistance~~ | ~~TAS 100(A)~~ |
| ~~'Large' Protruding  Ridge Ventilation  Products (~~*~~turbines,~~**~~powered vents, etc.~~*~~)~~ | ~~Pressure  Resistance~~ | ~~TAS 100(B)~~ |
| ~~Plastic Ridge Vents~~ | ~~Sunlight  Resistance~~ | ~~D 1929~~ |
| ~~Plastic Ridge Vents~~ | ~~Burning  Resistance~~ | ~~D 635~~ |

|  |  |  |
| --- | --- | --- |
| **Table 15** | | |
| **Product** | **Test** | **Test Standard** |
| Structural,  ~~and~~ Non-  Structural Metal Panels, and Metal Shingle Roof Assemblies~~y~~ | ~~Standard  Requirements~~Uplift Resistance | TAS 125 |
| Structural, Non-  Structural Metal Panels, and Metal Shingle Roof Assemblies | Wind and  Wind-Driven Rain  Resistance | TAS 100 |
| Structural, Non-  Structural Metal Panels, and Metal Shingle Roof Assemblies~~Structural and Non-  Structural Metal Panel  Roof Assembly~~ | Fire  Resistance | E 108  (min. Class “B”) |
| Structural, Non-  Structural Metal Panels, and Metal Shingle Roof Assemblies~~Structural and Non-  Structural Metal Panel  Continuous Roof  Assembly~~ | Accelerated  Weathering | G 152 or G 155  (2000 hours) |
| Structural, Non-  Structural Metal Panels, and Metal Shingle Roof Assemblies~~Structural or Non-  Structural Metal  Panels~~ | Salt Spray | B 117  (1000 hours) |
| Insulated Metal Panels | Thermal Value | C 518 (report) |

**16. Edge Metal and Flashings:**   
  
16.1 Edge metal and flashings and their installation shall be in compliance with the requirements set forth in RAS 111.   
  
16.1.1 Edge metal, including drip edge/gravel stop and metal profiles, may be tested for attachment performance in compliance with TAS 111(A) and TAS 111(B), the results from which shall be used to determine adequate attachment to resist wind induced upward and outward forces, as set forth in Chapter 16 of this code.   
  
16.1.2 Coping caps shall be tested for attachment performance in compliance with TAS 111(C), the results from which shall be used to determine adequate attachment to resist wind induced upward and outward forces, as set forth in Chapter 16 *Florida Building Code, Building*.

**17. Non-Rigid Tiles/Shakes/Slate/Shingles Products (Plastic):**   
  
17.1 Non-Rigid, discontinuous roof assemblies shall be applied in compliance with the requirements set forth in the roof assembly Product Approval.   
  
17.2 All non-rigid, discontinuous roof assemblies, and roofing components therein, shall be tested in compliance with the following requirements, as applicable.

|  |  |  |
| --- | --- | --- |
| **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 | G 26 (6500 watts) Test Method 1  or  G155 (4500 hours) |
|  | Tensile Test | D 638  (+/- 10% allowable difference between  exposed and non-exposed samples) |
| Flexural Test | C 158  (+/- 10% allowable difference between  exposed and non-exposed samples) |
| Plastic Tile/Shake/Slate | Self Ignition | D 1929 (greater than 650°F) |
| Plastic Tile/Shake/Slate | Smoke Density Rating | E 84 (rating less than 450)  or  D2843 (rating less than 75) |
| Plastic Tile/Shake/Slate | Rate of Burning | D 635  (Class C1 or C2) |
| **Underlayment** | | |
| Self Adhered  Underlayments | Physical Properties | TAS ~~-~~103 or ASTM D 1970 |
| 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 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 D 4798 as outlined in ASTM D 5147 for 1000 hours (cycle A); pass/fail established by physical properties testing of the weathered samples. Physical properties testing where specimen size will not fit into the accelerated weathering device ~~may be omitted~~are not required to be included. |

**18. Referenced Standards**

ASTM C158-02(2012) Standard Test Methods for Strength of Glass by Flexure (Determination of Modulus of Rupture)

ASTM C209-15 Standard Test Methods for Cellulosic Fiber Insulating Board

ASTM C518-15 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

ASTM D1970/D1970M-15a Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection

ASTM D2116-07(2112) Standard Specification for FEP-Fluorocarbon Molding and Extrusion Materials

ASTM D 2523-13 Standard Practice for Testing Load-Strain Properties of Roofing Membranes

ASTM D3409/D3409M-93(2016)e1 Standard Test Method for Adhesion of Asphalt-Roof Cement to Damp, Wet, or Underwater Surfaces

ASTM D 4073-06(2013) Standard Test Method for Tensile-Tear Strength of Bituminous Roofing Membranes

ASTM D 4329-13 Standard Practice for Fluorescent Ultraviolet (UV) Lamp Apparatus Exposure of Plastics

ASTM D4798/4798M-11 Standard Practice for Accelerated Weathering Test Conditions and Procedures for Bituminous Materials (Xenon-Arc Method)

ASTM D5147/5147M-14 Standard Test Methods for Sampling and Testing Modified Bituminous Sheet Material

ASTM D7158-16 Standard Test Method for Wind Resistance of Asphalt Shingles (Uplift Force/Uplift Resistance Method)

ASTM D 7311-07 Standard Specification for Liquid-Applied, Single-Pack, Moisture-Triggered, Aliphatic Polyurethane Roofing Membrane

**(R7093 AM)**

**TESTING APPLICATION STANDARD (TAS) No. 111(A)-95 TEST PROCEDURE FOR ROOF EDGE TERMINATION PERFORMANCE**

***Standard TAS No 111(A)-95. Add or modify to read as follows:***

**1. Scope:**   
  
1.1 This protocol covers determination of the attachment performance of roof edge terminations.   
  
1.2 The test procedures outlined in this protocol determine whether a roof edge termination, consisting of woodblocking, termination metal and the type of membrane being terminated, performs to resist an oblique load of 100 lbf/ft, as required in RAS 111.   
  
1.3 All testing and calculations shall be conducted by an approved testing agency and all test reports, including calculations, shall be signed by a Registered Design Professional ~~per F.S., Section 471 or 481.~~  **2. Referenced Documents:**   
  
2.1 *ASTM Standards:*   
  
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*.   
  
2.3 *Application Standards:*RAS 111 Standard Requirements for Attachment of Perimeter Woodblocking and Metal Flashings   
  
~~2.4~~ *~~Single Ply Roofing Institute:~~*~~SPRI Edge Design Guide, March 1994   
  
2.5~~ *~~Roof Consultants Institute:~~*~~Glossary of Terms~~  **3. Terminology & Units:**   
  
3.1 Definitions—For definitions of terms used in this specification, refer to Chapter 2 and Section 1513 of the *Florida Building Code, Building*~~; and/or the RCI Glossary of Terms~~. 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 method with which the edge of a roofing membrane is terminated (edge metal and woodblocking) is the last anchor point to hold the membrane in place should the membrane happen to separate from the roof deck during high winds. When this occurs, the membrane termination construction incurs a significant load.   
  
4.2 The test procedure outlined herein provides a means for determining whether a particular membrane termination detail performs to resist an oblique load of 100 lbf/ft.  **5. Apparatus:**   
  
5.1 The test apparatus shall consist of a tensile tester fitted with a suitable holding device for the membrane termination being tested. The load recording device attached to the tensile tester shall be capable of recording loads up to 300 lbf. (See Figures 1 and 2, herein.)  **6. Test Limitations and Precautions:**   
  
6.1 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.  **7. Test Specimen:**   
  
7.1 The test specimen shall consist of a 12 inch wide “mock-up” of the termination system as it would be installed in an actual field application. Not less than five test specimens shall be constructed and tested.  **8. Procedure**   
  
8.1 Mount the 12 inch wide test specimen to the base or holding device of the tensile tester such that the membrane is pulled at a 45-degree angle to the attachment substrate. This angle is chosen to simulate a “billowing” membrane.   
  
8.2 Photograph the test specimen prior to testing.   
  
8.2 Connect the tensile tester jaws to two bars which clamp the membrane edge creating even load distribution across the 12 inch specimen width.   
  
8.3 Apply uniform load at a constant rate to the membrane until failure, as noted below, occurs.   
  
8.3.1 Failure is defined as any event which allows the membrane to come free of the edge termination or the termination to come free from the substrate.   
  
8.4 Photograph the test specimen subsequent to failure.   
  
8.5 Record the failure load for each of five test specimens and calculated an average failure load.  **9. Interpretation of Results:**   
  
9.1 The membrane termination system shall record an average failure load not less than 100 lbf.  **10. Report:**   
  
10.1 The final report shall include the following:   
  
10.1.1 A complete description of the membrane termination system, including membrane type and attachment, edge metal type, material, thickness and attachment, and the attachment substrate (i.e., woodblocking, etc.).   
  
10.1.2 Recorded failure loads for each of five test specimens and an average failure load.   
  
10.1.3 Photographs of the test specimens prior and subsequent to failure.

|  |
| --- |
| http://floridabuilding2.iccsafe.org/app/book/content/2014_Florida/Test%20Protocols%20Code/Images/Bitmap_49.jpg |

**FIGURE 1 MEMBRANE TERMINATION PERFORMANCE TEST CONFIGURATION OPTION**

|  |
| --- |
| http://floridabuilding2.iccsafe.org/app/book/content/2014_Florida/Test%20Protocols%20Code/Images/Bitmap_50.jpg |

**FIGURE 2 MEMBRANE TERMINATION PERFORMANCE TEST CONFIGURATION OPTION**

**(R7094 AS)**

**TESTING APPLICATION STANDARD (TAS) No. 111(B)-95 TEST PROCEDURE FOR EDGE METAL PULL-OFF PERFORMANCE**

**1. Scope**   
  
1.1 This protocol covers determination of the pull-off resistance performance of various edge metal configurations when subjected to uniform loading.   
  
1.2 The test procedures outlined in this protocol determine the resistance to uniform loading of an edge metal configuration, such as drip edge, gravel stop or metal profile, as required in RAS 111. Resistance to uniform loading is determined for the horizontal (deck) flange (upward loading) and the vertical (face) flange (outward loading).   
  
1.3 All testing and calculations shall be conducted by an approved testing agency and all test reports, including calculations, shall be signed by a Registered Design Professional per F.S., Section 471 or 481.  **2. Referenced Documents**   
  
2.1 *ASTM Standards:*   
  
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*.   
  
2.3 *Application Standards:*   
  
RAS 111 Standard Requirements for Attachment of Perimeter Woodblocking and Metal Flashings   
  
2.4 *Single Ply Roofing Institute:*SPRI Edge Design Guide, March 1994 ~~2.5~~ *~~Roof Consultants Institute:~~* ~~Glossary of Terms~~  **3. Terminology & Units:**   
  
3.1 Definitions—For definitions of terms used in this specification, refer to Chapter 2 and Section 1513 of the *Florida* *Building* *Code,* *Building*~~; and/or the RCI Glossary of Terms~~. 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 procedure outlined herein provides a means for determining the maximum upward and outward pressures which a perimeter edge metal system can resist without failure.   
  
4.2 Results from this testing are used to determine whether a proposed perimeter edge metal system will provide sufficient resistance to upward and outward pressures to meet or exceed corresponding design pressures for perimeter and corner areas of a particular building, determined in compliance with Section 6 of RAS 111.  **5. Apparatus:**   
  
5.1 Load application device**:**   
  
5.1.1 The load application device shall consist of a tensile tester, or other device capable of providing uniform load, fitted with a load cell capable of recording loads up to 10,000 lbf.   
  
5.1.2 The load application device shall be fitted with an 11 foot long clamp or a series of ten 2 inch wide clamps capable of grasping a series of ten 12 ga. annular ring shank nails which form part of the load transfer device.   
  
5.2 Load transfer device:   
  
5.2.1 The load transfer device shall consist of a 1 inch wide x 11 foot long x 1/8 inch thick steel bar with 1/8 inch diameter predrilled holes spaced 12 inches o.c. with the two end holes located 1/2 inch from each end of the bar.   
  
5.2.2 The 11 feet long steel bar shall be mounted to the underside of the flange or load resisting component of the edge metal using 12 ga. x 11/2 inch long annular ring shank nails.   
  
5.3 A schematic of the test apparatus is provided in Figure 1, herein.   
  
5.4 The description of the test apparatus is general in nature and may be altered for ease of testing, provided the intent of the test is maintained.  **6. Test Limitations and Precautions:**   
  
6.1 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.  **7. Test Specimen:**   
  
7.1 The test specimen shall consist of a 10 foot long “mock-up” of the edge metal as it would be installed in an actual field application. Not less than five test specimens shall be constructed and tested for each directional load (i.e., upward for deck flange and outward for vertical flange/face).   
  
7.2 Prior to installation of the edge metal test specimen to its substrate, install the 11 foot long steel bar (load transfer device) through the back of the flange or load resisting component which is to be tested (i.e. deck flange, face flange or face cleat or hook strip) using 12 ga. x 11/2 inch long annular ring shank nails such that the points of the nails are directed outwardly normal from the load resisting component. (See Figure 1, herein.)  **8. Procedure:**   
  
8.1 Photograph the test specimen prior to testing.   
  
8.2 Position the test specimen, fitted with the load transfer device, in front of the load application device (tensile tester) and attach the 11 foot long clamp or series of ten clamps to the ends of the load transfer nails such that the clamp(s) do not interfere with the movement of the edge metal whatsoever and load generated from the load application device is normal to the surface of the edge metal flange or load resisting component being tested.   
  
8.3 Apply an initial load of 300 lbf to the load transfer device and hold the applied load for a period of one minute. At the end of one minute, reduce the load to zero and allow the test specimen to sit at zero-load for a period of two minutes. Thereafter, increase the applied load to 350 lbf and hold the applied load for a period of one minute. At end of one minute, reduce the load to zero-load and allow the test specimen to sit at zero-load for a period of two minutes. Continue this procedure in load increments of 50 lbf until failure, as defined below, occurs.   
  
8.3.1 Failure is defined as any occurrence of the following:   
  
• loss of securement;   
  
• permanent deformation; or,   
  
• component failure that will not allow the edge metal to perform as designed.   
  
8.4 Photograph the test specimen subsequent to failure.   
  
8.5 Record the failure load and the time at which failure occurred for each of five test specimens and calculated an average failure load.  **9. Interpretation of Results:**   
  
9.1 Convert the average failure load to pressure using the following equation:   
  
where:

|  |  |  |
| --- | --- | --- |
| P | = | maximum pressure (psf); |
| F | = | average failure load (lbf); and, |
| A | = | area of flange or load resistance component. |

9.2 The maximum pressure (outward or upward) shall meet or exceed corresponding design pressures for perimeter and corner areas of a particular building, determined in compliance with Section 6 of RAS 111.  **10. Report:**   
  
10.1 The final report shall include the following:   
  
10.1.1 A complete description of the edge metal system, including edge metal type, material, thickness and attachment, cleat or hook strip type, material, thickness, dimensions and attachment (if any), and the attachment substrate (i.e. woodblocking, etc.).   
  
10.1.2 Recorded failure loads for each of five test specimens, an average failure load and a maximum pressure of the edge metal system.   
  
10.1.3 Photographs of the test specimens prior and subsequent to failure.

|  |
| --- |
| http://floridabuilding2.iccsafe.org/app/book/content/2014_Florida/Test%20Protocols%20Code/Images/Bitmap_51.jpg |

**FIGURE 1 VIEW OF OUTWARD LOADING OF EDGE METAL VERTICAL FLANGE (UPWARD LOADING OF HORIZONTAL FLANGE ALSO REQUIRED)**

**(R7095 AM)**

***Standard TAS No. 111(C)-95. Add or modify to read as follows:***

**1. Scope:**   
  
1.1 This protocol covers determination of the pull-off resistance performance of various coping cap configurations when subjected to uniform loading.   
  
1.2 The test procedures outlined in this protocol determine the resistance to uniform loading of a coping cap configuration, as required in RAS 111. Resistance to uniform loading is determined for the top face (upward loading) and both vertical (face) flanges (outward loading) of the coping cap.   
  
1.3 All testing and calculations shall be conducted by an approved testing agency and all test reports, including calculations, shall be signed by a Registered Design Professional per F.S., Section 471 or 481.  **2. Referenced Documents:**   
  
2.1 *ASTM Standards:*   
  
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*.   
  
2.3 *Application Standards:*   
  
RAS 111 Standard Requirements for Attachment of Perimeter Woodblocking and Metal Flashings  
  
~~2.4~~ *~~Single Ply Roofing Institute:~~*~~ANSI/SPRI ES-1   
  
2.5~~ *~~Roof Consultants Institute:~~*~~Glossary of Terms~~  **3. Terminology & Units:**   
  
3.1 Definitions—For definitions of terms used in this specification, refer to Chapter 2 and Section 1513 of the *Florida Building* *Code,* *Building*; and/or the RCI Glossary of Terms. 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 procedure outlined herein provides a means for determining the maximum upward and outward pressures which a coping cap and its attachment can resist without failure.   
  
4.2 Results from this testing are used to determine whether a proposed coping cap and corresponding attachment method will provide sufficient resistance to upward and outward pressures to meet or exceed corresponding design pressures for perimeter and corner areas of a particular building, determined in compliance with Section 6 of RAS 111.  **5. Apparatus:**   
  
5.1 Load application device   
  
5.1.1 The load application device shall consist of a tensile tester, or other device capable of providing uniform load, fitted with a load cell capable of recording loads up to 10,000 lbf.   
  
5.1.2 The load application device shall be fitted with an 11 foot long clamp or a series of ten 2 inch wide clamps capable of grasping a series of ten 12 ga. annular ring shank nails which form part of the load transfer device.   
  
5.2 Load transfer device   
  
5.2.1 The load transfer device shall consist of a 1 inch wide x 11 foot long by 1/8 inch thick steel bar with 1/8 inch diameter predrilled holes spaced 12 inches o.c. with the two end holes located 1/2 inch from each end of the bar.   
  
5.2.2 The 11 foot long steel bar shall be mounted to the underside of the flange or load resisting component of the coping cap using 12 ga. by 11/2 inch long annular ring shank nails.   
  
5.3 A schematic of the test apparatus is provided in Figures 1 and 2, herein.   
  
5.4 The description of the test apparatus is general in nature and may be altered for ease of testing, provided the intent of the test is maintained.  **6. Test Limitations and Precautions:**   
  
6.1 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.  **7. Test Specimen:**   
  
7.1 The test specimen shall consist of a 10 foot long “mock-up” of the coping cap as it would be installed in an actual field application. Not less than five test specimens shall be constructed and tested for each directional load (i.e.,upward load resistance from the top and outward load resistance from each vertical flange).   
  
7.2 Prior to installation of the coping cap test specimen to its substrate, install the 11 foot long steel bar (load transfer device) through the back of the flange or load resisting component which is to be tested (i.e. top, inner or outer vertical flange or cleat/hook strip) using 12 ga. by 11/2 inch long annular ring shank nails such that the points of the nails are directed outwardly normal from the load resisting component. (See Figures 1 and 2, herein.)  **8. Procedure:**   
  
8.1 Photograph the test specimen prior to testing.   
  
8.2 Position the test specimen, fitted with the load transfer device, in front of the load application device (tensile tester) and attach the 11-foot long clamp or series of ten clamps to the ends of the load transfer nails such that the clamp(s) do not interfere with the movement of the coping cap whatsoever and load generated from the load application device is normal to the surface of the coping cap flange or load resisting component being tested.   
  
8.3 Apply an initial load of 300 lbf to the load transfer device and hold the applied load for a period of one minute. At the end of one minute, reduce the load to zero and allow the test specimen to sit at zero-load for a period of two minutes. Thereafter, increase the applied load to 350 lbf and hold the applied load for a period of one minute. At end of one minute, reduce the load to zero-load and allow the test specimen to sit at zero-load for a period of two minutes. Continue this procedure in load increments of 50 lbf until failure, as defined below, occurs.   
  
8.3.1 Failure is defined as any occurrence of the following:   
  
• loss of securement;   
  
• permanent deformation; or,   
  
• component failure that will not allow the coping cap to perform as designed.   
  
8.4 Photograph the test specimen subsequent to failure.   
  
8.5 Record the failure load and the time at which failure occurred for each of five test specimens and calculated an average failure load.  **9. Interpretation of Results:**   
  
9.1 Convert the average failure load to pressure using the following equation:

|  |
| --- |
| http://floridabuilding2.iccsafe.org/app/book/content/2014_Florida/Test%20Protocols%20Code/Images/FTP_61_885x555.jpg |

where:

|  |  |  |
| --- | --- | --- |
| P | = | maximum pressure (psf); |
| F | = | average failure load (lbf); and, |
| A | = | area of flange or load resistance component. |

9.2 The maximum pressure (outward or upward) shall meet or exceed corresponding design pressures for perimeter and corner areas of a particular building, determined in compliance with Section 6 of RAS 111.  **10. Report:**   
  
10.1 The final report shall include the following:   
  
10.1.1 A complete description of the coping cap system, including coping cap type, material, thickness and attachment, cleat or hook strip type, material, thickness, dimensions and attachment (if any), and the attachment substrate (i.e. woodblocking, etc.).   
  
10.1.2 Recorded failure loads for each of five test specimens, an average failure load and a maximum pressure of the coping cap system.   
  
10.1.3 Photographs of the test specimens prior and subsequent to failure.

|  |
| --- |
| http://floridabuilding2.iccsafe.org/app/book/content/2014_Florida/Test%20Protocols%20Code/Images/Bitmap_53.jpg |

**FIGURE 1 VIEW OF OUTWARD LOADING OF COPING CAP VERTICAL FLANGE (OUTWARD LOADING OF OTHER VERTICAL FLANGE ALSO REQUIRED)**

|  |
| --- |
| http://floridabuilding2.iccsafe.org/app/book/content/2014_Florida/Test%20Protocols%20Code/Images/Bitmap_54.jpg |

**FIGURE 2 VIEW OF OUTWARD LOADING OF COPING CAP VERTICAL FLANGE (UPWARD LOAD RESISTANCE)**

**(R7096 AS)**

**ROOFING ASSEMBLIESTESTING APPLICATION STANDARD (TAS) No. 114-11 TEST PROCEDURES FOR ~~ROOF SYSTEM~~ ROOFING ASSEMBLIES IN THE HIGH-VELOCITY HURRICANE ZONE JURISDICTION**

**1. Scope:**   
  
1.1 This protocol covers the requirements for approval of membrane roof system assemblies in the high-velocity hurricane zone jurisdiction. An approved membrane roof cover is one that meets the criteria of this protocol for accelerated weathering, corrosion of metal parts, ~~F.I.T. [Fatigue, Indentation (dynamic and static puncture) & Temperature],~~ fire, foot traffic, hail, leakage, and wind.   
  
1.2 This protocol applies to any membrane roof cover intended to protect the roof assembly and building contents from the weather.   
  
1.3 The performance of a membrane roof cover depends partially on the substrate materials over which it is applied. It is therefore necessary to evaluate the roof system assembly as a whole, including the cover and auxiliary items necessary to build up a roof system assembly. These components are included within the subject test criteria.   
  
1.4 This Protocol is intended to evaluate only those hazards investigated, and is not intended to determine suitability for the end use of product.   
  
1.5 This protocol evaluates roof system assemblies for their performance regarding accelerated weathering characteristics, corrosion resistance of metal parts, ~~[(Fatigue, Indentation (dynamic and static puncture) & Temperature)],~~ external fire (fire or burning debris from above), foot traffic resistance, susceptibility from hail storm damage, leakage, and simulated wind uplift.   
  
1.6 Approval is based on satisfactory evaluation of the product(s) and manufacturer in the following ~~major~~ areas:   
  
1.6.1 Examination and tests to evaluate: 1) the performance of the product as required by the authority having jurisdiction, and, as far as practical, 2) the marking procedures which shall be used to identify the product as set forth in Section 1517 of the *Florida* *Building Code, Building*.   
  
1.7 Continued approval is based upon:   
  
1.7.1 production or availability of the product as currently approved;   
  
1.7.2 the continued use of acceptable quality control procedures;   
  
1.7.3 satisfactory field experience; and,   
  
1.7.4 compliance with the terms and conditions of the Product Approval.   
  
1.8 All testing and calculations shall be conducted by an approved testing agency and all test reports, including calculations, shall be signed and sealed by a professional engineer.   
  
1.9 Design pressures calculated in accordance with ASCE 7 are permitted to be multiplied by 0.6 for the purposes of comparing to tested pressures in TAS 114.  **2. Referenced Documents:**   
  
2.1 *Florida Building Code, Building:* Chapters 15 and 16 (High-Velocity Hurricane Zones)   
  
2.2 *Application Standards:*

|  |  |
| --- | --- |
| TAS 105 | Field Withdrawal Resistance Test Procedure |
| TAS 105 | Field Withdrawal Resistance |
| Appendix A | Test Results Report |

2.3 *Application Standards:*

|  |  |
| --- | --- |
| RAS 111 | Standard Requirements for Attachment of Perimeter  Flashing and Woodblocking |
| RAS 117 | Standard Requirements for Bonding or Mechanical  Attachment of Insulation Panels and Mechanical  Attachment of Anchor or Base Sheets to Various  Substrates |
| RAS 137 | Standard Requirements for Mechanical Attachment  of Single-Ply Membrane Roof Coverings to Various  Substrates |

2.4 FM Global*~~Factory Mutual Engineering Corporation~~:*   
  
Loss Prevention Data Sheet 1-7, April, 1983   
  
Loss Prevention Data Sheet 1-28, September, 1991   
  
Loss Prevention Data Sheet 1-28(S), November, 1991   
  
Loss Prevention Data Sheet 1-30, May, 1990   
  
Loss Prevention Data Sheet 1-48, June, 1991   
  
2.5 FM Global*~~Factory Mutual Research Corporation Approval Standards~~:*

|  |  |
| --- | --- |
| 4450 | Class I Insulated Steel Deck Roofs |
| 4470 | Class I Roof Covers Annual Approval Guide, 1994 |

2.6 *The* *American* *Society* *of* *Civil* *Engineers (ASCE):*ASCE 7; Minimum Design Loads for Buildings and Other Structures   
  
2.7 *ASTM Standards:*

|  |  |
| --- | --- |
| A 90 | Standard Test Method for Weight of Coating on  Zinc-Coated (Galvanized) Iron or Steel Articles |
| A 641 | Standard Specification for Zinc-Coated  (Galvanized) Carbon Steel Wire |
| B 117 | Standard Test Method for Salt Spray (Fog) Testing |
| D 638 | Standard Test Method for Tensile Properties of Plastics |
| D 751 | Standard Test Methods for Coated Fabrics |
| D 1781 | Standard Test Method for Climbing Drum Peel for Adhesives |
| E 70 | Standard Test Method for pH of Aqueous Solutions  With the Glass Electrode |
| E 108 | Standard Test Methods for Fire Tests of Roof Coverings |
| E 380 | Excerpts from the Standard Practice for Use of the  International System of Units (SI) (the Modernized Metric System) |
| G 85 | Standard Practice for Modified Salt Spray (Fog) Testing |
| G 152 | Standard Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials |
| G 154 | Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials |
| G 155 | Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Nonmetallic Materials |

2.8 *DIN Standards:*

|  |  |
| --- | --- |
| 50018 | Testing in a Saturated Atmosphere in the Presence of Sulfur Dioxide |

2.9 *Norwegian Building Research Institute:*Roof Coverings: Dynamic Wind-Load Resistance   
  
2.10 *Roof Consultants Institute:*Glossary of Terms   
  
~~2.11~~ *~~Centre Scientifique et Technique du Batiment~~*~~Classification for Roofing Systems~~  **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 Section 6.2, herein; and/or the RCI Glossary of Terms. The definitions of 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 of Use:**   
  
~~4.1 The requirements of this protocol are based on experience, research and testing or the standards of other national and international organizations. The advice of manufacturers, users, and trade associations is also considered.~~   
  
4.~~2~~ 1 Meeting these requirements will qualify a product as a Product Approved roof system assembly. An approved roof system assembly of itself is not a significant fire hazard when reviewed from the aspect of external fire, and can withstand expected wind uplift forces, hail stones, etc., when installed in accordance with all Product Approval requirements. Approval requirements prohibit substitution of components in the roof system assembly without a revision to the manufacturer’s Product Approval. Please note that some Approvals include modified use of terminology relating to performance in hail. The High-Velocity Hurricane Zone jurisdiction is considered a moderate hail zone, as noted on the National Hailstorm Map published by the National Oceanic and Atmospheric Administration (NOAA).   
  
4.~~3~~ 2 Products that do not conform to these requirements may be Approved if they meet the intent of this Protocol. Conversely, those that do conform may not be Approved if other conditions prevail.   
  
4.~~4~~ 3 Effective date of revision:   
  
4.~~4~~3.1 The effective date of a protocol mandates that all products tested for Approval after the effective date must satisfy the requirements of that protocol. Products Approved under a previous Protocol must comply with the new version by the effective date or such date established by the ~~Authority Having Jurisdiction~~product approval entity or else forfeit Product Approval. The effective date may apply to the entire protocol, or, where so indicated, only to specific paragraphs of the protocol.   
  
4.~~4~~3.2 The effective date of this protocol is January 31, 1995, for full compliance with performance requirements.  **5. General Information:**   
  
5.1 Roof covers:   
  
5.1.1 Roof covers are supplied in ~~either~~ roll, sheet or liquid form. They may be fabricated in multi-plies (layers) or as a single ply. The single ply sheets are usually manufactured from thermoplastic materials (e.g., PVC - polyvinyl chloride); thermoset ~~tat~~ materials (e.g) EPDM - ethylene propylene diene monomers); uncured elastomer materials (e.g., PIB - polyisobutylene); or modified bitumen materials (e.g. rubberized asphalt or asphalt saturated or coated materials). The liquid covers may be supplied as silicone, polyurethane, chlorosulfonated polyethylene, acrylic, etc. Multiply systems may be various bituminous or coal tar pitch systems utilizing organic, fiberglass or polyester reinforced base, anchor or interply reinforcement.   
  
5.2 Application of this standard:   
  
5.2.1 To qualify as an approved roof system assembly, each assembly shall satisfy all of the following performance criteria, and be installed as tested over specific insulations and/or decks. Insulated and uninsulated deck types are listed in Product Approvals as follows:   
  
• Wood;   
  
• Steel;   
  
• Concrete;   
  
• Lightweight concrete;

• Cementitious wood fiber; and,   
  
• Poured gypsum concrete.   
  
5.2.2 The Approval examination includes 1) accelerated weathering; 2) corrosion resistance of metal parts; ~~3) F.I.T. testing which includes fatigue, dynamic and static puncture and temperature testing (F.I.T. testing is specified for modified bitumen roof membranes only; however, static and dynamic puncture testing is required for all membrane types);~~ ~~43~~) external fire; ~~5~~4) foot traffic, ~~65~~) simulated hail resistance; ~~7~~6) water leakage resistance; ~~87~~) simulated wind uplift, and other tests as noted. A complete review of construction and application specifications and details shall be conducted to insure, as far as possible, a practical and reliable installation.   
  
5.2.3 As noted in Section 4.2, approved components within a roof system assembly may not be substituted with components not listed in Product Approvals. However existing data in Product Approvals may be extrapolated, in compliance with methods set forth in RAS 117 (for insulation or base sheet attachment) or RAS 137 (for single-ply membrane attachment), to determine acceptable fastener spacing~~s~~ in elevated pressure zones.  **6. Applicable Documents and Glossary:**   
  
6.1 Applicable documents:   
  
6.1.1 The following standards, test methods and practices are referenced in this protocol and are summarized in the appendices herein.   
  
• Fire tests of roof coverings - ASTM E 108, American Society for Testing and Materials   
  
• Roof coverings: dynamic wind-load resistance, Norwegian Building Research Institute   
  
• Uplift pressure test standard for Class I roof covers, ~~Factory Mutual Research Corporation~~ FM Global  
  
• Uplift pull test standard for Adhered Class I Roof Covers, ~~Factory Mutual Research Corporation~~FM Global   
  
• Modified Salt Spay (Fog) Testing–ASTM G 85, American Society for Testing and Materials   
  
• Testing in a Saturated Atmosphere with the Presence of Sulfur Dioxide–DIN 50018   
  
• Susceptibility to Hail Damage Test Standard for Adhered Class I Roof Covers, ~~Factory Mutual Research Corporation~~FM Global   
  
• Susceptibility to Leakage Test for Class I Roof Covers, ~~Factory Mutual Research Corporation~~FM Global   
  
• Small Scale QC and Physical Properties Tests for Class I Roof Covers, ~~Factory Mutual Research Corporation~~FM Global   
  
• 12 foot by 24 foot Uplift Test Procedure, ~~Factory Mutual Research Corporation~~FM Global   
  
~~• F.I.T. Classification for Roofing Systems– Centre Scientifique et Technique du Batiment~~   
  
6.2 Glossary–The following definitions shall relate to this protocol only.   
  
*Adhere:* To cause two surfaces to be held together by adhesion. Single-ply membranes are often “partially-” or “totally-adhered” to a substrate with the use of contact cements, such as air-cured phenolic-neoprene mixtures, or other similar adhesives.   
  
*Ballast:* An anchoring material, such as rounded river rock, gravel, or precast concrete pavers, which is used to hold single-ply roofing membranes in place and to stabilize the roof system from wind uplift forces. Although ballasting materials differ greatly in size, composition, and weight, they are typically applied at a minimum rate between 10 and 15 pounds per square foot of roof area. Thus, ballast should be applied only to those roof structures able to support this added weight. Also, ballast materials should be large and heavy enough to resist being blown off the roof, yet light and smooth enough to avoid damaging the membrane. (Systems utilizing these applications are not generally approved in the high-velocity hurricane zone jurisdiction.)  
  
*Batten:* A narrow metal band or plate, usually of galvanized steel or aluminum, or a polymer band, which is used to fasten ~~or hold in place~~ a ~~single-ply~~ membrane~~,~~ to prevent its displacement.   
  
*Delamination:* Separation of the plies in a roof membrane or system in any laminated roofing material or component, e.g., laminated layers of rigid insulation or the felt plies in a built-up roof.   
  
*Disc Fasteners:* A wide variety of devices of mechanical assemblies used to attach single-ply membranes, insulation boards and/or base sheets to a substrate or deck. Disc attachments generally consist of a square- or circular-shaped plate with a hole in the center, through which a screw or nail-like clip may be inserted. They are generally set in place with a drill-like device.   
  
*EPDM:* Designated nomenclature for a tripolymer of ethylene, propylene, and diene.   
  
*Field Seam:* A splice made in the field which joins two sheets together using an adhesive splicing tape, or heat- or solvent-welding.   
  
*Heat Welding:* A process or method of melting and sealing or fusing the overlapping edges of separate sections of thermoplastic or uncured elastomeric roofing membranes by the application of heat and pressure. Small, portable “hot air” or “heat welding” devices are available which can, without the use of chemicals or adhesives, heat seal or fuse together overlapping edges to form waterproof seams.   
  
*Loosely Laid:* Membranes which are not attached to the substrate except at the perimeter of the roof and at projections. Loosely laid membranes are held in place with appropriate and adequate ballast, such as round river washed stone, gravel, pavers, etc. This assembly may be used only on roof structures able to support the added weight of the ballast, which is generally applied at a minimum rate of 10 pounds per square foot of roof area. (These systems are not generally approved in the high-velocity hurricane zone jurisdiction.)  
  
*Mechanically Fastened Membrane:* ~~Generally used to describe single-ply~~ A membrane~~s~~ which has ~~have~~ been positively attached at intervals to the substrate, usually with various fasteners and other mechanical devices such as battens. Mechanical fastening permits the membrane to float free between the fasteners, and allows greater movement between the membrane and the substrate than in fully adhered systems.   
  
*Modified* *Bitumen:* A material consisting of bitumen which has been modified through the inclusion of one or more polymers and may contain stabilizers and other additives. Modified bitumen roofing membranes may also contain a reinforcing material.   
  
*Partially* *Adhered:* A roofing assembly in which the membrane has been “spot affixed” to a substrate, usually with an adhesive, such as contact cement, or a mechanical device.   
  
*Polyisobutylene (PIB):* A synthetic uncured elastomer produced by the copolymerization of isobutylene and isoprene. PIB roofing membranes are composed of polyisobutylene, and various other reinforcing fillers and stabilizers.   
  
*Polyvinylchloride (PVC):* A thermoplastic polymer, synthesized from vinyl chloride monomer. Membranes containing polyvinyl chloride are used in single-ply roofing membranes.   
  
*Self-Adhesive Membranes:* ~~Single-ply m~~Membranes which can adhere to a substrate and to itself at overlaps without the use of an adhesive. The undersurface of a self-adhesive membrane is protected by a “release paper” that prevents the membrane from bonding to itself during shipping and handling. ~~Later, a~~As the membrane is unrolled, the release paper is peeled away, and the self-~~adhering~~ adhesive undersurface is applied to the substrate. Successful application of a self-adhesive membrane requires a clean and dry substrate and the application of firm, uniform pressure.   
  
*Single-Ply Membranes:* Roofing membranes that are field applied using just one layer of membrane material (either homogenous or composite) rather than multiple layers. However, the manufacture of the single-ply sheeting may involve lamination or several layers of the same or different materials.   
  
*Thermoplastic:* Polymers that soften when heated and harden when cooled. This process is repetitive provided the material is not heated above the point at which decomposition occurs.   
  
*Thermoset:* A material that solidifies or “sets” irreversibly when heated. This property is usually associated with crosslinking of the molecules induced by heat or radiation.   
  
*TPO:* Designated nomenclature for thermoplastic olefin elastomer based single-ply sheets made from ~~blends of polypropylene and ethylene-propylene polypylenene rubber.~~ a copolymer or blend of polyethylene and polypropylene polymers.  
  
*Wind* *Uplift:* The force generated by wind on a roof system or components in a roof system resulting from wind-induced pressures. Wind that is deflected around and across the surfaces of a building causes a drop in air pressure immediately above the roof surface. As a result, the air in the building will flow beneath the membrane and roof deck and tend to lift the roof upward. Wind uplift may also be caused by the introduction of wind underneath the membrane and roof edges, where it can cause the membrane to balloon and pull away from the substrate. Roof loss by wind can be avoided or prevented by proper installation and adequate adhesion, attachment, or ballasting.  **7. General Requirements:**   
  
7.1 During the initial investigation and before physical testing, the manufacturer’s specifications and details shall be reviewed to assess the ease and practicality of installation and use. Confirmation of specifications and details are assessed through an inspection of a field application or through viewing of a video of an application which includes all pertinent areas of the application. The product shall be capable of being used within the limits of the Approval investigation.   
  
7.2 Markings:   
  
7.2.1 Packaging material and/or containers shall bear the manufacturer’s name and product identification in compliance with provisions set forth Section 1517 of the *Florida Building Code, Building*.   
  
7.2.2 Product shall be marked by embossing, painting or cutting in compliance with *Florida* *Building Code, Building* requirements.   
  
7.3 Instructions:   
  
7.3.1 Printed, published installation instructions shall be provided by the manufacturer to demonstrate proper installation procedures to be followed by installers. As part of the approval examination, at least one inspection of a field installation, during and/or after its completion, shall be required. In some cases, a continued program of inspections shall be necessary to assess the application procedures or changes within the application techniques.   
  
7.3.2 Review of a Factory Mutual Approval Report and/or the listing of the roof system assembly in the current edition of the Factory Mutual Approval Guide may be, at the discretion of the chief compliance officer, sufficient evidence of compliance with any portion of this protocol.  **8. Performance Requirements and Tests:**   
  
8.1 General   
  
8.1.1 This protocol is intended to evaluate a roof system assembly for its performance as it relates to accelerated weathering, corrosion of metal parts, ~~F.I.T. performance (Fatigue, Indentation and Temperature),~~ fire, foot traffic, hail, leakage, and wind. ~~The applicant may submit up to five roof system assemblies in its Application for Product Approval.~~ The Authority Having Jurisdiction shall respond, in writing, stating which tests shall be required for sufficient evidence of compliance.   
  
8.2 Combustibility:   
  
~~Note: Roof adhesives effect the potential fire spread properties of a roof system assembly. In addition, combustible adhesives are susceptible to ignition during roof construction and cure periods. Therefore, fire testing shall be done after a minimum 28 day cure period.~~   
  
8.2.1 External fire testing shall be in strict compliance with ASTM E 108, as noted in Appendix A herein.   
  
8.2.2 Testing shall include:   
  
• spread of flame;   
  
• intermittent flame; and  
  
• burning brand~~; and~~   
  
• ~~flying brand~~   
  
tests as applicable.   
  
8.2.3 Tests of alternate constructions may be waived by the Authority Having Jurisdiction if considered less hazardous than those previously tested.   
  
~~8.2.4 During these tests, there shall be no flaming or burning particles blown off the test assembly and reaching the floor.~~   
  
8.3 Wind resistance:   
  
Note: Perimeter flashing, including metal components, shall be in fabricated and installed in compliance with RAS 111 for all approved roof system assemblies.   
  
8.3.1 Totally or partially adhered roof system assembly:   
  
8.3.1.1 Requirements:   
  
• The adhesive(s) used to bond insulation and/or roofing pl~~y~~ies or membrane shall penetrate or adhere to the substrates sufficiently to establish an adequate bond without degradation of the insulation. It shall be sufficiently fluid for effective application in accordance with the manufacturer’s directions. In addition, the application shall not be adversely affected by temperature extremes. Applications within the *Florida* *Building Code, Building* jurisdiction generally take place at temperatures above 70°F (21°C).   
  
• The adhesives shall achieve substantial adhesion with the insulation and at the laps within a minimum specified time such that winds will not lift the covering and/or insulation before the adhesive bond has fully developed. The solids within the adhesive shall generally remain in suspension. Any settlement must be redispersed after 5 minutes of agitation. Adhesives shall be designed and formulated to facilitate reliable field application according to the manufacturer’s specifications. All adhesives shall be labeled with maximum “open” time in a high temperature, high humidity climate to reduce the chance of application spoiled adhesive.   
  
8.3.1.2 Simulated uplift testing   
  
• After a 4 day laboratory cure time at ambient conditions, the totally or partially adhered roof system assembly shall be initially tested for uplift resistance in compliance with the test procedures outlined in Appendix C, D, H or J, herein. The roof system assembly shall attain a passing load not less than 30 psf (1.5 kPa). Thereafter, the roof system assembly test specimen shall be allowed to cure for the remaining cure time. Failure to meet this initial four (4) day cure time uplift criteria shall result in failure of the roof system assembly and no further testing shall be conducted.   
  
• After the remaining laboratory cure time, the totally or partially adhered roof system assembly shall be tested for uplift resistance in compliance with the test procedures outlined in Appendix C, D or J, herein.   
  
8.3.2 Mechanically attached roof system assembly:   
  
8.3.2.1 Mechanically attached roof covers are held in place by “single-type” or “batten type” fastener assemblies.   
  
• “Single-type” fastener assemblies include a fastener accompanied by a stress distribution plate which is installed in a specific pattern to secure roofing components within a roof system assembly. Stress plates are available in a variety of shapes and sizes, each of which may provide differing uplift resistance results when installed with the same fastener in an identical pattern. They may be: 1) installed under the roof cover with adhesive applied to the top surface of the plate; 2) installed through the roof cover and sealed; 3) installed within the lap as the covering is being installed; or, 4) installed under the roof cover with an integral fastener above (non-piercing types).   
  
• “Batten-type” fastener assemblies have a long bar or batten strip through which the fasteners are driven. They are usually installed: 1) through the roof cover with a patch or sealant applied over the batten; 2) as the cover is being installed within the lap; or, 3) under the roof cover with an integral fastener applied over the cover (non-piercing type).   
  
8.3.2.2 Requirements:   
  
• Fasteners and stress plates shall be tested in compliance with the requirements set forth in TAS 117, Appendices A, B and C.   
  
• All fasteners, other than base ply fasteners, shall record a withdrawal resistance value under static load greater than or equal to 275 lbf (1220 N) and a withdrawal resistance value under pulsating load greater than or equal to 175 lbf (778 N) when tested in compliance with Appendix A of TAS 117.   
  
• Fasteners shall be of proper length to penetrate the roof deck, if applicable. For steel deck application, fasteners must penetrate the top flange. Fasteners shall hold securely in the structural deck and prevent the covering from being lifted off. The fastening system shall secure the insulation in place under the roof cover. (Preliminary fasteners shall be used to maintain the insulation in place under the cover. See RAS 117.) If fasteners are installed within the lap, they shall be installed so as not to weaken the field seam. Any separation or delamination at the field seam that would require remedial measures shall be considered a failure. Materials and design shall be adequate to prevent fastener failure. The design must insure permanent securement to the deck, resisting horizontal and vertical deck movement due to temperature changes, live loads on the roof, and to vibration.   
  
• The fastener shall be capable of proper installation with the recommended equipment without damage to the roof cover. The fastener application density or spacing shall be initially verified through simulated uplift pressure testing, as noted in Section 8.3.2.3, herein. Data extrapolation for fastener density or spacing shall be conducted in strict compliance with RAS 117 (for insulation or base sheet attachment) or RAS 137 (for single-ply membrane attachment). Data extrapolation is limited by the test method utilized for simulated uplift testing. (See Section 8.3.2.3, herein.)   
  
• A minimum of two approved insulation fastener assemblies are required for preliminary attachment of insulation panels having dimensions less than or equal to 4 feet by 4 feet (1.2 m by 1.2 m). A minimum of four approved insulation fastener assemblies are required for preliminary attachment of insulation panels having dimensions greater than to 4 feet by 4 feet (1.2 m by 1.2 m).   
  
8.3.2.3 Simulated uplift testing:   
  
• Mechanically attached Roof System Assemblies shall be tested using one or more of the test procedures outlined in Appendices B, C, and/or J.   
  
• The test procedure outlined in Appendix B is a dynamic uplift test utilizing a dynamic wind chamber for testing of all mechanically attached roof system assemblies having a maximum fastener row spacing of 72 inches. Appendix B simulated uplift testing generates a fastener assembly design value and a maximum allowable fastener density or spacing. This maximum allowable fastener density or spacing may be altered through data extrapolation, in compliance with RAS 137 (for single-ply membrane attachment), to meet design pressures for a specific building.   
  
• The test procedure outlined in Appendix C is a static uplift test utilizing a 5 foot by 9 foot (1.5 m by 2.7 m) pressure vessel for testing of mechanically attached roofing assemblies with a row spacing less than or equal to 48 inches (1.2 m) o.c. or a fastener grid spacing less than or equal to ~~12~~24 inches by ~~24~~48 inches (~~0.6~~1.2 m by ~~1.2~~ 2.4 m); (8 square feet per attachment point). The roof system assembly shall attain a passing load not less than 90 psf (4.2 kPa). Data generated from Appendix C simulated uplift testing may not be used for extrapolation.

• The test procedure outlined in Appendix J is a static uplift test utilizing a 12 feet by 24 feet (3.6 m by 7.6 m) pressure vessel for testing of mechanically attached roof systems assemblies with a row spacing greater than 48 inches (1.2 m) o.c. or a fastener grid spacing greater than 12 inches by 24 inches (0.6 m by 1.2 m); (8 square feet per attachment point). The roof system assembly shall attain a passing load not less than 90 psf (4.2 kPa). Data generated from Appendix J simulated uplift testing may be used for extrapolation, in compliance with RAS 137 (for single-ply membrane attachment), to meet design pressures for a specific building. Extrapolation of data from Appendix J simulated uplift testing is limited to 1.75 times the maximum uplift pressure noted in the Product Approval.   
  
• The Authority Having Jurisdiction may, at his/her option, accept and publish in Product Approvals roof system assemblies that do not meet the minimum 90 psf (4.2 kPa) uplift criteria providing the manufacturer has one or more assemblies that meet the minimum uplift criteria.   
  
8.4 Corrosion Resistance:   
  
8.4.1 Nails and carbon steel fasteners:   
  
8.4.1.1 All nails and carbon steel fasteners shall be tested for corrosion resistance in compliance with ASTM Standard Practice G 85 [(Modified Salt Spray (Fog) Testing)], Annex A5 (Dolute Electrolyte Cyclic Fog/Dry Testing) as modified for the high velocity hurricane zone and noted in Section 2 of Appendix E, herein.   
  
8.4.2 Batten bars, stress distribution plates and fasteners (other than nails):   
  
8.4.2.1 All batten bars, stress distribution plates, and metal fasteners (other than nails) shall be tested for corrosion resistance in compliance with DIN 50018 as noted in Section 3 of Appendix E, herein.   
  
8.4.2.2 Each specimen shall be exposed to air saturated with water vapor (104°F, 40°C) containing a mild concentration of sulfur dioxide for 8 hours, followed by a drying period of 16 hours at room temperature. After each drying cycle, the specimen shall be inspected and signs of corrosion or rust shall be recorded.   
  
8.4.2.3 The 24-hour cycle shall be repeated 15 times and the corrosion percentage shall be recorded.   
  
8.4.2.4 To evaluate the corrosion increase after Cycle 1 through Cycle 15, the specimen shall be mounted to blue painted sheet backdrop.   
  
8.5 Hail resistance:   
  
Note: The high-velocity hurricane zone jurisdiction is a “moderate hail” area, as designated by the National Oceanic and Atmospheric Administration (NOAA).   
  
8.5.1 The roof system assembly shall be tested for hail damage resistance in compliance with either of the Simulated Hail Damage Test procedures noted in Appendix F, herein. A minimum of ten drops from the impactor is required, five of which shall be conducted ~~in~~onto a field-fabricated seam ~~or flashing detail~~ where appropriate.   
  
8.5.2 The roof cover and the field seam shall not show signs of cracking, splitting, internal separation, delamination, or rupture. Under adhered conditions, minor separation of the roof cover from the substrate (directly under the impact area) is acceptable performance for monolithic decks only (e.g. lightweight concrete, structural concrete, and gypsum, etc.). Severe degradation, such as cracking, crushing, etc., of the deck itself is reason for failure. The cover thickness shall be checked at the points of impact.   
  
8.6 Water leakage:   
  
8.6.1 The roof cover shall be tested for water leakage resistance in compliance with the Water Leakage Test procedures noted in Appendix G, herein. A sample 18 inches (45 cm) in diameter shall be prepared and, where appropriate, a field seam and/or penetration detail shall be included. The sample shall be conditioned (weathered) for 1000 hours in a fluorescent ultraviolet condensation type weathering apparatus before being cut into a size 10 inches (25 cm) in diameter and placed in the leakage test apparatus. The sample shall be maintained at ambient conditions.   
  
8.6.2 The roof cover and field seam and/or penetration detail shall not show signs of a leakage during or at the end of the 7 day period.   
  
8.7 Accelerated weathering:   
  
8.7.1 Accelerated weathering testing shall be in strict compliance with ASTM G 152 or G 155.   
  
8.8 RESERVED ~~F.I.T. Testing (F = Fatigue, I = Indentation, T = Temperature):   
  
Note: Complete F.I.T. testing is required for modified bitumen roof membranes only; however, static and dynamic puncture resistance testing, which forms a part of F.I.T., is required for all membrane types.   
  
8.8.1 Fatigue:   
  
8.8.1.1 Fatigue testing of modified bitumen roofing membranes shall be in compliance with the test procedures outlined in Appendix K, herein.   
  
8.8.2 Static and dynamic puncture:   
  
8.8.2.1 Static and dynamic puncture resistance testing shall be in strict compliance with the test procedures outlined in Appendix I, herein.   
  
8.8.3 Temperature:   
  
8.8.3.1 Temperature testing of modified bitumen roofing membranes shall be in compliance with the test procedures outlined in Appendix K, herein.~~  
8.9 Resistance to foot traffic:   
  
8.9.1 Resistance to foot traffic testing shall be in strict compliance with the test procedures outlined in this section.   
  
8.9.2 Test:   
  
8.9.2.1 A 3 inch (76 mm) square steel plate with rounded corners shall be centered on the centerline of a 12 inch (305 mm) square horizontal panel and positioned along the butt edge and side joint of the insulation boards.   
  
8.9.2.2 A 200 lbf (889 N) load shall be imposed on the plate. The superimposed load shall be reduced to zero and the sample cover reloaded a minimum of four additional times, with penetration and residual readings taken each time without removing the plate. The specimen shall be inspected after the test and the condition of the cover noted at the steel plate interface.   
  
8.9.2.3 Tearing or cracking of the protective coating causing exposure of the plastic, glass fibers, foam or other compressible core material shall be unacceptable.  **~~9. Manufacturing and Field Installation Requirements:~~**  ~~9.1 Demonstrated QC Program:   
  
9.1.1 A Quality Control Program is required to insure that subsequent roof covers produced by the manufacturer shall present the same quality and reliability as the specific roof cover samples examined. Design quality, conformance to design and performance are the areas of primary concern. Design quality is determined during the examination and tests, and is covered in the Product Approval. Conformance to design is verified by quality control in the following areas:   
  
• Existence of corporate quality control guidelines;   
  
• Incoming inspection and testing;   
  
• In-process inspection and testing;   
  
• Final inspection and testing;   
  
• Equipment calibration;   
  
• Drawing and change control; and,   
  
• Packaging and shipping.   
  
9.1.2 Quality of performance is determined by field performance and by periodic re-examination and testing.   
  
9.1.3 The manufacturer shall establish a system of product configuration control to prevent unauthorized changes, including the following, as appropriate:   
  
• Engineering drawings;   
  
• Engineering change requests;   
  
• Engineering orders; and/or,   
  
• Change notices.   
  
These shall be implemented through policy and detailed procedures to implement engineering change requests, orders or change notices; and records of all revisions to all approved products shall be kept.   
  
9.2 Inspection procedures:   
  
9.2.1 At manufacturing plant:   
  
9.2.1.1 An inspection of the product manufacturing facility may be part of the approval application. Its purpose shall be to determine that equipment, procedures, and the manufacturer’s quality controls are properly maintained to produce a product of the same quality as initially tested.   
  
9.2.1.2 Periodic, unannounced follow-up inspections may be conducted to insure continued quality control and product uniformity.   
  
9.2.1.3 The Authority Having Jurisdiction may rely on continued listing of approved systems in the annual Factory Mutual Approval Guide and quarterly supplements as confirmation of requirements under this section.   
  
9.2.2 At site of installation:   
  
9.2.2.1 Field inspections may be conducted to review roof system assembly installations. The inspections shall be conducted to assess ease of application, workability, and conformance to written specifications and details. When more than one application technique is used, one or all may be inspected.   
  
9.2.2.2 The Authority Having Jurisdiction shall review established procedures from recognized testing and listing agencies to confirm compliance with the requests set forth herein.~~

**(R7083 AM)**

**TESTING APPLICATION STANDARD (TAS) 114-11 APPENDIX A TEST PROCEDURE FOR ABOVE DECK COMBUSTIBILITY ASTM E 108**

**1. Scope:**   
  
1.1 Flame propagation over the exterior surface of a roofing ~~system~~ assembly is dependent on the rate at which the fuel is liberated from the test sample. The extent of spread and speed of propagation is influenced not only by the roof cover, but also by the substrate insulation and slope. Therefore, it is necessary to select constructions for evaluation that will demonstrate the performance of the roof cover when applied to a variety of roof insulation materials.   
  
1.2 The applicant shall submit in the initial application all roofing ~~system~~ assemblies requested over combustible and noncombustible decks. From this submission, the Authority Having Jurisdiction may list a limited number of roofing ~~system~~ assemblies which will require external fire testing to represent all proposed assemblies.   
  
1.3 Alternatively, the applicant may submit copies of its listing(s) from Underwriters Laboratories’ Annual *Roofing* *Materials and* *Systems* *Guide*, Warnock Hersey’s Annual *Certification Listing Guide*, and/or Factory Mutual Research Corporation’s Annual *Approval Guide* or Quarterly *Supplement Approval Guide* to confirm those assemblies tested in compliance with ASTM E 108 (or UL 790). Copies of test reports from these organizations, or any other approved testing agency, are also acceptable.  **2. Test Procedure:**   
  
2.1 The above deck combustibility tests shall be conducted in strict compliance with ASTM E 108 test procedure.   
  
2.2 Testing in compliance with ASTM E 108 yields the following external fire ratings:   
  
• Class “A” external fire tests are applicable to roof coverings that are effective against severe exposure to external fire, afford a high degree of fire protection to the roof deck, do not slip from position, and do not present a flying brand hazard.   
  
• Class “B” external fire tests are applicable to roof coverings that are effective against moderate exposure to external fire, afford a moderate degree of fire protection to the roof deck, do not slip from position, and do not present a flying brand hazard.   
  
2.3 RESERVED  ~~A rating of Class “A” or “B” shall be obtained. Use of a Class “C” external fire rated roof system assembly is extremely limited in the high-velocity hurricane zone jurisdiction.~~   
  
2.4 Refer to Section 1516 of the *Florida Building* *Code,* *Building* for fire resistance roof covering requirements.  **3. Evaluation of Results:**   
  
3.1 A minimum external fire rating of Class “B” is required for approval of any roofing ~~system~~ assembly.

**(R7083 AM)**

**TESTING APPLICATION STANDARD (TAS) 114-95 APPENDIX B TEST PROCEDURE FOR SIMULATED DYNAMIC UPLIFT PRESSURE RESISTANCE OF MECHANICALLY ATTACHED ROOFING ~~SYSTEM~~ ASSEMBLIES**

**1. Scope:**   
  
1.1 Loads incurred on roofing assemblies generated from external wind, in combination with internal pressure, are dynamic in nature.   
  
1.2 Damage incurred by the effects of wind over and internal pressure under a mechanically attached roofing ~~system~~ assembly generally results in failure of the fastener/substrate combination, the fastener/insulation combination or the fastener/roof cover combination.   
  
1.3 Thus, the dynamic nature of external wind and internal pressure loading on mechanically attached roofing ~~system~~ assemblies, in combination with incurred damage to these assemblies, suggests that an instrument designed to measure the stability of roofing ~~system~~ assemblies be equipped to evaluate fastener withdrawal from the substrate, roof cover blow-off from the substrate, the influence of the airtightness of the substructure on load transfer to the fasteners, and the effects of fastener fatigue when subjected to dynamic loading. The Dynamic Uplift Pressure Test Procedure has been designed for this purpose.   
  
1.4 Testing under this test method is limited to mechanically attached roofing ~~system~~ assemblies having a fastener row spacing not greater than 72 inches.   
  
**2. Terminology**–the following definitions apply to the test procedure outlined herein.   
  
2.1 P = the static positive pressure applied as a uniform load on the roofing ~~system~~ assembly underside while dynamic loading is being applied from below.   
  
2.2 Pd = the dynamic negative pressure applied as gusts of suction to the storage tank; the suction is noted as the instantaneous pressure measured at the air intake slit above the roofing membrane (see Figure B1, herein).   
  
2.3 Failure = roofing ~~system~~ assembly failure under this test standard could be one or more of the following:   
  
• withdrawal or breakage of fasteners;   
  
• tearing, splitting or other breakage of the roof cover at the point(s) of attachment;   
  
• impairment of the waterproofing function of the roofing ~~systems~~ assembly; or,   
  
• permanent deformation of the roof cover or fastener assembly, including stress plate, which may reduce the waterproofing function of the roofing ~~system~~ assembly over time.  **3. Apparatus:**   
  
3.1 The test apparatus for determining dynamic wind-load resistance is shown in Figure B1, herein.  **4. Test Limitations and Precautions:**   
  
4.1 Testing under this test method is limited to mechanically attached roofing ~~system~~ assemblies having a fastener row spacing not greater than 72 inches.   
  
4.2 During the test, all testing agency representatives and other test observers shall wear ear and eye protection and hard hats to prevent injury.   
  
4.3 This test procedure 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. Test Specimens:**   
  
5.1 The test specimen(s) shall be constructed in compliance with the manufacturer’s current, published installation specifications and details for the roofing ~~system~~ assembly under consideration for approval. If the fastener density or spacing for the roofing ~~system~~ assembly varies, those having the lowest number of attachment points shall be tested.   
  
5.2 Roofing ~~system~~ assemblies whose wind-load resistance performance may be affected by bad weather conditions during installation shall be constructed in a manner which simulates actual working conditions.  **6. Test Procedure:**   
  
6.1 Principal:   
  
6.1.1 The roofing ~~system~~ assembly test specimen is mounted between two air-tight boxes. A pressure difference is applied across the test specimen. Subsequent increasing pressure differences are applied until failure occurs.   
  
6.2 A constant, positive static pressure (P) of 15 psf (718 Pa) shall be applied to the underside of the test specimen during all dynamic pressure intervals. This constant, positive static pressure shall be applied from the lower box of the test apparatus. See Figure B1, herein.   
  
6.3 The dynamic pressure (Pd) is applied as gusts of suction in a 11/8 inches (30 mm) slit positioned above the roof cover and between fastener rows where insulation has been removed, resulting in initial upward deflection of the roof cover and non-axial loading at attachment points.   
  
6.4 The dynamic pressure (Pd) gusts, as measured at the air intake slit above the roof cover, are applied in 60 minute time intervals with each interval having increasing pressure gusts as noted in Table B1, below.   
  
6.5 Subsequent to each dynamic pressure interval, the apparatus shall be turned off and the test specimen shall be inspected for signs of failure.   
  
6.6 The passing load interval shall be that which the roofing ~~system~~ assembly resisted dynamic pressure (Pd) and static pressure (P) without failure for the 60 minute duration. The maximum allowable fastener density or spacing shall be that which was utilized in test specimen construction.  **7. Calculations:**   
  
7.1 Determine the maximum uplift pressure (Pm):   
  
7.1.1 The maximum uplift pressure shall be the passing dynamic pressure (Pd) interval, recorded subsequent to testing, plus the static pressure (P) applied to the underside.

|  |  |
| --- | --- |
| *Pm = Pd + P* | where, |

|  |  |  |
| --- | --- | --- |
| Pm | = | maximum uplift pressure (psf); |
| Pd | = | passing dynamic pressure (psf); and, |
| P | = | static pressure = 15 psf. |

**TABLE B1 DYNAMIC PRESSURE GUST INTERVALS**

|  |  |  |  |
| --- | --- | --- | --- |
| **Load Interval1** | **Dynamic Pressure (Pd)** | **Load Interval1** | **Dynamic Pressure (Pd)** |
| 1 | 15 psf (718 Pa) | 6 | 90 psf (4309 Pa) |
| 2 | 30 psf (1436 Pa) | 7 | 105 psf (5027 Pa) |
| 3 | 45 psf (2154 Pa) | 8 | 120 psf (5745 Pa) |
| 4 | 60 psf (2872 Pa) | 9 | 135 psf (6437 Pa) |
| 5 | 75 psf (3590 Pa) | etc. | etc. |

|  |
| --- |
| 1 Each load interval is 60 minutes long consisting of dynamic pressure gust loading every 15 seconds. |

7.2 Determine the fastener assembly design value (dv) using the maximum uplift pressure (Pm), achieved during testing, and the maximum allowable fastener density or spacing utilized for test specimen construction.

|  |  |
| --- | --- |
| http://floridabuilding2.iccsafe.org/app/book/content/2014_Florida/Test%20Protocols%20Code/Images/Bitmap_68.jpg | where, |

|  |  |  |
| --- | --- | --- |
| *dv* | = | fastener assembly design value (lbf); |
| *Pm* | = | maximum uplift pressure (psf); |
| *l* | = | length of test specimen (ft); |
| *w* | = | width of test specimen (ft); and, |
| *n* | = | number of fasteners. |

**8. Interpretation of Results:**   
  
8.1 The maximum allowable fastener density or spacing utilized for test specimen construction relates directly to the maximum uplift pressure (Pm), determined in Section 7.1.   
  
8.2 A 2:1 margin of safety shall be applied to the maximum uplift pressure (Pm) determined in Section 7.1.   
  
8.3 The fastener assembly design value (dv) determined from dynamic uplift testing may be used to alter the maximum allowable fastener density or spacing through data extrapolation, in compliance with RAS 137 (for single-ply membrane attachment), to meet design pressures for a specific building. Only “upward” extrapolation is acceptable (i.e. fastener density may not be decreased and fastener spacing may not be increased for lesser design pressures).  **9. Report:**   
  
9.1 The final test report shall include the following:   
  
9.1.1 A description of the roofing ~~system~~ assembly test specimen, including the manufacturer of all components, a description of all components and the method of test specimen construction (including the fastener density or spacing).   
  
9.1.2 A copy of the published application instructions provided by the roofing ~~system~~ assembly manufacturer.   
  
9.1.3 A description of the test apparatus.   
  
9.1.4 A record of all observations noted during inspections subsequent to each dynamic pressure interval, including the final mode of failure.   
  
9.1.5 The dynamic pressure interval, and time within the interval, at which the test specimen failed. If failure was not observed until the end of the dynamic pressure interval, record only the “failure interval.”   
  
9.1.6 A copy of the calculations from Section 7 and the results thereof.

|  |
| --- |
| http://floridabuilding2.iccsafe.org/app/book/content/2014_Florida/Test%20Protocols%20Code/Images/Bitmap_1.jpg |

**FIGURE B1 DYNAMIC UPLIFT TEST APPARATUS**

|  |
| --- |
| 1. Storage tank (388 cubic feet) for air at low pressure |
| 2. Connection to fan for air evacuation |
| 3. Valve to operate dynamic suction |
| 4. Connection to fan operating pulsating suction for standard wind load testing |
| 5. Main air duct |
| 6. Upper box |
| 7. Inspection window |
| 8. Flexible air tubes (7 with 6-inch diameter) |
| 9. Air cooler |
| 10. 11/8 inch: air intake slot |
| 11. Holes to equalize pressure after gust |
| 12. Roof cover with fasteners |
| 13. Roof deck with insulation |
| 14. Section without insulation |
| 15. Steel frame |
| 16. Lower box |
| 17. Inspection manhole |
| 18. Connection to fan operating static pressure for standard wind load testing. |

**(R7083 AM)**

**TESTING APPLICATION STANDARD (TAS) 114-95 APPENDIX C TEST PROCEDURE FOR SIMULATED UPLIFT PRESSURE RESISTANCE OF ROOFING ASSEMBLIES**

**1. Scope:**   
  
1.1 Damage incurred by the effects of wind over and internal pressure under a totally adhered, partially adhered or mechanically attached roofing ~~system~~ assembly generally results in one or more of the following:   
  
• Uplift of the cover (when totally adhered);   
  
• Delamination within the roof insulation cover (when totally or partially adhered);   
  
• Failure of adhesive between the insulation and the deck or between the insulation and the vapor retarder and/or between the vapor retarder and the deck; and,   
  
• Failure of the fastener/substrate, fastener/insulation or fastener/roof cover combination.   
  
1.2 Thus the nature of the damage incurred would suggest that an instrument designed to measure the stability of roof assemblies be equipped to evaluate bond strength indicated in the items above. The Uplift Pressure Test has been designed for this purpose.   
  
1.3 This procedure is not applicable to mechanically attached roofing ~~system~~ assemblies having a batten or fastener row spacing greater than 48 inch (1.2 m) o.c. or a spot/grid attachment density greater than 8 square feet (0.7432 m2) per fastener.   
  
**2. Terminology –**the following definitions apply to the test procedure outlined herein.   
  
2.1 Failure: Roofing ~~system~~ assembly failure under this test standard could be one or more of the following:   
  
• withdrawal or breakage of fasteners;   
  
• tearing, splitting or other breakage of the roof cover at the point(s) of attachment;   
  
• impairment of the waterproofing function of the roofing ~~systems~~ assembly (i.e. cracking of components within the assembly);   
  
• permanent deformation of the roof cover or fastener assembly, including stress plate, which may reduce the waterproofing function of the roofing ~~system~~ assembly over time; and,   
  
• delamination or separation of adhered areas.  **3. Apparatus:**   
  
3.1 The uplift pressure apparatus is a steel pressure vessel arranged to supply air pressure at pre-established standard rates to the underside of the roofing ~~system~~ assembly test specimen which forms the top of the test apparatus.   
  
3.2 The pressure vessel measures 9 feet long by 5 feet wide by 2 inches deep (2.7 m by 1.5 m by 51 mm) (See Figures C1 and C2, herein).   
  
3.3 A 3/4 inch (19 mm) opening is supplied in one 9 foot (2.7 m) side for an air supply inlet. A 1/4 inch (6 mm) opening in the opposite 9 foot (2.7 m) side serves as a manometer connection. A rubber gasket that lies between the top angle of the pressure vessel and the test assembly minimizes air leakage when the sample is clamped on.   
  
3.4 Air pressure is supplied through the use of an air compressor (5 horse power electric motor, 1200 rpm) in conjunction with a 21 foot (6.4 m) section of 12 inch (305 mm) pipe which serves as a reservoir. Pressure readings are obtained from a water-filled, or other type of, manometer, calibrated to read directly in pounds per square foot (kg/m2).  **4. Test Limitations and Precautions:**   
  
4.1 During the test, all testing agency representatives and other test observers shall wear ear and eye protection and hard hats to prevent injury.   
  
4.2 This test procedure 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. Test Specimens:**   
  
5.1 The components for a proposed test panel are assembled to the desired specifications and details (gauge of steel, application method and rate for the adhesives or fasteners, size and thickness of insulation, type of cover) and then left to “cure” for a specified time period.   
  
5.1.1 Test specimens assembled in hot asphalt shall be allowed to cure for not less than 24 hours prior to testing.   
  
5.1.2 Test specimens assembled in cold adhesive shall be allowed to cure for not less than 28 days prior to testing, with the exception of the preliminary four day testing noted in Section 8.3.1.2 of TAS 114.   
  
5.1.3 Test specimens assembled over lightweight concrete deck substrates shall be constructed seven days after the deck is poured and shall be tested on the 28th day.   
  
5.2 If the test specimen is a totally or partially adhered roofing ~~system~~ assembly, the test specimen shall be tested to 30 psf (1.4 kPa) after a 4 day laboratory cure time at ambient conditions. If the test specimen fails to resist this initial test pressure, the test shall be discontinued. Upon passing this initial testing, the test specimen shall be allowed to cure for the remaining cure time.   
  
5.3 When ready for testing, the panel is placed on top of the uplift pressure apparatus. A 7/8 inch (22 mm) thick, 2 inch (51 mm) wide board is placed around the perimeter of the sample followed by 2 inch by 3 inch (51 mm by 76 mm) metal angles (smaller dimension horizontal). Five C-clamps are securely attached on each 9 feet (2.7 m) edge three along each 5 foot (1.4 m) edge. The appropriate hose connections are then made to the air supply and manometer.   
  
5.4 Not less than three test specimens shall be constructed for each roofing ~~system~~ assembly being tested.   
  
5.5 Roofing ~~system~~ assemblies whose wind-load resistance performance may be affected by bad weather conditions during installation shall be constructed in a manner which simulates actual working conditions.  **6. Test Procedure:**   
  
6.1 Principal:   
  
6.1.1 The roofing ~~system~~ assembly test specimen is mounted on the test apparatus. A pressure difference is applied across the test specimen. Subsequent increasing pressure differences are applied until failure occurs. Three roofing ~~system~~ assembly test specimens shall be tested and the average passing load reported.   
  
6.2 After the test specimen is mounted on the test apparatus, compressed air is introduced beneath the sample in accordance with Table C1, below:  **TABLE C1** **UPLIFT PRESSURE INTERVALS**

|  |  |  |
| --- | --- | --- |
| **Time  (Minutes)** | **Static Uplift Pressure** | |
| **psf** | **kPa** |
| 0:01 to 1:00 | 30.00 | 1.40 |
| 1:01 to 2:00 | 45.00 | 2.20 |
| 2:01 to 3:00 | 60.00 | 2.90 |
| 3:01 to 4:00 | 75.00 | 3.60 |
| 4:01 to 5:00 | 90.00 | 4.20 |
| 5:01 to 6:00 | 105.00 | 4.90 |
| 6:01 to 7:00 | 120.00 | 5.70 |
| 7:01 to 8:00 | 135.00 | 6.50 |
| 8:01 to 9:00 | 150.00 | 7.20 |

|  |
| --- |
| 1 Add 15 psf (0.7 kPa) for each successive one minute interval. |

6.3 Prior to and during the attainment of the uplift pressures noted above, the test specimen is examined for failure. Upon failure, the test specimen is dismantled and examined to determine the exact mode of failure.   
  
6.4 Record the mode, time and pressure interval of failure.   
  
6.5 Repeat Sections 6.2 through 6.4 for each of three test specimens.  **7. Interpretation of Results:**   
  
7.1 The passing uplift pressure shall be the average of the three pressures which the test specimens resisted for one minute without failure. If one or more of the three tests yields a passing uplift pressure greater or less than 15 percent of other recorded values, an additional test shall be conducted.   
  
7.2 The minimum passing uplift pressure for an approved roofing ~~system~~ assembly shall be 90 psf (4.2 kPa).   
  
7.3 A 2:1 margin of safety shall be applied to the passing uplift pressure prior to inclusion in the ~~system~~ manufacturer’s Product Approval.   
  
7.4 Average wind velocities can vary considerably from area to area. The *Florida* *Building* *Code,* *Building* utilizes a windspeed as noted in Section 1620.2. These wind velocities in miles per hour are related to the design pressure, in pounds per square feet (kg/m2), for a particular building. Refer to Chapter 16 (High-Velocity Hurricane Zones) of the *Florida* *Building* *Code,* *Building* and ASCE 7.   
  
7.5 No extrapolation of resulting data will be accepted.   
  
7.6 Design pressures calculated in accordance with ASCE 7 are permitted to be multiplied by 0.6 for the purposes of comparing to tested pressures in TAS 114.  **8. Report:**   
  
8.1 The final test report shall include the following:   
  
8.1.1 A description of the roofing ~~system~~ assembly test specimen, including the manufacturer of all components, a description of all components and the method of test specimen construction (including the fastener density or spacing and/or asphalt or adhesive application rate).   
  
8.1.2 A copy of the published application instructions provided by the roofing ~~system~~ assembly manufacturer.   
  
8.1.3 A description of the test apparatus.   
  
8.1.4 A record of all observations noted during each test during each pressure interval, including the final mode(s) of failure.   
  
8.1.5 The pressure interval, and time within the interval, at which each test specimen failed.   
  
8.1.6 The passing uplift pressure for each test specimen and the calculated average passing uplift pressure from the three tests. If additional tests are conducted to maintain the +15 percent criteria, record results from all additional testing.

|  |
| --- |
| http://floridabuilding2.iccsafe.org/app/book/content/2014_Florida/Test%20Protocols%20Code/Images/Bitmap_177.jpg |

**FIGURE C1 UPLIFT PRESSURE TEST APPARATUS**

|  |
| --- |
| http://floridabuilding2.iccsafe.org/app/book/content/2014_Florida/Test%20Protocols%20Code/Images/Bitmap_178.jpg |

**FIGURE C2 UPLIFT PRESSURE TEST SPECIMEN MOUNTED IN TEST**

**(R7083 AM)**

**TESTING APPLICATION STANDARD (TAS) 114-95 APPENDIX D TEST PROCEDURE FOR SIMULATED UPLIFT PRESSURE RESISTANCE OF ADHERED ROOFING ~~SYSTEM~~ ASSEMBLIES**

**1. Scope:**   
  
1.1 In situations where the uplift pressure test procedure described in Appendix B, C or J is not applicable, especially for liquid/spray applied roof constructions, the following test procedure may be used as an alternate method for evaluation of uplift resistance of the roof construction.   
  
**2. Terminology**–the following definitions apply to the test procedure outlined herein.   
  
2.1 Failure = roofing ~~system~~ assembly failure under this test standard could be one or more of the following:   
  
• tearing, splitting or other breakage of the roof cover;   
  
• impairment of the waterproofing function of the roofing ~~systems~~ assembly (i.e. cracking of components within the assembly);   
  
• permanent deformation of the roof cover, which may reduce the waterproofing function of the roofing ~~system~~ assembly over time; and,   
  
• delamination or separation of adhered areas.  **3. Apparatus:**   
  
3.1 The uplift pressure apparatus is a 2 foot by 2 foot by 11/2 inch (0.6 m by 0.6 m by 39 mm) plywood square containing a centrally located eyebolt secured to the top of the test panel. The plywood square is bonded to the top surface of the roofing ~~system~~ assembly test specimen.   
  
3.2 A load cell, or other force sensing device, is positioned in line and connected to the eyebolt. The opposite end of the load cell is attached to a chain-hoist assembly. Prior to testing, the load cell shall be calibrated such that the downward force incurred by the test apparatus mass is eliminated from recorded load values.   
  
3.2 A minimum 2 inch (51 mm) wide strip is cut around and adjacent to the perimeter of the plywood down through the insulation to the deck.  **4. Test Limitations and Precautions:**   
  
4.1 During the test, all testing agency representatives and other test observers shall wear ear and eye protection and hard hats to prevent injury.   
  
4.2 This test procedure 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. Test Specimens:**   
  
5.1 The components for a proposed test panel are assembled to the desired specifications and details (gauge of steel, application method and rate for the adhesives, size and thickness of insulation, type of cover) and then left to “cure” for a specified time period.   
  
5.2 The test specimen shall be tested to 30 psf (1.4 kPa) after a 4 day laboratory cure time at ambient conditions. If the test specimen fails to resist this initial test pressure, the test shall be discontinued. On passing this initial testing, the test specimen shall be allowed to cure for the remaining cure time.   
  
5.3 If insulation panels for part of the test specimen, a panels shall be installed such that a three way joint is located in the center of the test specimen. If more than one layer of insulation forms part of the test specimen, the top layer shall employ the three way joint.   
  
5.4 Roofing ~~system~~ assemblies whose wind-load resistance performance may be affected by bad weather conditions during installation shall be constructed in a manner which simulates actual working conditions.   
  
5.5 Not less than three test specimens shall be constructed for each roofing ~~system~~ assembly being tested.  **6. Test Procedure:**   
  
6.1 Principal   
  
6.1.1 The test apparatus is secured to the roofing ~~system~~ assembly test specimen which is cut around the perimeter of the test apparatus. Thereafter, an uplift load is applied to the test apparatus which distributes the load over its area. The distributed load is transferred to the test specimen. Subsequent increasing uplift loads are applied until failure occurs.   
  
6.2 Once the test specimen has cured and the test apparatus is secured, uplift loads are applied through the test apparatus in accordance with Table D1, below:   
  
6.3 Prior to and during the attainment of the uplift pressures noted above, the test specimen is examined for failure. On failure, the test specimen is dismantled and examined to determine the exact mode of failure.   
  
6.4 Record the mode, time, and pressure interval of failure.  **7. Interpretation of Results:**   
  
7.1 The passing uplift pressure shall be the average of the three pressures which the test specimens resisted for one minute without failure. If one or more of the three tests yields a passing uplift pressure greater or less than 15 percent of other recorded values, an additional test shall be conducted.   
  
7.2 The minimum passing uplift pressure for an approved roofing ~~system~~ assembly shall be 90 psf (4.2 kPa).   
  
7.3 A 2:1 margin of safety shall be applied to the passing uplift pressure prior to inclusion in the ~~system~~ manufacturer’s Product Approval.   
  
7.4 Average wind velocities can vary considerably from area to area. The *Florida Building Code, Building* utilizes a windspeed as noted in section 1620.2. These wind velocities in miles per hour are related to the design pressure, in pounds per square feet (kg/m2), for a particular building. Refer to Chapter 16 (High-Velocity Hurricane Zones) of the *Florida Building Code, Building* and ASCE 7.   
  
7.5 No extrapolation of resulting data will be accepted.  **8. Report:**   
  
8.1 The final test report shall include the following:   
  
8.1.1 A description of the roofing ~~system~~ assembly test specimen, including the manufacturer of all components, a description of all components and the method of test specimen construction.  **APPARATUS TABLE D1 UPLIFT LOAD INTERVALS AND CORRESPONDING PRESSURES**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Time  (Minute)** | **Load** | | **Pressure** | |
| **lbf** | **N** | **psf** | **kPa** |
| 0:01 to 1:00 | 120 | 534 | 30 | 1.4 |
| 1:01 to 2:00 | 180 | 801 | 45 | 2.2 |
| 2:01 to 3:00 | 240 | 1067 | 60 | 2.9 |
| 3:01 to 4:00 | 300 | 1334 | 75 | 3.6 |
| 4:01 to 5:00 | 360 | 1601 | 90 | 4.2 |
| 5:01 to 6:00 | 420 | 1868 | 105 | 4.9 |
| 6:01 to 7:00 | 480 | 2135 | 120 | 5.7 |
| 7:01 to 8:00 | 540 | 2402 | 135 | 6.5 |
| 8:01 to 9:00 | 600 | 2670 | 150 | 7.2 |

|  |
| --- |
| 1 Add 60 lbf (N) from each successive one minute interval. |

8.1.2 A copy of the published application instructions provided by the roofing ~~system~~ assembly manufacturer.   
  
8.1.3 A description of the test apparatus.   
  
8.1.4 A record of all observations noted during each pressure interval, including the final mode of failure.   
  
8.1.5 The pressure interval, and time within the interval, at which the test specimen failed.

**(R7083 AM)**

**TESTING APPLICATION STANDARD (TAS) 114-95 APPENDIX F TEST PROCEDURE FOR SUSCEPTIBILITY TO HAIL DAMAGE FOR ROOFING SYSTEMS ~~ASSEMBLIES~~**

**1. Scope:**   
  
1.1 Simulated hail damage test procedures are designed to assess the potential for damage to roofing ~~system~~ assemblies when adhered directly to insulation, lightweight concrete roof decks, structural concrete roof decks, gypsum decks or fire-treated wood roof decks. The procedures were developed to determine the potential for puncture of the roof cover resulting from hail storms when the roof cover is applied over its tested substrate within an approved assembly.   
  
1.2 Due to the variable severity of potential damage resulting from hail storms in different geographic areas, two separate hail damage tests are used. The tests yield ratings identified as Class “SH” (Severe Hail Damage Resistant) and Class “MH” (Moderate Hail Damage Resistant).  **2. Description of Test Apparatus:**   
  
2.1 *Class* *“SH”*—The test apparatus consists of a plastic tube 2 inches (51 mm) inside diameter, supported above the sample. A steel ball 13/4 inch (45 mm) in diameter, weighing 0.79 pounds (358g~~3.5 N~~) is dropped from a height of 17 feet 91/2 inches (5.4 m) onto the sample. This procedure is repeated 10 times on various sections of the sample. This procedure generates an impact energy of approximately 14 pounds per feet (19 J) over the impact area of a 13/4 inch (45 mm) diameter ball.   
  
2.2 *Class* *‘MH’*-The test apparatus consists of a steel tube 21/4 inches (57 mm) inside diameter supported vertically above the sample by a tripod. Holes are drilled in the steel tube to allow the release mechanism to be adjusted for the proper drop height. A steel ball 2 inches (51 mm) in diameter, weighing 1.625 pounds (737 g) is dropped from a height of 5 feet (1.5 m) through the tube onto the sample. This procedure is repeated 10 times on various sections of the sample. This procedure generates an energy of approximately 8 pounds per feet (10.8 J) over the impact area of a 2 inch (51 mm) diameter ball.  **3. Test Procedure:**   
  
3.1 Two identical roof cover samples, 2 feet by 4 feet (0.6 m by 1.2 m) are selected from the material to be tested. The first sample is prepared with the roof cover applied to the selected insulation substrate(s) or ~~adhered~~ directly to the appropriate roof deck in accordance with the manufacturer’s specifications. After preparation, the sample is conditioned for up to 28 days (laboratory cure). For materials supplied as sheets or rolls, the sample shall incorporate a field seam within the assembly, in the center and running parallel to the 4 foot (1.2 m) side. The second sample is loose laid over the matching substrate or roof deck. Both samples are subjected to initial testing. The 13/4 inch (45 mm) diameter steel ball is dropped onto the sample from a height of 17 feet 91/2 inches (5.4 m) for a Class “SH” rating, or the 2 inch (51 mm) diameter ball is dropped onto the sample from a height of 5 feet (1.5 m) for a Class “MH” rating. A minimum of ten drops of the impactor is required, five of which shall be on the field-fabricated seam, if appropriate. The samples are then removed and inspected for damage.   
  
3.2 A piece of loose laid sample 12 inch by 24 inch (305 mm by 610 mm) is cut from the original sample, and then further conditioned (weathered) for 1000 hours in a fluorescent ultraviolet condensation-type weathering apparatus using ~~the~~ ASTM G 154 ~~53 Test Method~~. After weathering, the impact test procedure is repeated. The sample is then removed and inspected for damage.  **4. Evaluation of Results:**   
  
4.1 The roof cover shall not show any signs of cracking or splitting. The field seam shall not show any signs of cracking, splitting, or separation or rupture when examined closely under a 10x magnification. ~~The cover thickness shall be checked at the points of impact~~.

**(R7083 AM)**

**TESTING APPLICATION STANDARD (TAS) 114-95 APPENDIX G TEST PROCEDURE FOR SUSCEPTIBILITY TO LEAKAGE FOR ROOFING SYSTEMS ~~ASSEMBLIES~~**

**1. Scope:**   
  
1.1 The Susceptibility to Leakage Test Procedure is designed to assess the potential for water migration when the cover is fabricated with a typical lap seam or perimeter detail.  **2. Description of Test Apparatus**   
  
2.1 The test apparatus consists of top and bottom sections that are bolted together with the specimen being evaluated placed as a diaphragm between the sections. The top section consists of a 91/4 inch (203 mm) diameter cap which has two 1/2 inch (13 mm) diameter threaded inlet holes. This top cap is cemented to a 53/4 inch (146 mm) length of 73/4 inch (1197 mm) diameter clear acrylic pipe which is cemented to an 115/8 inch (295 mm) diameter pipe flange. The bottom section consists of a 91/4 inch (235 mm) cap which has two 1/2 inch (13 mm) diameter threaded inlet holes. The bottom cap is cemented to a 57/8 inch (149 mm) length of 73/4 inch (197 mm) diameter clear acrylic pipe which is cemented to an 115/8 inch (295 mm) diameter pipe flange.   
  
2.2 Both top and bottom sections are bolted together at the flanges with the cover being evaluated between them. The top and bottom caps are fabricated to allow a standing head of water above and additional air pressure above and below. Each section is fabricated with two 1/2 inch (13 mm) diameter pipe outlets to allow connection of an air pressure inlet and pressure gauge.  **3. Test Procedure:**   
  
3.1 An 18 inch (457 mm) diameter sample is prepared with the roof cover. This specimen is prepared with a field seam and/or penetration detail included and running along the diameter of the sample. The completed sample is conditioned (weathered) for 288 hours (minimum) in an Ultraviolet Weatherometer before being cut to a 10 inch (254 mm) diameter size.   
  
3.2 The 10 inch (254 mm) diameter specimen is then bolted in place between the flanges of the test apparatus. Water is then placed over the sample to a depth of 6 inches (152 mm) and maintained for a period of 7 days. At the end of the 7 day period, air is introduced below the water to a 1 pound per square inch (6.8 kPa) level and cycled 25 times from 1 pounds per square inch (6.8 kPa) level and cycled 25 times from 1 pounds per square inch (6.8 kPa) to ambient.  **4. Evaluation of Results:**   
  
4.1 There shall be no signs of water leakage during the 7 day period. In addition, there shall be no signs of water leakage during or after the pressure cycles.

**(R7083 AM)**

**TESTING APPLICATION STANDARD (TAS) 114-95 APPENDIX H TEST PROCEDURES FOR SMALL SCALE QC AND PHYSICAL PROPERTIES OF APPROVED ROOFING SYSTEMS ~~ASSEMBLIES~~**

**1. Scope:**   
  
1.1 The following series of small scale tests are designed to allow monitoring of quality controls exercised in the manufacture of single-ply roof covers and/or to characterize individual materials. In addition, they may be used to assess certain physical characteristics necessary for the continued performance of a cover assembly when installed within a construction. It may not be appropriate to require all tests for each construction. A preliminary decision shall be made as to which tests will be required. The decision will be based on several factors: e.g., (a) from what basic material or polymer is the roof membrane fabricated; (b) how is the roof membrane applied; (c) how is the roof membrane secured; (d) to what substrates is the roof membrane applied, etc.  **2. Delamination Test:**   
  
2.1 The roof membrane is applied to the top surface of an insulation sample in accordance with the manufacturer’s specifications and allowed to cure for the specified period of time, maximum 28 days. This assembly is then cut into 6 inch by 6 inch (152 mm by 152 mm) pieces prior to assembly of the test specimen. Plywood, 6 inch by 6 inch by 3/4 inch (152 mm by 152 mm by 19 mmm), is adhered to the top and bottom surface of the prefabricated specimen with a compatible adhesive. A steel plate, 6 inch by 6 inch by 1/2 inch thick (152 mm by 152 mm by 13 mm), is fastened to the plywood facers with four #12, 11/4 inch diameter by 6 inch (152 mm) long bolts on each plate. Force is exerted in a direct line parallel to the shank of the bolt at a constant machine speed of 2 inch (51 mm) per minute. A minimum of three tests must be conducted on each selected substrate. The ultimate average load of failure is then determined.  **3. Peel Test (ASTM D 1781):**   
  
3.1 The roof membrane is applied to the top surface of an insulation sample in accordance with the manufacturer’s specifications such that a minimum 1 inch (25 mm) extends beyond the edge of the rigid insulation after cutting and trimming. The top 3 inches (76 mm) of the cover is not adhered to the insulation substrate. The sample is allowed to cure for the specified time, maximum 28 days. The assembly is cut into 3 inch (76 mm) by 12 inch (305 mm) pieces with the 1 inch (25 mm) excess cover at each 3 inch (76 mm) end. The top edge is held with a suitable clamp and the bottom edge is clamped to the peel drum tester.   
  
3.2 The specimen and test apparatus are then suspended from the top head of the testing machine. A peel of at least 6 inches (152 mm) of the cover is then made with the machine speed set at 1 inch (25 mm) per minute. A minimum of 3 tests shall be conducted on each selected substrate. The average peeling load required to peel the facing is then calculated in pound per inch of peel torque.  **4. Tensile Test (ASTM D 1781):**   
  
4.1 ASTM D 638—The roof cover is cut according to ASTM D 638 Type IV. The specimen is clamped into the upper and lower jaws of the tensile testing machine, with the machine speed set at 20 inches per minute (8.5 mm/s). Determination of stress is conducted at 100 percent, 200 percent, and 300 percent elongation as well as ultimate failure (if possible). A minimum of 3 tests shall be conducted.   
  
4.2 ASTM D 751—The roof cover is fabricated with a field seam according to the manufacturer’s specifications before being cut according to ASTM D 751 seam strength determination instructions. The specimen is clamped into the upper and lower jaws of the tensile testing machine, with the machine speed set at 12 inch per minute (5 mm/s). Determination of stress is conducted at 100 percent, 200 percent, and 300 percent elongation, as well as at ultimate failure (if possible). A minimum of 3 tests shall be conducted.

**(R7083 AM)**

**TESTING APPLICATION STANDARD (TAS) 114-95 APPENDIX I TEST PROCEDURE FOR STATIC AND DYNAMIC PUNCTURE RESISTANCE OF ROOFING ~~SYSTEM~~ ASSEMBLIES**

**1. Scope:**   
  
1.1 The test procedures outlined herein cover the maximum static and dynamic puncture loads which roofing membrane samples can withstand without allowing the passage of water due to puncture. Membrane samples are subjected to both static and dynamic puncture loads from a rigid object having a sharp edge to determine their puncture resistance performance.   
  
1.2 This laboratory test is conducted at any desired temperature using sheet membrane samples manufactured in a factory or prepared in a laboratory.   
  
1.3 Roof membrane samples to which the method is applicable include bituminous built-up, polymer-modified bitumen, vulcanized rubber, non-vulcanized polymeric, and thermoplastic materials. The method is not applicable to aggregate-surfaced membrane samples.  **2. Terminology:**   
  
2.1 *Definitions*—For definitions of terms, refer to ASTM D 1079 or Chapter 2 and Section 1513 of the *Florida Building Code, Building*. The definitions from the *Florida Building Code, Building* shall take precedence.  **3. Significance and Use:**   
  
3.1 An important factor affecting the performance of membrane roofing ~~system~~ assembly is their ability to resist static and/or dynamic puncture loads. The test procedures outlined herein provide a means to assess static and dynamic puncture resistance.   
  
3.2 The methods can be used to compare the puncture resistance of a single type of membrane sample as a function of a variety of insulation substrates or, conversely, to compare the resistance of a number of membrane samples set on a single type of insulation.   
  
3.3 The effect of temperature on puncture resistance can be studied by conducting the test under controlled conditions using such equipment as an environmental chamber, oven, or freezer.   
  
3.4 The methods can be useful in developing puncture resistance performance criteria and/or classifications for membrane roofing ~~system~~ assemblies.  **4. Apparatus:**   
  
4.1 Static puncture test   
  
4.1.1 The static puncture test apparatus shall consist primarily of a movable rod to which a 3/8 inch (10 mm) diameter ball bearing is attached at one end and a means for loading the specimen is attached to the other. The static puncture test apparatus is shown in Figure I1, herein.   
  
4.1.2 One means for static puncture loading is to attach to the movable rod a platform on which deadweights are placed. Alternatively, pneumatic loading may be used whereby the ball bearing is attached to the movable rod and the load is measured by an air pressure gauge which has been calibrated against a load cell.   
  
4.1.3 The length of the rod above the specimen shall be not less than 3.9 inch (100 mm). A framework, having a minimum width of 9.8 inches (250 mm), supports the rod perpendicular to the surface of the test specimen. Free vertical movement of the rod shall not be hindered by the framework. The rod and framework shall be capable of supporting loads up to 56 lbf (250 N).   
  
4.2 Dynamic puncture test:   
  
4.2.1 The dynamic puncture test apparatus shall consist primarily of a heavy base, a falling arm and a puncture head. The dynamic puncture test apparatus is shown in Figure I2, herein.   
  
4.2.2 The falling arm shall be attached to the base such that it can rotate freely (e.g. using ball bearings) from a vertical to a horizontal position. The length of the arm shall be 1.7 feet (0.51 m).   
  
4.2.3 The shape and dimensions of the puncture head are shown in Figure I3, herein Several heads of differing mass may be needed. Alternatively, a means of adding mass to a given puncture head may be utilized. The puncture head and additional masses shall constitute a continuous series of mass from 2.2 to 22.0 pounds (1 to 10 kg) in 1.1 pounds (0.5 kg) increments. The mass of the puncture head for any given test shall be within + 5 percent of that selected.   
  
4.2.4 When mounted on the rotating arm, the face of the puncture head shall be parallel to the arm’s axis of rotation. When the puncture head contacts the membrane surface, the rotating arm shall be horizontal.   
  
4.2.5 The apparatus shall incorporate a mechanism which allows the puncture head to remain stationary when in an upright position, forming an angle with the vertical of not greater than 5 degrees. The mechanism shall allow for release of the arm such that is falls freely from gravitational forces only. A vacuum release mechanism has been found suitable for this purpose.   
  
4.2.6 The apparatus base, on which the rotating arm and puncture head are mounted, shall be placed on a horizontal surface such that no movement occurs when the test is conducted at maximum impact energy.   
  
4.2.7 The membrane test specimen shall be held in place over the substrate with a square frame having minimum exterior and interior dimensions of 9.8 inches (250 mm) and 7.9 inches (200 mm), respectively.  **5. Test Limitations and Precautions:**   
  
5.1 This test procedure 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.  **6. Test Specimens:**   
  
6.1 Sampling – single-ply specimens:   
  
6.1.1 Test specimens shall be cut directly from the sheet membrane and insulation materials provided for the test using a metal template having dimensions of 7.9 inches by 7.9 inches (200 mm by 200 mm), ± 5 percent.   
  
6.2 Sampling – multi-ply specimens:   
  
6.2.1 Test samples, having dimensions not less than 3 feet by 4 feet (0.9 m by 1.2 m), shall be prepared in compliance with the roofing ~~system~~ assembly manufacturer’s published installation instructions and details. The quantity of materials in each layer shall be within + 10 percent of that specified in the published installation instructions.   
  
6.2.2 All roofing components to be used in the roofing ~~system~~ assembly test specimen shall be conditioned at 77°F + 3°F (25°C + 2°C) and 50 percent + 5 percent relative humidity for a 24 hour period prior to test sample construction.   
  
6.2.3 Test specimens shall be cut directly from the constructed 3 feet by 4 feet (0.9 m x 1.2 m) test sample as noted in Section 6.1.1, herein.   
  
6.3 A minimum of 4 test specimens shall be constructed and tested.   
  
6.4 Unless otherwise specified, the membrane substrate shall be expanded polystyrene board having a density within the range of 1.7 to 2.0 lbm/ft3 (27 to 32 kg/m3) and a thickness of 1.5 inch (38 mm), +/- 15 percent.  **7. Conditioning:**   
  
7.1 The test apparatus and test specimen shall be conditioned at the desired temperature for a minimum of 8 hours prior to testing. The selected temperature shall be maintained at + 3°F (+ 2°C) for the duration conditioning.  **8. Test Principal:**   
  
8.1 Static puncture:   
  
8.1.1 The roofing ~~system~~ assembly test specimen is subjected to a predetermined static puncture load using a ball bearing for a period of 24 hours. The puncture loads are increased in 2.2 lbf (10 N) increments until puncture of the test specimen occurs or until the maximum load of 56 lbf (250 N) is reached. Puncture of the test specimen is assessed by visual examination and verified by conducting a watertightness pressure test.   
  
8.2 Dynamic puncture:   
  
8.2.1 The roofing assembly ~~Roof System Assembly~~ test specimen is subjected to a predetermined dynamic puncture load created by a rigid puncture head falling through a 90 degree trajectory from a vertical position to a horizontal position under gravitational acceleration. The impact energy is increased from 119 foot-pdl (5 J) in 59.4 foot-pdl (2.5 J) increments until puncture of the test specimen occurs or until the maximum impact energy of 1190 foot-pdl (50 J) is reached. Puncture of the test specimen is assessed by visual examination and verified by conducting a watertightness pressure test.   
  
8.2.2 The impact energy is equated to the potential energy of the raised puncture head, as noted below.

|  |  |
| --- | --- |
| http://floridabuilding2.iccsafe.org/app/book/content/2014_Florida/Test%20Protocols%20Code/Images/fig_8.2.2.jpg | where, |

|  |  |  |
| --- | --- | --- |
| E | = | impact energy (ft-pdl or J); |
| m | = | puncture head mass (lbm or kg); |
| g | = | gravitational acceleration (32.2 ft/s2 or 9.8 m/s2): |
| h | = | the puncture head fall distance (1.7 ft or 0.51 m). |

**9. Test Procedures:**   
  
9.1 Static puncture:   
  
9.1.1 Place a test specimen on an insulation substrate and position the assembly within the framework of the test apparatus such that the ball bearing is set on the center of the surface of the specimen. Assure that the movable rod is aligned perpendicular to the specimen surface.   
  
9.1.2 Select a static puncture load, in an increment of 2.2 lbf (10 N), somewhat below that at which the specimen may be expected to fail.   
  
Notes:   
  
1. Pretesting specimens under various loads is useful to estimate the initial load to be applied.   
  
2. If a platform and deadweights are used as the means to provide loading of the specimen, then the mass of the ball bearing, rod, and platform assembly must be included in the load applied to the specimen.   
  
9.1.3 Apply the initial static puncture load to the test specimen for 24 hours. ~~Then r~~Remove the specimen from the test apparatus and visually examine it to determine whether puncture has occurred.   
  
9.1.4 If test specimen puncture cannot be determined through visual examination, a suitable watertightness test, using a water pressure of 0.73 lbf/in2 (5000 Pa) applied to the surface of the membrane, shall be conducted for 15 minutes.   
  
Note: One type of watertightness test that has been used to examine whether membrane specimens have been punctured incorporates a water column sealed to the top of the membrane specimen. A water height of 20 inches (500 mm) provides a pressure of 0.73 lbf/in2 (5000 Pa). Alternatively, a chamber in which the membrane specimen is sealed and into which water is forced at the specified pressure may be utilized.   
  
9.1.5 If the test specimen punctures or is not watertight due to the initial static puncture load, repeat Sections 9.1.1 through 9.1.4 on another test specimen using a lesser initial load. If no puncture is seen or if the test specimen is determined to be watertight after the initial loading, continue the test as noted in Section 9.1.6.   
  
9.1.6 Increase the applied static load by 2.2 lbf (10 N) on the same specimen and maintain this for 24 hours. Determine whether membrane puncture has occurred, either through visual examination or through watertightness testing. Continue increasing the applied static load on the same specimen in increments of 2.2 lbf (10 N), maintaining each load for 24 hours, until puncture occurs or until the maximum load of 56 lbf (250 N) is reached. Record the load at which puncture occurs or a maximum load of 56 lbf (250 N) if no puncture occurs.   
  
9.1.7 Conduct the test on three additional test specimens according to Section 9.1.6 using a initial load that is 2.2 lbf (10 N) less than that which caused puncture in the first set of tests or using an initial load of 56 lbf (250 N) if the first set of tests yielded no puncture. Consider the results as follows:   
  
9.1.7.1 If none of the three specimens are punctured at this selected load, report that load as the puncture resistance of the test specimen. A watertightness test shall be conducted on all three test specimens to verify that puncture did not occur.   
  
9.1.7.2 If puncture occurs on any of the three test specimens, repeat Section 9.1.6 using an initial load that is 2.2 lbf (10 N) less than that which caused puncture. Repeat until no puncture is observed in all three test specimens as noted in Section 9.1.7.1.   
  
9.2 Dynamic puncture:   
  
9.2.1 Place a test specimen on an insulation substrate and position the assembly within the horizontal framework of the test apparatus such that the puncture head will strike the center of the test specimen.   
  
9.2.2 Select an initial mass of the puncture head, in an increment of 1.1 pounds (0.5 kg), somewhat below that at which the specimen may be expected to fail.   
  
Notes: 1. Pretesting specimens under various loads is useful to estimate the initial puncture head mass to be used.   
  
9.2.3 Position the rotation arm, with the selected puncture head, in the vertical position and allow the arm to drop under gravitational acceleration. Then remove the specimen from the test apparatus and visually examine it to determine whether puncture has occurred.   
  
9.2.4 If test specimen puncture cannot be determined through visual examination, a suitable watertightness test, using a water pressure of 0.73 lbf/in2 (5000 Pa) applied to the surface of the membrane, shall be conducted for 15 minutes.   
  
Note: One type of watertightness test that has been used to examine whether membrane specimens have been punctured incorporates a water column sealed to the top of the membrane specimen. A water height of 20 inches (500 mm) provides a pressure of 0.73 lbf/in2 (5000 Pa). Alternatively, a chamber in which the membrane specimen is sealed and into which water is forced at the specified pressure may be utilized.   
  
9.2.5 If the test specimen punctures or is not watertight due to the initial dynamic puncture load, repeat Sections 9.2.1 through 9.2.4 on another test specimen using a lesser initial load. If no puncture is seen or if the test specimen is determined to be watertight after the initial loading, continue the test as noted in Section 9.2.6.   
  
9.2.6 Increase the mass of the puncture head by 1.1 pounds (0.5 kg) and conduct the test on the same specimen. Determine whether membrane puncture has occurred, either through visual examination or through watertightness testing. Continue increasing the mass of the puncture head in increments of 1.1 pounds (0.5 kg) and conduct the test on the same specimen until puncture occurs or until the maximum puncture head mass of 22 pounds (10 kg) has been used. Record the puncture head mass at which puncture occurs or a maximum puncture head mass of 22 pounds (10 kg) if no puncture occurs.   
  
9.2.7 Conduct the test on three additional test specimens according to Section 9.2.6 using an initial puncture head mass that is 1.1 pounds (0.5 kg) less than that which caused puncture in the first set of tests or using an initial puncture head mass of 22 pounds (10 kg) if the first set of tests yielded no puncture. Consider the results as follows:   
  
9.2.7.1 If none of the three specimens are punctured at this puncture head mass, calculate the energy in compliance with Section 8.2.2 and report that energy as the dynamic puncture resistance. A watertightness test shall be conducted on all three test specimens to verify that puncture did not occur.   
  
9.2.7.2 If two of the three specimens are not punctured, test one additional specimen using the same puncture head mass as used in Section 9.2.7. If this additional test specimen is not punctured, calculate the energy in compliance with Section 8.2.2 and report that energy as the dynamic puncture resistance. If the additional test specimen is punctured, repeat Section 9.2.7 using three new test specimens and a puncture head mass which is 1.1 pounds (0.5 kg) less than that which caused puncture in the additional specimen.   
  
9.2.7.3 If two of the three specimens are punctured, repeat Section 9.2.7 using three new test specimens and a puncture head mass which is 1.1 pounds (0.5 kg) less than that which caused puncture in two of the three specimens. Consider the results as noted in Sections 9.2.7.1 through 9.2.7.3.  **10. Report:**   
  
10.1 The report of test shall include the following:   
  
10.1.1 Complete identification of the test specimen including types, sources, manufacturers, dimensions, etc. of all components in the specimen and the method of preparation.   
  
10.1.2 The temperature of the test.   
  
10.1.3 A description of the watertightness test used.   
  
10.1.4 The static puncture resistance of the specimen as the load which three specimens can support for 24 hours without puncture and without loss of watertightness.   
  
10.1.5 The dynamic puncture resistance of the membrane material as the maximum impact energy which three specimens sustained without puncture and without loss of watertightness. The direct of the specimen shall be included.

|  |
| --- |
| http://floridabuilding2.iccsafe.org/app/book/content/2014_Florida/Test%20Protocols%20Code/Images/Bitmap_40.jpg |

|  |
| --- |
| 1. Membrane test specimen |
| 2. Insulation substrate |
| 3. Movable rod |
| 4. Ball bearing |
| 5. Framework supporting movable rod and load |
| 6. Applied load |

**FIGURE I1 STATIC PUNCTURE TEST APPARATUS**

|  |
| --- |
| http://floridabuilding2.iccsafe.org/app/book/content/2014_Florida/Test%20Protocols%20Code/Images/Bitmap_42.jpg |

|  |
| --- |
| For SI: 1 inch = 25.4 mm. |

**FIGURE I2 DYNAMIC PUNCTURE TEST APPARATUS**

|  |
| --- |
| http://floridabuilding2.iccsafe.org/app/book/content/2014_Florida/Test%20Protocols%20Code/Images/Bitmap_43.jpg |

|  |
| --- |
| For SI: 1 inch = 25.4 mm. |

**FIGURE I3 TYPICAL DYNAMIC PUNCTURE HEAD**

**(R7083 AM)**

**TESTING APPLICATION STANDARD (TAS) 114-95 APPENDIX J TEST PROCEDURE FOR 12 FOOT BY 24 FOOT SIMULATED UPLIFT PRESSURE RESISTANCE OF ROOFING ~~SYSTEM~~ ASSEMBLIES**

**1.    Scope:**   
  
1.1 Damage incurred by the effects of wind over and internal pressure under a totally adhered, partially adhered or mechanically attached roofing assembly ~~Roof System Assembly~~ generally results in one or more of the following:   
  
• Uplift of the cover (when totally adhered);   
  
• Delamination within the roof insulation cover (when totally or partially adhered);   
  
• Failure of adhesive between the insulation and the deck or between the insulation and the vapor retarder and/or between the vapor retarder and the deck; and,   
  
• Failure of the fastener/substrate, fastener/insulation or fastener/roof cover combination.   
  
1.2 Thus the nature of the damage incurred would suggest that an instrument designed to measure the stability of roof assemblies be equipped to evaluate bond strength indicated in the items above. The 12 foot by 24 foot simulated uplift pressure test has been designed for this purpose.   
  
1.3 The object of the test is to provide a realistic method of evaluating the uplift resistance of a completed roof construction and its individual components when applied within a completed assembly. The test procedure must contain the ability to realistically evaluate the actual size of the roof components which comprise a completed roofing ~~system~~ assembly.   
  
1.4 The test method is applicable to any roofing ~~system~~ assembly incorporating the deck, air/vapor retarders, insulation, roof cover, adhesives, sealants, mechanical fasteners, batten bars and proprietary fastening systems.   
  
1.5 The test method is designed to measure the stability of the roofing assembly ~~Roof System Assembly~~ on its supports and to evaluate the ultimate strength of the individual components in the completed roofing assembly ~~Roof System Assembly~~ under static conditions which are intended to simulate the uplift loads imposed by wind forces on the roofing assembly ~~system~~. The roof specimen is sufficiently large so that the means of securing the perimeter of the sample to the pressure vessel have virtually no effect on the ultimate behavior of the assembly during testing.   
  
1.6 The test procedure described in Appendix C does not adequately evaluate the performance of some newer roof constructions. With the increased use of extended fastener spacings in mechanically attached single-ply cover construction and air/vapor retarders, the perimeter edge effect of small or intermediate scale tests produces unreliable results. Therefore, a larger sample size is needed to properly evaluate resistance to wind uplift forces.   
  
**2. Terminology**–the following definitions apply to the test procedure outlined herein.   
  
2.1 Failure–Roofing ~~system~~ assembly failure under this test standard could be one or more of the following:   
  
• withdrawal or breakage of fasteners;   
  
• tearing, splitting or other breakage of the roof cover at the point(s) of attachment;   
  
• impairment of the waterproofing function of the roofing ~~systems~~ assembly (i.e. cracking of components within the assembly);   
  
• permanent deformation of the roof cover or fastener assembly, including stress plate, which may reduce the waterproofing function of the roofing ~~system~~ assembly over time; and,   
  
• delamination or separation of adhered areas.  **3. Apparatus:**   
  
3.1 The 12 foot by 24 foot uplift pressure apparatus is a steel pressure vessel arranged to supply air pressure at pre-established pressure levels to the underside of the roofing ~~system~~ assembly. This roofing ~~system~~ assembly, when secured in place, forms and seals the top of the pressure vessel.   
  
3.2 The pressure vessel measures 24 feet-7 inch long by 12 feet-7 inch wide by 2 inch deep (7.5 m by 3.8 m by 51 mm). It is fabricated from 8 inch (203 mm) deep steel channel sections as the perimeter structure with 6 inch (152 mm) deep steel beams spaced 2 feet (0.6 m) o.c. running parallel to the width. The bottom of the pressure vessel is sheathed with a 7 gauge (4.8 mm) thick steel plate spot welded to the top of the steel beams and continuously welded to the inside perimeter channels.   
  
3.3 The air supply into the sealed vessel is provided by an inlet manifold constructed with 4 inch (102 mm) diameter PVC pipe. Four openings, equally spaced, penetrate the steel plate and serve as the air inlet on the bottom of the pressure vessel. A 1/4 inch (6.4 mm) opening on the bottom of the vessel serves as the manometer connection. A foam gasket that lies between the top channel of the pressure vessel and the sample construction frame minimizes air leakage when the sample is clamped into place.   
  
3.4 Pressurized air is supplied to the inlet manifold by a turbo pressure blower having the capability of generating 600 cubic feet per minute (17 m3/min). The air flow is regulated by a manually operated 4 inch (102 mm) diameter PVC butterfly valve. Pressure readings are obtained from a water filled manometer calibrated to read directly in pounds per square feet.  **4. Test Limitations and Precautions:**   
  
4.1 During the test, all testing agency representatives and other test observers shall wear ear and eye protection and hard hats to prevent injury.   
  
4.2 This test procedure 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. Test Specimens:**   
  
5.1 The components for a proposed test panel are assembled to the desired specifications and details (type and thickness of the deck, application method and rate for the adhesive or fasteners, size and thickness of insulation and type of cover) and then left to “cure” for the manufacturer’s specified time period (maximum of 28 days).   
  
5.2 When steel decking is used, it is secured to a 24 feet-7 inch by 12 feet-7 inch by 1/4 inch (7.5 m by 3.8 m by 6.4 mm) angle iron frame. This test specimen frame typically includes a structural steel support located along the centerline and parallel to the length. In addition, three intermediate structural steel supports are located parallel to the width, 6 feet (1.8 m) o.c.. The steel deck is then applied parallel to the length. It is welded to the perimeter angle iron with 1/2 inch (13 mm) diameter puddle welds 12 inch (305 mm) o.c. along the entire perimeter. In addition, it is fastened at all supports [6 feet (1.8 m) spans for 22 gage (0.75 mm) steel] 12 inch (305 mm) o.c. with approved fasteners. All deck side laps are fastened with approved fasteners spaced at a maximum of 30 inch (762 mm) o.c. Other structural roof decks may be used if requested by the program sponsor. Their application is according to the manufacturer’s specifications and approval requirements.   
  
Note: The method of securing the steel deck to the test frame may vary when a specific test, as requested by an applicant, dictates.   
  
5.3 When ready for testing, the test specimen frame, containing the test specimen, is placed on the pressure vessel and clamped into place using C-clamps and 2 inch by 3 inch by 1/4 inch (51 mm by 76 mm by 6.4 mm) steel angles placed around the perimeter of the sample [smaller dimension horizontal and the 3 inch (76 mm) leg facing down]. See Figures K1 and K2, herein. In addition, the test specimen frame is secured to the pressure vessel at the three intermediate support clips located near the centerline of the pressure vessel. The appropriate hose connections are then made to the air supply and the manometer.   
  
5.4 Roofing ~~system~~ assemblies whose wind-load resistance performance may be affected by bad weather conditions during installation shall be constructed in a manner which simulates actual working conditions.  **6. Test Procedure:**   
  
6.1 ~~Principal:~~ ~~6.6.1~~The framed roofing ~~system~~ assembly test specimen is mounted on the test apparatus and sealed by a foam polyurethane gasket located between the top of the pressure vessel and the bottom of the test specimen frame. Air is supplied to the vessel in increasing amounts to maintain a certain pressure for a given length of time on the underside of the test specimen and to offset minor pressure loss due to leaks. The sustained air pressure delivered to the underside of the test specimen represents the combined positive and negative pressures incurred on an actual roofing ~~system~~ assembly from above and below. Pressure is increased until failure occurs.   
  
6.2 After the test specimen is mounted on the test apparatus, air is introduced beneath the sample in accordance with Table J1, below.  **TABLE J1 12 FOOT BY 24 FOOT UPLIFT PRESSURE INTERVALS**

|  |  |  |
| --- | --- | --- |
| **Time  (Minutes)** | **Static Uplift Pressure1** | |
| **psf** | **kPa** |
| 0:01 to 1:00 | 30 | 1.4 |
| 1:01 to 2:00 | 45 | 2.2 |
| 2:01 to 3:00 | 60 | 2.9 |
| 3:01 to 4:00 | 75 | 3.6 |
| 4:01 to 5:00 | 90 | 4.2 |
| 5:01 to 6:00 | 105 | 4.9 |
| 6:01 to 7:00 | 120 | 5.7 |
| 7:01 to 8:00 | 135 | 6.5 |
| 8:01 to 9:00 | 150 | 7.2 |

|  |
| --- |
| 1 Add 15 psf (0.7 kPa) for each successive one minute interval. |

6.3 Prior to and during the attainment of uplift pressures noted above, the test specimen is examined for failure. Upon failure, the test specimen is dismantled and examined to determine the exact mode of failure.   
  
6.4 Record the mode, time and pressure interval of failure.  **7. Interpretation of Results:**   
  
7.1 The passing uplift pressure shall be the pressure which the test specimen resisted for one minute without failure.   
  
7.2 The minimum passing uplift pressure for an Approved roofing ~~system~~ assembly shall be 90 psf (4.2 kPa).   
  
~~7.3 A 2:1 margin of safety shall be applied to the passing uplift pressure prior to inclusion in the system~~ manufacturer’s Product Approval.   
  
7.4 RESERVED. ~~Average wind velocities can vary considerably from area to area. The~~ *~~Florida Building Code, Building~~* ~~utilizes a windspeed of 110 mph at a height of 33 feet above ground. These wind velocities in miles per hour are related to the design pressure, in pounds per square feet, for a particular building. Refer to Chapter 16 (High-Velocity Hurricane Zones) of the~~ *~~Florida Building Code, Building~~* ~~and ASCE 7.~~  
7.5 Data generated from Appendix J simulated uplift testing may be used for extrapolation, in compliance with RAS 137 (for single-ply membrane attachment), to meet design pressures for a specific building. Extrapolation of data from Appendix J simulated uplift testing is limited to 1.75 times the maximum uplift pressure noted in the Product Approval. Only ‘upward’ extrapolation is acceptable (i.e., fastener density may not be decreased and fastener spacing may not be increased for lesser design pressures).

**(R7083 AM)**

**NOTE: DELETE ENTIRE APPENDIX**

**~~TESTING APPLICATION STANDARD (TAS) 114-95 APPENDIX K TEST PROCEDURES FOR F.I.T. CLASSIFICATION OF MODIFIED BITUMEN ROOF SYSTEM ASSEMBLIES~~**

**~~1. Scope:~~**  ~~1.1 F.I.T. is a performance-based classification for modified bitumen roof membranes. F.I.T. classifications are intended to provide performance capacities required of a particular roof system assembly when different levels of operating conditions are assumed.   
  
1.2 The F.I.T. classification of modified bitumen roof membranes determines their suitability (fitness) for use with respect to the following parameters:~~

|  |  |  |
| --- | --- | --- |
| ~~F~~ | ~~→~~ | ~~Fatigue~~ |
| ~~I~~ | ~~→~~ | ~~Indentation (i.e. puncture)~~ |
| ~~T~~ | ~~→~~ | ~~Temperature~~ |

~~The classification defines, in terms of these parameters, both the roof system assembly requirements and the membrane performance capabilities to satisfy these requirements.   
  
1.3 Each letter (F, I and T) is assigned a numerical index, thereby providing a brief, yet precise indication of the following parameters:   
  
• the requirements to be satisfied by the roof system assembly; or,   
  
• the performance capabilities of the modified bitumen roof membrane.   
  
The index increases with the severity of the requirements and with the level of performance provided by the roof membrane.   
  
1.4 For each parameter (F, I and T) of the classification, the modified bitumen roof membrane must provide a performance index (number) better than or equal to the requirement of the roof system assembly in question.~~  **~~2. F.I.T. Classification:~~**  ~~2.1 Classification F—Substrate Movement (Fatigue) Test:   
  
2.1.1 The F classification index is based on results of fatigue testing noted herein. Testing conducted on bonded modified bitumen roof membranes characterizes the membrane resistance to cyclic substrate movement at a given amplitude consisting of 500 cycles for new roof membranes and 200 cycles for aged roof membranes.   
  
2.1.2 Table K1, below, indicates the conditions under which performance indices 1 to 5 are determined.~~  **~~TABLE K1 CLASSIFICATION F (FATIGUE) PERFORMANCE INDICES~~**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **~~Class~~** | **~~Initial Joint Width  (mm)~~** | **~~Amplitude of Joint  Movement  (mm)~~** | | | **~~Test Temperature  F(°C)~~** | |
| ~~F~~~~1~~ | ~~1~~ | ~~-0.5~~ | ~~to~~ | ~~+0.5~~ | ~~+68~~ | ~~(+20)~~ |
| ~~F~~~~2~~ | ~~1~~ | ~~-0.5~~ | ~~to~~ | ~~+0.5~~ | ~~32~~ | ~~(0)~~ |
| ~~F~~~~3~~ | ~~2~~ | ~~-1~~ | ~~to~~ | ~~+1~~ | ~~32~~ | ~~(0)~~ |
| ~~F~~~~4~~ | ~~2~~ | ~~-1~~ | ~~to~~ | ~~+1~~ | ~~+14~~ | ~~(-10)~~ |
| ~~F~~~~5~~ | ~~2~~ | ~~-1~~ | ~~to~~ | ~~+1~~ | ~~-4~~ | ~~(-20)~~ |

~~2.1.3 Apparatus:   
  
2.1.3.1 The test apparatus shall consist of the following:   
  
• two plates with clamping screws to attached two concrete slabs so that the edges form a butt joint;   
  
• a device to open and close the joint at a rate of~~ ~~5~~~~/~~~~8~~ ~~inch per hour (16 mm/hr) and at a controlled amplitude;   
  
• a climactic chamber so the test specimen can be kept at a controlled temperature.   
  
2.1.4 Test specimens:   
  
2.2.4.1 Test specimen shall consist of 12 inch by 2 inch (300 mm by 50 mm) strips of membrane placed on the concrete slabs with the center of the 12 inch dimension centered at the butt joint, which is set at the joint width for the various F classifications noted in Table K1.   
  
2.2.4.2 A total of six test specimen strips shall be tested; three unaged and three which have been conditioned at 176°F (80°C) for 28 days.   
  
2.2.4.3 Specimens shall be fully adhered to the concrete slabs using the method noted in the membrane manufacturer’s published literature.   
  
2.1.5 Procedure:   
  
2.1.5.1 From the initial position, the joint is opened and closed alternately under the following conditions:   
  
• the amplitude of movement is + 0.5 mm or + 1 mm, depending on the performance index being tested (see Table K1);   
  
• the test temperature is +68°F, +32°F, +14°F or -4°F depending on the performance index being tested; and,   
  
• the number of cycles is 500 for unaged and 200 for aged specimens.   
  
2.1.6 Observations:   
  
2.1.6.1 The test is terminated at the end of 200 cycles for aged and 500 cycles for unaged specimens at which time:   
  
• the samples are checked for watertightness under a 5 centimeters high water column or by equivalent method; and,   
  
• any loss of bond is observed and reported.   
  
2.1.6.2 Failure criteria shall be complete loss of adhesion or delamination of the specimens.   
  
2.2 Classification I–Static and Dynamic Puncture Test:   
  
2.2.1 The I classification index is based on results of static and dynamic puncture resistance testing noted in Appendix I of TAS 114. Testing conducted on bonded roof membranes characterizes the membrane resistance to static and dynamic impact loading.   
  
2.2.2 Tables K2 through K4, below, indicate the conditions under which performance indices 1 to 5 are determined.~~  **~~TABLE K2 SUBCLASSIFICATION L (STATIC PUNCTURE) PERFORMANCE INDICES~~**

|  |  |
| --- | --- |
| **~~Subclass~~** | **~~Static Load lb (kg)~~** |
| ~~L~~~~1~~ | ~~<15 (7)~~ |
| ~~L~~~~2~~ | ~~>15 (7)~~ |
| ~~L~~~~3~~ | ~~>33 (15)~~ |
| ~~L~~~~4~~ | ~~>55 (25)~~ |

**~~TABLE K3 SUBCLASSIFICATION D (DYNAMIC PUNCTURE) PERFORMANCE INDICES~~**

|  |  |
| --- | --- |
| **~~Subclass~~** | **~~Impact Energy  ft-pdl (J)~~** |
| ~~D~~~~1~~ | ~~<240 (10)~~ |
| ~~D~~~~2~~ | ~~>240 (10)~~ |
|  | ~~<480 (20)~~ |
| ~~D~~~~3~~ | ~~>480 (20)~~ |

**~~TABLE K4 CLASSIFICATION I (INDENTATION) PERFORMANCE INDICES~~**

|  |  |  |
| --- | --- | --- |
| **~~Class~~** | **~~Subclass L~~** | **~~Subclass D~~** |
| ~~I~~~~1~~ | ~~L~~~~1~~ | ~~D~~~~2~~ |
| ~~I~~~~2~~ | ~~L~~~~2~~ | ~~D~~~~2~~ |
| ~~I~~~~3~~ | ~~L~~~~3~~ | ~~D~~~~2~~ |
| ~~I~~~~4~~ | ~~L~~~~4~~ | ~~D~~~~2~~ |
| ~~I~~~~5~~ | ~~L~~~~5~~ | ~~D~~~~3~~ |

~~2.2.3 Apparatus, Procedure and Observations shall be in compliance with Appendix I of TAS 114.   
  
2.3 Classification T–Temperature Stability:   
  
2.3.1 The T classification index is based on results of slippage resistance testing under the effects of temperature noted herein. Testing conducted on bonded modified bitumen roof membranes characterizes the membrane resistance to slippage under the effects of temperature.   
  
2.3.2 Table K5, below, indicates the conditions under which performance indices 1 to 4 are determined.~~  **~~TABLE K5 CLASSIFICATION T (TEMPERATURE STABILITY) PERFORMANCE INDICES~~**

|  |  |  |
| --- | --- | --- |
| **~~Class~~** | **~~Slippage Amplitude~~****~~(mm)~~** | **~~Test Temperature~~****~~F (C)~~** |
| ~~T~~~~1~~ | ~~> 2~~ | ~~140 (60)~~ |
| ~~T~~~~2~~ | ~~< 2~~ | ~~140 (60)~~ |
| ~~T~~~~3~~ | ~~< 2~~ | ~~176 (80)~~ |
| ~~T~~~~4~~ | ~~< 2~~ | ~~194 (90)~~ |

~~2.3.3 Apparatus   
  
2.3.3.1 The test apparatus shall consist of the following:   
  
• A heat chamber controlled to within +5°F, with an operating range from +120°F to not less than +250°F;   
  
• A frame to which the test specimen described below is attached in a sloping position of 45 degrees. The frame must allow the test specimen to be kept in a horizontal position during the time necessary for the selected test temperature to stabilize;   
  
• A series of clean degreased steel plates, 0.08 inch thick by 7~~~~3~~~~/~~~~4~~ ~~inch by 15~~~~3~~~~/~~~~4~~ ~~inch (2 mm thick by 200 mm by 400 mm), prepared according to Figure K1, below. Each plate has 2 screws and nuts of appropriate diameter for the holes drilled in the edges of the plate;   
  
• A metal rule not less than 7~~~~3~~~~/~~~~4~~ ~~inches (200 mm) long;   
  
• A device to measure length to within 0.1 mm; and   
  
• Thin aluminum plates 2 inch by 6 inch (50 mm by 150 mm) and a 2-component adhesive.~~

|  |
| --- |
| ~~http://floridabuilding2.iccsafe.org/app/book/content/2014_Florida/Test%20Protocols%20Code/Images/Bitmap_52.jpg~~ |

|  |
| --- |
| ~~For SI: 1.02 mm = 0.040 inch~~ |

**~~FIGURE K1 SCHEMATIC OF STEEL PLATE FOR TEMPERATURE STABILITY TEST~~**  ~~2.3.4 Test Specimens:   
  
2.3.4.1 Test specimen shall consist of 12 inch by 6 inch (300 mm by 150 mm) membrane samples adhered or torched to the steel plate (do not use primer) in compliance with the membrane manufacturer’s published instructions.   
  
2.3.4.2 Put the screws and nuts in place.   
  
2.3.4.3 Glue the aluminum plate to the membrane surface such that it is possible, before and after exposure to heat, to draw a line on the plate with a scribe using a metal rule which is placed against the screws.   
  
2.3.4.4 Three test specimens shall be constructed.   
  
2.3.5 Procedure:   
  
2.3.5.1 Condition the test specimens at ambient conditions in the horizontal position for 24 hours.   
  
2.3.5.2 Draw a line to show the initial position.   
  
2.3.5.3 Set the heat chamber to the required test temperature.   
  
2.3.5.4 Place the test specimen in horizontal position in the heat chamber, and allow it to remain there for one hour.   
  
2.3.5.5 Put the test specimen in the test position, sloping at an angle of 45 degrees, in less than 5 seconds. Keep it in this position at the test temperature for 2 hours.   
  
2.3.5.6 Remove the test specimen from the chamber and allow it to cool at ambient conditions in the horizontal position.   
  
2.3.5.7 Draw a line to indicate the final position.   
  
2.3.6 Observations:   
  
2.3.6.1 Measure the difference between the two lines along each edge.   
  
2.3.6.2 Slippage of the membrane is expressed as the average of the three test specimens.~~  **~~3. Classification of Membrane Use:~~**  ~~3.1 The ascending order of the indices assigned to each of the F.I.T. letters corresponds to increasingly severe conditions of use.   
  
3.2 Table K6, below, summarizes the classification of the roof system assembly with respect to the three parameters F.I.T. It provides the total classification of the required modified bitumen membrane roof system assembly.   
  
3.2.1 Based on the premise of increasing performance capacity, a modified bitumen membrane classification greater than that required of the roof system assembly would be a wise precaution.~~**~~TABLE K6~~**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **~~Membrane~~****~~Substrate~~** | **~~Slope~~** | **~~Roof Use and Type of Protection~~** | | | | | |
| **~~Non-Functional~~** | **~~Functional Access Roof~~** | | | | **~~Equipment~~****~~Maintenance~~****~~Walkway~~** |
| **~~Pedestrian~~** | **~~Vehicles~~** | **~~Pedestrian~~** | **~~Gardens~~** |
| **~~Factory Applied~~****~~Surfacing~~** | **~~Slabs - Pavers~~** | | **~~Protection Slabs~~****~~on Spacers~~** | **~~Direct Drainage  Layer~~** | **~~Factory Applied~~****~~Surfacing~~** |
| ~~Thermal  Insulation~~ | ~~0~~ | ~~F~~~~4~~~~I~~~~2~~~~T~~~~2~~~~(1) (2)~~ |  |  | ~~F~~~~5~~~~I~~~~4~~~~T~~~~3~~ | ~~F~~~~3~~~~I~~~~5~~~~T~~~~1~~ | ~~F~~~~4~~~~I~~~~4~~~~T~~~~2~~ |
| ~~Low  (<4″:12″)~~ | ~~F~~~~4~~~~I~~~~2~~~~T~~~~2~~~~(1) (2)~~ | ~~F~~~~4~~~~I~~~~4~~~~T~~~~2~~ | ~~F~~~~4~~~~I~~~~4~~~~T~~~~2~~ | ~~F~~~~5~~~~I~~~~4~~~~T~~~~3~~ | ~~F3~~~~I~~~~5~~~~T~~~~2~~ | ~~F~~~~4~~~~I~~~~4~~~~T~~~~2~~ |
| ~~Pitched  (4″:12″)~~ | ~~F~~~~4~~~~I~~~~2~~~~T~~~~2~~~~(3)~~ |  |  |  |  | ~~F~~~~4~~~~I~~~~2~~~~T~~~~2~~~~(3)~~ |
| ~~Concrete~~ | ~~0~~ | ~~F~~~~4~~~~I~~~~2~~~~T~~~~2~~ |  |  | ~~F~~~~5~~~~I~~~~4~~~~T~~~~3~~ | ~~F~~~~3~~~~I~~~~5~~~~T~~~~1~~ | ~~F~~~~4~~~~I~~~~4~~~~T~~~~2~~ |
| ~~Low  (<4″:12″)~~ | ~~F~~~~4~~~~I~~~~2~~~~T~~~~2~~ | ~~F~~~~4~~~~I~~~~4~~~~T~~~~2~~ | ~~F~~~~4~~~~I~~~~4~~~~T~~~~2~~ | ~~F~~~~5~~~~I~~~~4~~~~T~~~~3~~ | ~~F~~~~3~~~~I~~~~5~~~~T~~~~2~~ | ~~F~~~~4~~~~I~~~~4~~~~T~~~~2~~ |
| ~~Pitched  (4″:12″)~~ | ~~F~~~~4~~~~I~~~~2~~~~T~~~~2~~ |  |  |  |  | ~~F~~~~4~~~~I~~~~4~~~~T~~~~2~~ |
| ~~Concrete &  Protected  Membrane~~ | ~~0~~ |  |  |  | ~~F~~~~3~~~~I~~~~3~~~~T~~~~2~~ | ~~F~~~~3~~~~I~~~~5~~~~T~~~~1~~ |  |
| ~~Low  (<4″:12″)~~ |  | ~~F~~~~3~~~~I~~~~3~~~~T~~~~2~~ |  | ~~F~~~~3~~~~I~~~~3~~~~T~~~~2~~ | ~~F~~~~3~~~~I~~~~5~~~~T~~~~2~~ |  |
| ~~Cellular  Concrete~~ | ~~Low  (<4″:12″)~~ | ~~F~~~~4~~~~I~~~~2~~~~T~~~~2~~ |  |  |  |  | ~~F~~~~4~~~~I~~~~4~~~~T~~~~2~~ |
| ~~Pitched  (4″:12″)~~ | ~~F~~~~4~~~~I~~~~2~~~~T~~~~2~~ |  |  |  |  | ~~F~~~~4~~~~I~~~~4~~~~T~~~~2~~ |
| ~~Wood and  Derived Panels~~ | ~~Low  (<4″:12″)~~ | ~~F~~~~4~~~~I~~~~2~~~~T~~~~2~~ |  |  |  |  | ~~F~~~~4~~~~I~~~~4~~~~T~~~~2~~~~(3)~~ |
| ~~Pitched  (4″:12″)~~ | ~~F~~~~4~~~~I~~~~2~~~~T~~~~2~~~~(3)~~ |  |  |  |  | ~~F~~~~4~~~~I~~~~4~~~~T~~~~2~~~~(3)~~ |
| ~~Existing  Membrane~~ | ~~0~~ | ~~F~~~~4~~~~I~~~~2~~~~T~~~~2~~ |  |  | ~~F~~~~5~~~~I~~~~4~~~~T~~~~3~~ | ~~F~~~~3~~~~I~~~~5~~~~T~~~~1~~ | ~~F~~~~4~~~~I~~~~4~~~~T~~~~2~~ |
| ~~Low  (<4″:12″)~~ | ~~F~~~~4~~~~I~~~~2~~~~T~~~~2~~ | ~~F~~~~4~~~~I~~~~4~~~~T~~~~2~~ | ~~F~~~~4~~~~I~~~~4~~~~T~~~~2~~ | ~~F~~~~5~~~~I~~~~4~~~~T~~~~3~~ | ~~F~~~~3~~~~I~~~~5~~~~T~~~~2~~ | ~~F~~~~4~~~~I~~~~4~~~~T~~~~2~~ |
| ~~Pitched  (4″:12″)~~ | ~~F~~~~4~~~~I~~~~2~~~~T~~~~2~~~~(3)~~ |  |  |  |  | ~~F~~~~4~~~~I~~~~4~~~~T~~~~2~~~~(3)~~ |

|  |
| --- |
| ~~1 Index I becomes I~~~~3~~ ~~for mineral wool over concrete and cellular concrete.~~ |
| ~~2 Index I becomes I~~~~3~~ ~~on R > 2m~~~~2~~ ~~°C/W mineral wool.~~ |
| ~~3 Index T becomes T~~~~3~~ ~~if R > 2m~~~~2~~ ~~°C/W.~~ |

**(R7083 AM)**

**TESTING APPLICATION STANDARD (TAS) 121-95 STANDARD REQUIREMENTS FOR TESTING AND APPROVAL OF ROOFING ADHESIVES, MASTICS AND COATINGS**

***Standard TAS 121-95 . Add or modify to read as follows:***

**1. Scope:**   
  
1.1 This protocol cover the procedures for testing of adhesives, mastics and coatings used in roofing applications and the approval process for all products which have successfully met the testing criteria.   
  
1.2 This protocol applies to all products used in both low and steep slope roofing applications, other than sealants (see TAS 132 for sealant requirements).   
  
1.3 All testing shall be conducted by an approved testing agency, which provides a listing service. All test reports shall be executed by a professional engineer and an authorized signatory of the testing/listing agency.   
  
1.4 This protocol establishes the testing and listing program required of these products to confirm continuing compliance with the ASTM or Testing Application Standards.   
  
1.5 This protocol has not been contemplated to measure the performance of the adhesives, mastics and coatings in conjunction with all approved roof system assemblies.  **2. Referenced Documents:**   
  
2.1 *The Florida Building Code, Building.*   
  
2.2 *ASTM Standards:*

|  |  |
| --- | --- |
| D 140 | Standard Practice for Sampling Bituminous Materials |
| C 1021 | Standard Practice for Laboratories Engaged in the Testing of Building Sealants |
| D 1079 | Standard Definitions and Terms Relating to Roofing, Waterproofing and Bituminous Materials |
| E 380 | Excerpts from the Standard Practice for Use of the International System of Units (SI) (the Modernized Metric System) |

2.3 *Application Standards*

|  |  |
| --- | --- |
| TAS 110 | Testing Requirements for Physical Properties of Roof Membranes, Insulation Coatings and Other Roofing Components. |

~~2.4~~ *~~Roof Consultants Institute:~~* ~~Glossary of Terms~~  **3. Terminology:**   
  
3.1 Definitions –For definitions of terms used in this Protocol, refer to ASTM D 16; and/or ASTM D 1079 and/or ~~Chapter 2 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 E 380.  **4. Test Specimens:**   
  
4.1 Sampling of all bituminous products under this Protocol shall be in compliance with ASTM D 140.   
  
4.2 Unless otherwise noted in the specific ASTM Test Standard, sampling of all non-bituminous products under this protocol shall be in compliance with ASTM C 1021. Particular reference is made to Subsection 5.2.1 of this test standard.  **5. Listing Services:**   
  
5.1 All products which require testing shall be tested by an approved testing agency which provides an annual listing service.   
  
5.2 All products shall be listed in the testing agency’s annual directory and shall be subject to unannounced manufacturing audits to insure compliance with manufacturing guidelines.  **6. Testing Requirements:**   
  
6.1 All products noted herein which successfully obtain Product Approval shall have been tested in compliance with all applicable ASTM or Testing Application Standards enumerated in TAS 110.   
  
6.2 All applicable test data and test reports shall be submitted with the roofing component manufacturer’s application for Product Approval.   
  
~~6.3 When a roofing component Product Approval is attained, the approved product shall have its Product Approval number imprinted on it or its packaging, along with the approved testing/listing agency’s name and logo, as noted in Section 6.3, herein.~~  **7. Packaged Material:**   
  
7.1 Packaged material shall bear a label indicating certified by the manufacturer to be in compliance with this specification and shall be labeled in compliance with ~~Section 1517 of~~ the *Florida* *Building* *Code,* *Building*. Product Approval documents shall be provided to the purchaser or end user upon request.   
  
7.2 ~~Shipping containers~~ Packaging materials shall be marked by the manufacturer as required by the approval entity ~~with the name of the material, stock number, lot number, year of issue and quantity therein and the name of the manufacturer or supplier.~~  **~~8. Rejection and Reinspection~~**  ~~8.1 The authority having jurisdiction may periodically purchase commercial quantities of the approved product for testing at approved Testing Agencies to confirm compliance with the provisions of the ASTM Standard or Testing Application Standards. Failure to meet the minimum physical property and performance properties of the test standard shall constitute grounds for rejection of the lots and suspension of the Product Approval. In cases of rejection the Authority Having Jurisdiction shall request removal of the rejected lot number(s) from commercial sale.   
  
8.2 The Authority Having Jurisdiction may, after rejection of one or more lots, require third party quality control inspection as a provision to lifting of approval suspension~~

**(R7097 AS)**

**TESTING APPLICATION STANDARD (TAS) 124-11 TEST PROCEDURE FOR FIELD UPLIFT RESISTANCE OF EXISTING MEMBRANE ROOF SYSTEMS AND IN SITU TESTING FOR REROOF AND NEW CONSTRUCTION APPLICATIONS**

***Standard TAS 124-11. Add or modify to read as follows:***

**1. Scope:**   
  
1.1 This protocol covers the determination of the resistance to uplift pressure of newly installed, adhered, 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 to determine the performance of a new roof system assembly when installed over an existing roof system assembly or directly over a roofing substrate.   
  
1.3 The test procedures outlined herein are intended to determine whether the uplift resistance performance of a newly installed Roof System Assembly meets the design pressure requirements of ASCE 7, as required in ~~Section 1609 of~~ the *Florida Building Code, Building*. The design pressure requirements for the building in question are listed on Section II of the Uniform Building Permit.   
  
1.4 Tests shall be conducted prior to full-scale test assemblies to ensure that the specific maximum pressures set forth in the built-up roofing manufacturer’s Product Approval can be achieved utilizing the specified components (i.e., fasteners, insulation, etc.).   
  
1.5 When insulation boards are mechanically attached or adhered to the deck, the test shall be conducted not less than 7 days after roofing work is complete. Systems containing cold adhesive shall be in place not less than 14 days prior to conducting the test.   
  
1.6 All testing shall be conducted by an approved testing agency and all test reports shall be signed by a Registered Design Professional ~~per F.S., Section 471 or 481~~ or Registered Roof Consultant.   
  
1.7 Design pressures calculated in accordance with ASCE 7 are permitted to be multiplied by 0.6 for the purposes of comparing to tested pressures in TAS 124.   
  
**2. Referenced Documents:**   
  
2.1 *ASTM Standards*

|  |  |
| --- | --- |
| D 41 | Standard Specification for Asphalt Primer used in Roofing, Damp proofing, and water proofing |
| D 1079 | Definitions and Terms Related to Roofing, Waterproofing and Bituminous Materials |
| E 380 | Excerpts from Standard Practice for Use of the International System of Units (SI) (the Modernized Metric System) |
| E 575 | Practice for Reporting Data from Structural Tests of Building Constructions, Elements, Connections and Assemblies. |
| ~~E 907~~ | ~~Test Method for Field Testing Uplift Resistance of Roofing Systems Employing Steel Deck, Rigid Insulation and Bituminous Built-Up Roofing~~ |

~~2.2~~ *~~Factory Mutual Engineering Corporation:~~*~~Loss Prevention Data Sheet 1-28(S), November, 1991   
Loss Prevention Data Sheet 1-49, June, 1985   
Loss Prevention Data Sheet 1-52, February, 1986~~  
~~2.3~~ *~~National Roofing Contractors Association:~~*~~NRCA/ARMA Manual of Roof Maintenance and Repair   
NRCA Roofing and Waterproofing Manual~~   
  
2.4 *The Florida Building Code, Building:*Chapter 16 (High-Velocity Hurricane Zones) Design Loads   
Chapter 19 (High-Velocity Hurricane Zones)   
Reinforced Gypsum Concrete and Insulating Concrete   
Chapter 21 (High-Velocity Hurricane Zones) Masonry   
Chapter 22 (High-Velocity Hurricane Zones) Steel and Iron   
Chapter 23 (High-Velocity Hurricane Zones) Wood   
Chapter 15 (High-Velocity Hurricane Zones) Assemblies and Rooftop Structures ~~Roof Covering and Application~~   
  
2.5 *Application Standards:*

|  |  |
| --- | --- |
| TAS 105 | Test Procedure for Field Withdrawal Resistance Testing |
| TAS 114 | Test Procedures for Roof System Assemblies in the High-Velocity Hurricane Zone Jurisdiction |

2.6 *Application Standards:*

|  |  |
| --- | --- |
| RAS 111 | Standard Requirements for Attachment of Perimeter Woodblocking and Perimeter Flashing |
| RAS 117 | Standard Requirements for Bonding or Mechanical Attachment of Insulation Panels to and Mechanical Attachment of Anchor or Base Sheets to Various Substrates |

~~2.7~~ *~~Roof Consultants Institute:~~*~~Glossary of Terms~~   
  
**3. Terminology & Units:**   
  
3.1 Definitions–For definitions of terms used in this Protocol, refer ASTM D 1079; 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 E 380.   
  
**4. Significance and Use:**   
  
4.1 The field test procedures specified herein provide a means for determining the uplift resistance of a new, adhered, built-up, bituminous roof system 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 ~~Section 1609 of~~ the *Florida Building Code, Building*.   
  
4.1.1 Field testing of an assembly may be used to support the uplift resistance performance of a specific roof system assembly when the required number of samples noted in Section 7.1 and 7.2 have been tested, and averaged. A margin of safety of 1.45:1 shall be applied to the sample average.   
  
4.1.2 Laboratory conditions may enable uplift investigations to include:   
  
• examination of the critical components and their orientation within the roof system assembly;   
  
• examination of the roof system assembly’s long-term uplift resistance; and   
  
• examination of the roof system assembly’s uplift resistance from the dynamic affect of variable wind velocities.   
  
4.2 A contractor licensed to install roofing in the high-velocity hurricane zone shall be present during all tests should roof repairs be necessary. Any roofing component damaged during testing shall be repaired immediately subsequent to test completion.   
  
4.3 When new construction will require a tear off of the existing roof system assembly, areas of existing roofing shall be removed to deck level. Sample assemblies shall be applied including a lifting panel, as detailed in Section 5.2 when the bonded pull test procedure is utilized. Sample panels shall be covered and waterproofed with a membrane roof covering to return the existing assembly to a waterproof condition.   
  
**5. Apparatus:**   
  
5.1 Bell chamber tests:   
  
5.1.1 Square Uplift Chamber   
  
• The square pressure chamber shall be 60 + 1/2 inch (1500 ± 15 mm) in size with a maximum height in the center of the bell of 18 inches.   
  
• The chamber shall be of sufficient strength to withstand not less than 125 pounds per square feet without collapsing.   
  
5.1.2 Pressure measurement device:   
  
• The pressure within the square uplift chamber shall be measured with a manometer which is calibrated to indicate negative pressures in increments of 15 ± 0.5 pound foot per square foot (720 ± 20 Pa).   
  
5.1.3 Vacuum pump:   
  
• Negative pressures shall be created within the pressure chamber with a vacuum pump of sufficient capacity to create the negative pressures specified in Section 8.9.   
  
• The vacuum pump shall also be equipped with controls to maintain a constant pressure at each test pressure increment, as noted in Section 8.9.   
  
5.1.4 Dial indicator:   
  
• Membrane deflections shall be measured using an analog dial indicator with a reset face graduated in units not greater than 0.002 inch (0.05 mm) and having a range not less than 2 inches (50 mm).   
  
• The analog dial indicator shall be mounted at the center of a 2 inch by 2 inch (50 mm by 50 mm) aluminum (or material of equivalent stiffness) bar having a length of 60 inches (1500 mm). The bar shall be supported with support legs which clear the roof membrane by not less than 2 inches (50 mm).   
  
5.2 Bonded pull test:   
  
5.2.1 Load transfer device:   
  
• The load transfer device shall consist of two pieces of 2 feet square, 7/8 inch thick plywood fastened together using 12 each, 11/4 inch long wood screws to form a 2 feet by 2 feet by 13/4 inch panel. Screw placement shall be as noted in Figure 1, below.

|  |
| --- |
| http://floridabuilding2.iccsafe.org/app/book/content/2014_Florida/Test%20Protocols%20Code/Images/Bitmap_188.jpg |

**FIGURE 1 SCREW AND EYE-BOLT LOCATIONS**   
  
• Alternatively the top plywood panel may be substituted with a 3/8inch thick steel panel reinforced with two 2 inch sections of angle iron welded to the top face of the panel. The steel panel shall have 7/16 inch diameter holes drilled at locations noted in Figure 1, above, through which 3/8 inch countersunk machine screws shall be installed through the base of the plywood panel and secured to the steel plate with a washer and wing nut. (See Figure 2, below.)

|  |
| --- |
| http://floridabuilding2.iccsafe.org/app/book/content/2014_Florida/Test%20Protocols%20Code/Images/Bitmap_189.jpg |

**FIGURE 2 ALTERNATE LOAD TRANSFER DEVICE**   
  
• One 1/2 inch diameter eye-bolt shall be installed in the center of the test panel and shall be secured to the underside with a lock nut and washers, as noted in Figure 1, above. Alternatively a ring shall be welded to the steel panel.   
  
• A block and tackle or chain hoist shall be attached to the eye-bolt or welded ring with the opposite end attached to the top of a tripod, or equivalent support system, capable of withstanding a minimum of 1200 lbf downward load. The hoist assembly shall be capable of an incremental rise of 1/4 inch.   
  
5.2.2 Load cell:   
  
• A load cell, or equivalent load measurement device, capable of recording loads up to 2000 lbf to an accuracy of 0.5 lbf, shall be attached between the hoist assembly and the eye-bolt or welded ring to measure the applied load.   
  
**6. Test Limitations and Precautions:**   
  
6.1 General:   
  
6.1.1 Conduct tests when the roof’s surface temperature is within a range of 40°F to 100ºF (4°C to 38ºC) as measured by a surface thermometer. The surface temperature shall be noted on the test report.   
  
6.1.2 For safety considerations, it is recommended that tests not be conducted when the wind speed at the roof level is greater than 15 miles per hour (6.5 m/s). (A portable anemometer to measure wind speed may be utilized.)   
  
6.2 Bell chamber tests:   
  
6.2.1 The manometer shall serve as a safety device to prevent negative pressures that could cause the plastic or fiberglass dome to shatter. The maximum negative pressure for the dome shall be clearly marked on the manometer. Alternatively other safety features shall be added to the test chamber to eliminate negative pressure greater than the design capabilities of the dome.   
  
6.2.2 Safety goggles or face shield shall be worn by persons operating the equipment or observing its operation as a precaution against injury that could be caused by sudden failure of the test chamber or roofing system.   
  
6.2.3 Care shall be taken to ensure that movement of persons and/or equipment during the test does not lead to movement of the analog dial indicator. During the test, all persons not involved shall stay far enough away from the test area to not influence the analog dial indicators.   
  
6.2.4 Testing under this protocol shall be conducted on mechanically attached roof system assemblies.   
  
6.3 Bonded pull test:   
  
6.3.1 Testing shall only be conducted on fully adhered roof coverings.   
  
6.3.2 Proper safety equipment shall be utilized and proper safety procedures followed during the application of hot asphalt or coal tar pitch. Application of roofing products shall be in compliance with the safety guidelines published and recommended by the roof membrane manufacturer and by the National Roofing Contractors Association.   
  
**7. Sampling:**   
  
7.1 The total number of tests to be conducted when testing over an existing roof assembly is listed in Table 1, below. Of these tests, half shall be conducted at selected locations within the perimeter area of the roof and half shall be conducted at selected locations within the field area of the roof.   
  
**TABLE 1 NUMBER OF BELL CHAMBER OR BONDED PULL TESTS TO BE CONDUCTED PER ROOF AREA**

|  |  |
| --- | --- |
| **Roof Area (A)** | **Number of Tests** |
| 10 squares < A < 50 squares  (100 m2 < A < 450 m2) | 2 |
| 50 squares < A < 100 squares  (450 m2 < A < 1000 m2) | 4 |
| A > 100 squares  (A > 1000 m2) | 4 plus 1 additional test for  each additional 100 squares  (1000 m2) or portion thereof |

|  |
| --- |
| 1 1 square = 100 ft2 = 9.3 m2 |

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.)   
  
**8. Acceptable Roof Deck Constructions:**   
  
8.1 Acceptable deck types for testing under this protocol are as follows:   
  
• minimum 15/32 inch plywood or wood plank;   
  
• cementitious wood fiber;   
  
• poured gypsum concrete;   
  
• structural poured concrete;   
  
• structural concrete plank;   
  
• aggregate lightweight insulating concrete;   
  
• cellular insulating lightweight concrete;   
  
• aggregate/cellular insulating lightweight;   
  
• 18-22 gage steel;   
  
• > 22 gage steel; and   
  
• composite deck system (e.g. load master).   
  
**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.   
  
• 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.   
  
9.1.2 Place the bar with attached dial indicator such that the tip of the dial indicator is in contact with the roof membrane at the center of the test area.   
  
9.1.3 Place the assembled chamber over the roof test area such that the bar with attached dial indicator is centered within the chamber and is perpendicular to the sides of the chamber. The edges of the chamber shall be in complete contact with the roof surface. Position the chamber such that its edges are parallel with the direction of the structural framing of the building.   
  
9.1.4 Install the pressure measurement device to the uplift pressure chamber and calibrate to zero pressure.   
  
9.1.5 Position the vacuum pump over the hole provided in the chamber, insuring that the bypass valve on the pump is open before starting the pump or, if a rheostat is used, that it is in the OFF position.   
  
9.1.6 Raise the pressure within the chamber to 15 + 0.5 lbf/ft2 (720 + 20 Pa) and hold this pressure level for one minute.   
  
9.1.7 Continuously observe the deflection and pressure measurement device throughout the vacuum pumping process for sudden or variable rates of movement.   
  
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., field, perimeter or corner area) for a period of one minute. These design pressures are determined in compliance with ASCE 7, as specified in ~~Section 1609 of~~ the *Florida Building Code, Building* and are listed on Section II of the Uniform Building Permit.   
  
9.1.9 If “failure,” as defined in Section 10.1, occurs, record the applied load and time.   
  
9.2 Bell chamber test for a new roof system assembly applied directly to the substrate:   
  
9.2.1 Remove the existing roofing membrane to the deck in an area of 8 feet by 8 feet, thoroughly cleaning the deck of all existing roofing material.   
  
9.2.2 If the new assembly is to be adhered, prime the deck with ASTM D 41 primer and allow to completely dry.   
  
9.2.3 Install the proposed roof system assembly utilizing the precise materials proposed for the reroof application. Install the test assemblies in strict compliance with published application recommendations.   
  
9.2.4 Provide the testing agency with two copies of manufacturer’s literature and application instructions.   
  
9.2.5 Allow the test panel to cure for 48 hours if applied in hot asphalt or 28 days if solvent or waterbased adhesives are employed.   
  
9.2.6 Do not apply aggregate surfacing to the test assembly. If an aggregate surface or coating is to be applied to the final assembly finish the test assembly with a flood coat of asphalt at an application rate of 384 pounds ± 10 pounds.   
  
9.2.7 Seal the test assembly by strip flashing the test panel to the existing roof system assembly.   
  
9.2.7.1 If the test assembly is lower than the existing roof system assembly the test assembly area shall be filled with a loose insulation material and the test area shall be covered for the cure period.   
  
9.2.8 Testing of the panel shall be as noted in Section 9.1   
  
9.3 Bonded pull test over existing roof system assemblies:   
  
9.3.1 The test area’s membrane surface shall be clean, smooth and dry to provide a continuous contact surface for test panel adhesion.   
  
9.3.2 Cut an indentation in the center of the test area to accommodate the nut and washer on the underside of the test panel where a double plywood panel is used. Outline the test area perimeter, assign a reference number and photograph.   
  
9.3.3 Suspend the wood or wood and steel test panel, with eye-bolt or welded ring installed, from the load application apparatus and record the downward load.   
  
9.3.4 Apply a flood coat of hot steep asphalt or 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.   
  
9.3.4.1 Report any variation in cure time.   
  
9.3.4.2 The flood coat application rate may be increased for unusual conditions to ensure a complete bond of the test assembly.   
  
9.3.4.3 Report any variation in the adhesive application rate.   
  
9.3.5 Determine the required uplift force (F) to be applied using information determined in Section 9.3.3 and the following equation:

|  |  |
| --- | --- |
| *F* = *(4 by P)* + *W* | where, |

|  |  |  |
| --- | --- | --- |
| *F* | = | required uplift force (lbf); |
| *P* | = | design pressure (lbf/ft2); and |
| *W* | = | weight of test panel (lbf). |

9.3.6 When the flood coat, noted in Section 9.3.4, has fully cured, cut a 2 inch to 3 inch wide strip through the roof covering around the test panel down to deck level. The intent is to fully isolate the test sample from surrounding roofing materials.   
  
9.3.7 Position the support system over the test panel and attach the load application and measurement devices to the eye-bolt or welded ring.   
  
9.3.8 Apply an initial load of 40 lbf plus the weight of the test panel (W + 40) and hold for 1 minute. After the initial 1 minute, increase the applied load by 40 lbf increments in 1 minute time intervals until the design pressure (P) is attained, as noted in Table 2, below.   
  
**TABLE 2 APPLIED LOAD INCREMENTS**

|  |  |  |
| --- | --- | --- |
| **Load (lbf)** | **Pressure (psf)** | **Hold Time (min)** |
| W + 80 | 20 | 1 |
| W + 120 | 30 | 1 |
| W + 160 | 40 | 1 |
| W + 200 | 50 | 1 |
| F | P | 1 |

9.3.9 If “failure,” as defined in Section 10.2, occurs, record the applied load and time.   
  
**10. Interpretation of Results:**   
  
10.1 Bell chamber test:   
  
10.1.1 Most roof system assemblies subjected to a negative pressure will exhibit an upward deflection that will increase as the negative pressure increases. Poorly adhered systems will exhibit relatively large increases in upward deflections with relatively small increases in applied pressure. For roof system assemblies that are well adhered, the increase in deflection will be gradual and at a relatively constant rate up to a point at or near failure. The upward deflection may slowly increase while maintaining the pressure within the chamber. When failure occurs due to lack of adhesive or cohesive resistance of the roof system assembly, there will be a sudden increase in the upward deflection, and most likely the deflection will exceed the capacity of the dial indicator.   
  
10.1.2 Any roof system assembly which exhibits an upward deflection greater than or equal to 1 inch (25 mm) during any of the tests shall be considered as failing at the point where 1 inch (25 mm) of deflection is recorded.   
  
10.1.3 An upward deflection in excess of 1/4 inch (6 mm) or a sudden increase in deflection, as measured by the dial indicator, may indicate an attachment and/or adhesion problem in the roof system assembly and may require further investigation.   
  
10.1.4 Upward deflection of the roof system assembly due to negative pressure may vary at different locations due to varying stiffness of the roof system assembly. Stiffness of a roof system assembly is influenced by the thickness of insulation; stiffness of decking; and by the type, proximity and rigidity of connections between the decking and framing system.   
  
10.2 Bonded pull test:   
  
10.2.1 Any roof system assembly which exhibits delamination of any portion of the test sample prior to the full 1 minute duration at an applied load equal to the design load (*F*) shall be considered as failing the bonded pull test.   
  
10.2.2 If delamination occurs between the plywood test panel and the roof covering, the test panel shall be re-adhered to the test area, increasing the curing period of the hot steep asphalt coal tar pitch or such other adhesive material that may better adhere the test panel to the roof membrane.   
  
**11. Report:**   
  
11.1 Refer to ASTM E 575 for general use in reporting structural performance tests of building assemblies.   
  
11.2 For either bell chamber tests or bonded pull tests, the final report shall include the following:   
  
11.2.1 A copy of the roof system assembly manufacturer’s Product Approval, indicating the maximum design pressure for the system, product data sheets and published application instructions.   
  
11.2.2 A copy of Section II of the Uniform Building Permit for the project in question indicating design pressures for the field area, perimeter area, and if applicable, corner and extended corner areas of the structure.   
  
11.2.3 The area, height, and plan view of the roof showing the location of the test areas, numbered to correspond with the test report.   
  
11.2.4 A complete detailed description of the roof system assembly construction being tested. Include the type of steel roof deck and method of attachment, deck support spacing, vapor retarder and adhesive (if any), types and thicknesses of insulation and methods of attachment, and the type of adhered roof membrane including surfacing.   
  
11.2.5 Dates of tests, air and roof surface temperatures, wind velocity.   
  
11.2.6 Names, signatures and affiliations of all persons observing the tests.   
  
11.2.7 Photographs documenting all pertinent aspects of the test, including test assembly construction, actual testing, failure examination (if applicable), and repair procedures (if applicable).   
  
11.3 For bell chamber tests, the final report shall include the following:   
  
11.3.1 A brief description of the test procedure, including the negative pressure increments, hold times for each pressure increment and the maximum applied pressure.   
  
11.3.2 Tabulated results recorded at each pressure increment including observations and deflection measurements. Deflection shall be recorded at the start and end of each pressure increment.   
  
11.3.3 If “failure” occurs during any of the bell chamber tests, the test area shall be cut and thoroughly examined and the complete record should include:   
  
• the negative pressure at which the failure occurred;   
  
• the type of failure and its location within the roof system assembly; and,   
  
• other observations of the roof system assembly conditions that may be attributed to the failure.   
  
The cut area of roofing should be repaired after examination of the failed area or where roofing has been removed to deck level for the purpose of testing. Insulated assemblies shall be filled with like insulation prior to membrane repair.   
  
11.3.4 The attached “Bell Chamber Test Results” sheet completed in full. Make photocopies of the “Data Recording Sheet” and indicate on each sheet the “Level #” and the “Test #.”   
  
11.4 For bonded pull tests, the final report shall include the following:   
  
11.4.1 A brief description of the test procedure, including the applied load increments, hold times for each load increment, the maximum applied load and the calculated maximum applied pressure.   
  
11.4.2 Tabulated results recorded at each applied load increment including observations.   
  
11.4.3 If “failure” occurs during any of the bonded pull tests, the test area shall be cut and thoroughly examined and the complete record should include:   
  
• the applied load and calculated applied pressure at which the failure occurred;   
  
• the type of failure and its location within the roof system assembly; and   
  
• other observations of the roof system assembly conditions that may be attributed to the failure.   
  
The cut area of roofing should be repaired after examination of the failed area or where roofing has been removed to deck level for the purpose of testing. Insulated assemblies shall be filled with like insulation prior to membrane repair.   
  
11.4.4 The attached “Bonded Pull Test Results” sheet completed in full. Make photocopies of the “Data Recording Sheet” and indicate on each sheet the “Level #” and the “Test #.”

**(R7098 AS)**

**TESTING APPLICATION STANDARD (TAS) 125-03**

**STANDARD REQUIREMENTS FOR METAL ROOFING SYSTEMS**

***Modify the second bullet of Section 5.1.1 as shown:***

Deflection of structural metal roof panels shall not exceed ~~L/240~~ L/180.

**(S6611 AM)**

**TESTING APPLICATION STANDARD (TAS) 132-95 STANDARD REQUIREMENTS FOR TESTING AND APPROVAL OF SEALANTS USED IN ROOFING**

***Standard TAS 132-95. Add or modify to read as follows:***

**1. Scope:**   
  
1.1 This Protocol covers the procedures for testing of sealants used in roofing applications and the approval process for all products which have successfully met the test criteria.   
  
1.2 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.   
  
1.3 This Protocol has not been contemplated to measure the performance of the sealants in conjunction with any particular Roof System Assembly.   
  
**2. Referenced Documents:**   
  
2.1 *The Florida Building Code, Building*.   
  
2.2 *ASTM Standards*

|  |  |
| --- | --- |
| C 661 | Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer |
| C 679 | Test Method for Tack-Free Time of Elastomeric Sealants |
| C 719 | Test Method for Adhesion and Cohesion of Elastomeric joint Sealants Under Cyclic Movement |
| C 792 | Test Method for Effects of Heat Aging on Weight Loss, Cracking, and Chalking of Elastomeric Sealants |
| C 793 | Test Method for Effects of Accelerated Weathering on Elastomeric Joint Sealants |
| C 794 | Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants |
| C 1021 | Standard Practice for Laboratories Engaged in the Testing of Building Sealants |
| D 140 | Standard Practice for Sampling Bituminous Materials |
| D 412 | Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension |
| D 624 | Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers ~~Test Method for Rubber Property -Tear Resistance.~~ |
| D 1079 | Standard Definitions and Terms Relating to Roofing, Waterproofing and Bituminous Materials |
| D 1149 | Test Methods for Rubber Deterioration – Cracking in an Ozone Controlled Environment ~~Test Method for Ozone Resistance~~ |
| E 380 | Excerpts from the Standard Practice for Use of the International System of Units (SI) (the Modernized Metric System) |

D 16-14 Standard Terminology for Paint, Related Coatings, Materials, and Applications

2.3 *Application Standards*   
  
TAS 110 Standard Requirements for Physical Properties of Roof Membranes, Insulation, Coatings and Other Roofing Components.   
  
~~2.4~~ *~~Roof Consultants Institute~~*   
  
~~Glossary of Terms~~   
  
**3. Terminology:**   
  
3.1 Definitions - For definitions of terms used in this Protocol, refer to ASTM D 16 and/or ASTM D 1079 and/or Chapter 2 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 E 380.   
  
**4. Limitations and Precautions:**   
  
4.1 This Protocol may involve hazardous materials, operations and equipment. This Protocol does not purport to address all of the safety problems associated with its use. It is the responsibility of whomever uses this Protocol to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.   
  
**5. Sampling:**   
  
5.1 Unless otherwise noted in the specific ASTM Test Standard, sampling of all non-bituminous products under this Protocol shall be in compliance with ASTM C 1021. Particular reference is made to Subsection 5.2.1 of this ASTM Test Standard.   
  
**6. Materials and Manufacture:**   
  
6.1 *Composition -* Sealants shall consist of an elastomeric material that can be applied in a bead to create a homogenous sealant joint, such as, but not limited to:   
  
• one-part, low modulus, neutral-curing silicone;   
  
• one-part, architectural grade polyure-thane;   
  
• one-part, architectural grade butyl rubber sealant;   
  
• one-part, architectural grade poly sulfidel; or,   
  
• acrylic.   
  
**7. Performance Requirements:**   
  
7.1 *Physical Properties -* Sealants products used in roofing shall be in compliance with the minimum physical property requirements listed below:   
  
**PHYSICAL PROPERTY REQUIREMENTS**

|  |  |  |
| --- | --- | --- |
| **Physical Property** | **Test Standard** | **Requirement** |
| Joint Movement  Capability | C 719 | min. ± 25% |
| UV Resistance | C 793 | Good |
| Heat Aging | C 792 | Good |
| Modulus of  Elongation | D 412 | min. 50 psi |
| Tensile Strength | D 412 | min. 125 psi |
| Elongation | D 412 | min. 500% |
| Tear Strength | D 624 | min. 25 pli |
| Peel Strength | C 794 | min. 18 pli (aluminum)  min. 16 pli (concrete)  min. 18 pli (steel)  min. 20 pli (vinyl)  min. 20 pli (wood) |
| Shore “A” Hardness | C 661 | min. 30 |
| Ozone Resistance | D 1149 | Good |

7.2 *Performance -* Sealant products used in roofing shall be in compliance with the minimum performance requirements listed below:   
  
**PERFORMANCE REQUIREMENTS**

|  |  |  |
| --- | --- | --- |
| **Performance  Characteristic** | **Test  Standard** | **Requirement** |
| Shelf Life | see Section 7.2.1 | min. 1 year |
| Tool/Work Time |  | min. 20-30 minutes |
| Tack Free Time | C 679 | min. 2 hours |
| Curing Time @  77° F (25°C) |  | 2-14 days |
| Full Adhesion  Development |  | 14-21 days |

7.2.1 *Shelf Storage Life -* One tube or container of sealant shall be stored for 12 months from the date of manufacture at 77° ± 2° F (25° ± 1.1° C) and a relative humidity of 50 ± 5% and then shall be tested to determine compliance with the requirements of Section 7.2.   
  
7.2.2 Product shall be approved by the manufacturer for application in a temperature range of 40°F to 100°F (4.4°C to 37.8°C).   
  
**8. Installation:**   
  
8.1 Sealant shall be installed to create two-point adhesion and in accordance with the manufacturer’s installation instructions. Bond breakers and backer rods shall be applied in compliance with manufacturer’s instructions.   
  
**9. Packaged Material:**   
  
9.1 Packaged material shall bear a label indicating ~~certified by the manufacturer to be in~~ compliance with this specification and shall be labeled in compliance with ~~Section 1517~~ of the *Florida Building Code, Building*. Product Approval documents shall be provided to the purchaser or end user upon request.   
  
9.2 Packaging materials shall be marked by the manufacturer as required by the approval entity.~~Shipping containers shall be marked with the name of the material, stock number, lot number, year of issue and quantity therein and the name of the manufacturer or supplier.~~   
  
~~9.3 Packaging shall provide coverage for bead size, storage requirements, limitations of use, and safety precautions.   
  
9.4 Not all sealants are compatible for all roofing materials and adjoining substrates. The Sealant manufacturer shall provide a Product Data Sheet detailing applicable use and non-compatible substrates.   
  
9.4.1 Product Data Sheet shall also include detailed instructions for substrate adhesion tests.   
  
9.4.2 Product Data Sheets shall note any substrates that require primer before sealant application. Product Data Sheets shall note the name of the primer used for a specific substrate.~~  
**~~10. Rejection and Reinspection:~~**  ~~10.1 The Authority Having Jurisdiction may periodically purchase commercial quantities of the approved product for testing at Approved Testing Agencies to confirm compliance with the provisions of this Protocol. Failure to meet the minimum requirements set forth in Section 5 shall constitute grounds for rejection of the lots and suspension of the Product Approval. In cases of rejection the Authority Having Jurisdiction shall request removal of the rejected lot number(s) from commercial sale.   
  
10.2 The Authority Having Jurisdiction may, after rejection of one or more lots, require third party quality control inspection as a provision to lifting of Approval suspension.   
  
10.3 Shipping containers shall be marked with the name of the material, the stock number, lot number, quantity therein, and the name of the manufacturer or supplier.~~

**(R7099 AS)**

**TESTING APPLICATION STANDARD (TAS) 138-95 STANDARD REQUIREMENTS FOR ALUMINUM PIGMENTED EMULSIFIED ASPHALT USED AS A PROTECTIVE COATING FOR ROOFING**

***Standard TAS 138-95. Add or modify to read as follows:***

**1.Scope:**   
  
1.1 This Protocol covers aluminum pigmented emulsified asphalt suitable for application as a protective coating for built-up roofs and other exposed surfaces by brush, roller or spray application.   
  
1.2 All testing shall be conducted by an approved testing agency and all test reports shall be signed by an authorized signer of the testing agency and/or Professional Engineer.   
  
**2. Referenced Documents:**   
  
2.1 *ASTM Standards*

|  |  |
| --- | --- |
| B 209 | Specification for Aluminum and Aluminum-Alloy Sheet and Plate |
| D 16 | Terminology Relating to Paint, Varnish, Lacquer and Related Products |
| D 562 | Standard Test Method for Consistency of Paints Using the Stormer Viscometer |
| D 1079 | Definitions of Terms Relating to Roofing, Waterproofing, and Bituminous Materials |
| D 2824 | Specification for Aluminum-Pigmented Asphalt Roof Coatings |
| D 2939 | Standard Test Method of Testing Emulsified Bitumens Used as Protective Coatings |
| D 4798 | Standard Test Method for Accelerated Weathering Test Conditions and Procedures for Bituminous Materials (Xenon - ARC Method) |
| D 4799 | Standard Test Method for Accelerated Weathering Test Conditions and Procedures for Bituminous Materials (Fluorescent UV and Condensation Method) |
| E 380 | Excerpts from Standard Practice for Use of the International System of Units (SI) (the Modernized Metric System) |
| G 154 | Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials |
| G 155 | Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Nonmetallic Materials |

2.2 *The Florida Building Code, Building*   
  
~~2.3~~ *~~Roof Consultants Institute~~*~~Glossary of Terms~~   
  
**3. Terminology & Units:**   
  
3.1 Definitions - For definitions of terms used in this Protocol, refer to ASTM D 16; and/or ASTM D 1079; and/or Chapter 2 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 E 380.   
  
**4. Limitations and Precautions:**   
  
4.1 This Protocol may involve hazardous materials, operations and equipment. This Protocol does not purport to address all of the safety problems associated with its use. It is the responsibility of whomever uses this Protocol to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.   
  
4.2 The user is cautioned that aluminum pigmented emulsified asphalt may generate a reaction resulting in the evolution of Hydrogen gas. Use caution when opening containers.   
  
**5. Sampling:**   
  
5.1 Sampling shall be in compliance with requirements set forth in ASTM D 2939.   
  
**6. Materials and Manufacture:**   
  
6.1 Aluminum pigmented emulsified asphalts covered by this Protocol are of general types such as:

|  |  |  |
| --- | --- | --- |
| 6.1.1 | Type I | Nonfibrated |
| 6.1.2 | Type III | Fibrated (containing no asbestos fiber) |

6.2 *Composition -* The aluminum pigmented emulsified asphalt shall conform to composition requirements as follows:   
  
**7. Performance Requirements:**

|  |  |  |  |
| --- | --- | --- | --- |
| **COMPONENT PROPERTY** | **TEST**  **STANDARD** | **ALL TYPES** | |
| **Min.** | **Max** |
| Weight per U.S. Gallon, (lbs.) | D 2939  Section 5 | 8.4 | 10 |
| Weight per Liter, (g) | D 2939  Section 5 | 1,008 | 1,200 |
| Residue by Evaporation  (mass %) | D 2939  Section 8 | 30 | — |
| Water Content (volume %) | D 2939  Section 11 | — | 70.00 |
| Consistency, 77°F (25°C),  Krebs units (Ku) | D 562  Procedure  A or B | 50 | 125 |

7.1 Physical Properties - The aluminum pigmented emulsified asphalt shall conform to physical property requirements as follows:   
  
7.2 *Uniformity* - After a thoroughly stirred sample has stood for 72 hours at room temperature 77° ± 2.0°F (25° ± 1.1°C) the aluminum emulsion shall be of smooth, uniform consistency without separation or settlement in storage to the extent that it cannot be readily dispersed by moderate stirring.

|  |  |  |  |
| --- | --- | --- | --- |
| **PHYSICAL PROPERTY** | **REFERENCE**  **SECTION** | **ALL TYPES** | |
| **Min.** | **Max** |
| Reference, initial (%) | See Section 8.1 | 50 | — |
| Reflectance, 500 hours,  (% retained) | See Section  8.4.5 | 90 | — |
| Firm Set, (hours) | See Section | — | 24 |
| Resistance to Water | See Section 8.3 | No blistering, no  reemulsification | |

7.3 *Workability* - The aluminum pigmented emulsified asphalt shall be of suitable consistency for application above freezing by brush, roller, or suitable spray equipment without thinning with water or heating, and shall bond to either damp or dry surfaces to produce a film in which the aluminum pigment forms a bright reflective surface on smooth surfaced emulsion, sheet metal, conventional BUR and modified bitumen systems when applied according to manufacturers recommendations.   
  
7.4 Application of the aluminum pigmented emulsified asphalt shall be between 50°F (10°C) and 100°F (37.8°C) surface temperature. At temperatures above 100°F (37.8°C), a fine water mist to aid cooling of the roof surface to be coated prior to application is recommended.   
  
7.5 The product is not intended for use where ponding water conditions exist.   
  
**8. Test Methods:**   
  
8.1 *Reflectance* - Test Method D 2824, Section 8.6   
  
8.2 *Firm Set* - Test Method D 2939, Section 14   
  
8.2.1 No reference lines shall be drawn across the faces of the panel.   
  
8.2.2 Cure period shall be 24 hours.   
  
8.3 *Resistance to Water* - Test Method D 2939, Section 17, Alternative B (17.3)   
  
8.4 *Accelerated Weathering* - Test Method G 154 or G 155 ~~(Test Method A)~~  
8.4.1 Apparatus   
  
8.4.1.1 For information on the test apparatus, refer to Section 9 of this Protocol.   
  
8.4.2 Procedure   
  
8.4.2.1 Thoroughly stir the sample to homogeneity. Clean the aluminum panels with industrial grade ~~1,1,1 trichloroethane,~~ xylol, or an aliphatic solvent such as hexane followed by acetone prior to preparation of test specimens.   
  
8.4.2.2 Prepare two (2) test specimens by spreading with a spatula through masks centered over two (2) metal, aluminum or aluminum alloy panels as described in Table 2 of Specification B 209 under alloy 3003-H14. Doctor off the excess level with a flat scraper. The mask shall have openings 21/2 by 41/8 in. (63.5 by 104.8 mm). The wet film thickness of non fibrated coating shall be 0.015 in. (0.38 mm) and fibrated coating shall be 0.020 in. (0.51 mm). Allow specimens to dry 48 hours at room temperature of 75.0° ± 3.0°F (23.9° ± 1.7° C).   
  
8.4.2.3 Measure the initial percent luminous reflectance of each panel using Test Method D 2824, Section 8.6.   
  
8.4.2.4 Place the coated panels into the weatherometer ~~immediately~~ after reflectance measurements.   
  
8.4.2.5 Specimens shall always be placed in the QUV/Condensation chamber during the UV cycle.   
  
8.4.2.6 Specimens shall always be placed in the Xenon-ARC during the “Light Only Time.”   
  
8.4.3 Evaluation Test Results   
  
8.4.3.1 Inspect specimens at the end of a daily cycle during the UV period when the panels are thoroughly dry.   
  
8.4.3.2 If using Xenon-ARC Method inspect specimens at the end of a complete cycle, 24 hours, during the light only period when the panels are thoroughly dry.   
  
8.4.3.3 Periodically during, and at the conclusion of 500 hours, visually inspect specimens to determine physical changes. Accelerated weathering at 500 hours shall be as prescribed in Section 8.4, herein.   
  
8.4.3.4 Repeat reflectance measurement as in Section 8.4.2.3, herein.   
  
8.4.4 Accelerated Weathering Failures   
  
8.4.4.1 *Cracking* At no time during the exposure cycles shall the film exhibit surface cracking as determined by viewing the weathered area through a microscope at 40x magnification.   
  
8.4.4.2 *Sagging/Sliding* At no time during the exposure cycles shall the film show any signs of sagging or sliding beyond the exposed area of the draw down.   
  
8.4.4.3 *Loss of Adhesion* Adhesion to the aluminum panels shall be maintained at 100 percent during the exposure cycles.   
  
8.4.4.4 *Blisterin*g At no time during the exposure cycles shall the film exhibit development of blistering.   
  
8.4.4.5 *Loss of Reflectance* At the conclusion of 500 hours exposure, the cured film shall maintain 90 percent of initial reflectance.   
  
8.4.5 Reflectance Retained Calculation   
  
8.4.5.1 Calculate the % reflectance retained after 500 hours as follows:

|  |
| --- |
| http://floridabuilding2.iccsafe.org/app/book/content/2014_Florida/Test%20Protocols%20Code/Images/Bitmap_212.jpg |

where,

|  |  |  |
| --- | --- | --- |
| A | = | reflectance at 500 hours, and |
| B | = | initial reflectance. |

8.4.6 Report   
  
8.4.6.1 If failure occurs, ~~D~~designate the failure end point of the specimens as the exposure hours where cracking, sagging, sliding, loss of adhesion, blistering, or loss of more than 10% of initial reflectance first occurred.   
  
**9. Apparatus:**   
  
9.1 Operating light and water exposure apparatus (Fluorescent, UV Condensation Type) for Exposure of Nonmetallic Materials as described in Section 6 of Recommended Practice G 154. Unless otherwise specified, the lamps shall be UV-B lamps with a peak emission at 313 nm and a spectral energy distribution as shown in Figure X1.2 of Recommended Practice G 154.   
  
9.2 Calibration and Standardization, G 154, ~~Section 6~~.   
  
9.3 Procedure, G 154, ~~Section 9~~.   
  
9.4 Test Conditions.   
  
9.4.1 Unless otherwise specified, the apparatus shall be operated 7 days each week, two cycles per day, according to the following schedule. Each cycle shall consist of the following:

|  |  |  |
| --- | --- | --- |
| **Exposure Type** | **Hours** | **Exposure  Temperature** |
| Ultra Violet (UV) | 8 | 140.0°F ± 3°F  (60°C ± 1.7°C) |
| Condensation | 4.00 | 122.0°F ± 3°F  (50°C ± 1.7°C) |

9.5 Xenon-Arc Type as described in ~~Section 6 of Procedure of Practice~~ G 155, Test Cycle 1.   
  
**10. Package and Package Marking:**   
  
10.1 Packaged material shall bear a label indicating ~~certified by the manufacturer to be~~ in compliance with this specification and shall be labeled in compliance with Section 1517 of the *Florida Building Code, Building*. Product Approval documents shall be provided to the purchaser or end user upon request.   
  
10.2 ~~Shipping containers~~ Packaging materials shall be marked by the manufacturer as required by the approval entity ~~with the name of the material, stock number, lot number, year of issue and quantity therein and the name of the manufacturer or supplier~~.   
  
**~~11. Rejection and Reinspection:~~**  ~~11.1 The Authority Having Jurisdiction may periodically purchase commercial quantities of the approved product for testing at Approved Testing Agencies to confirm compliance with the provisions of this Protocol. Failure to meet the minimum requirements set forth in Sections 6 and 7 shall constitute grounds for rejection of the lots and suspension of the Product Approval. In cases of rejection the Authority Having Jurisdiction shall request removal of the rejected lot number(s) from commercial sale.   
  
11.2 The Authority Having Jurisdiction may, after rejection of one or more lots, require third party quality control inspection as a provision to lifting of Approval suspension.   
  
11.3 Shipping containers shall be marked with the name of the material, the stock number, lot number, quantity therein, and the name of the manufacturer or supplier.~~

**(R7100 AS)**