

## 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

#### 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 (i.e. ridge vents, static vents, turbines 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

- 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, 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 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 simu-

lated 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  $\pm 10\%$  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 cap-

ture the water. Record the flow meter reading ( $\frac{\text{gallons}}{\text{minute}}$ ) during this process.

- 7.2.3 Convert the flow meter reading ( $\frac{\text{gallons}}{\text{minute}}$ ) to rainfall simulation ( $\frac{\text{inches}}{\text{hour}}$ ) using the following formula:

$$\left[ \frac{\left( \frac{\text{gallons}}{\text{minute}} \right) \times \left( \frac{60 \text{ minutes}}{1 \text{ hour}} \right) \times \left( \frac{231 \text{ in}^3}{1 \text{ gallon}} \right)}{6,912 \text{ in}^2} \right] = \times \left( \frac{\text{inches}}{\text{hour}} \right)$$

- 7.2.4 The quantity of rainfall simulation determined in 7.2.3 shall be within  $\pm 5\%$  of the desired rainfall simulation of  $8.8 \frac{\text{inches}}{\text{hour}}$ .
- 7.2.5 Measure the volume of water ( $\text{in}^3$ ) captured and convert this to rainfall simulation ( $\frac{\text{inches}}{\text{hour}}$ ) using the following formula:

$$\left[ \frac{\left( \frac{\text{inches}^3}{6,912 \text{ inches}^2} \right)}{1 \text{ minute}} \right] \times \left( \frac{60 \text{ minutes}}{1 \text{ hour}} \right) = \left( y \frac{\text{inches}}{\text{hour}} \right)$$

- 7.2.6 The rainfall simulation determined in 7.2.3 (x) shall be within  $\pm 5\%$  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 frame 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 ( $\text{in}^3$ ) striking each square sample at the particular wind speed and flow meter setting.
- 7.3.5.1 Determine the rain simulation ( $\frac{\text{inches}}{\text{hour}}$ ) absorbed into each square sample using the following formula:

$$\left[ \frac{\left( \frac{\text{volume of water (in}^3\text{)}}{576 \text{ in}^2} \right)}{\text{time duration (hours)}} \right] = \times \left( \frac{\text{inches}}{\text{hour}} \right)$$

- 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  $15/32$  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. 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  $72 \pm 5$  in<sup>2</sup>. 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.
- 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 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 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 120°F to 135°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.

## 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.

**TABLE 1  
WINDSPEED AND WATER SPRAY INTERVALS FOR  
WIND DRIVEN RAIN RESISTANCE TESTING**

Interval #	Wind Speed (mph)	Time (min)	Water Spray
1	35	15	on
2	0	5	off
3	70	15	on
4	0	5	off
5	90	15	on
6	0	5	off
7	110	5	on
8	0	5	off

<sup>1</sup> 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.

TABLE 2 WINDSPEED INTERVALS FOR INCREASED WIND RESISTANCE TESTING OF STATIC VENTS, TURBINES <sup>1</sup> OR POWERED VENTS			
Interval #	Wind Speed (mph)	Time (min)	Water Spray <sup>2</sup>
1	110	1	off
2	115	1	off
3	120	1	off
4	125	1	off
5	130	1	off
6	135	1	off
7	140	1	off

<sup>1</sup> If the ventilator is a turbine vent, the turbine unit shall have been replaced with a storm cap subsequent to completion of Interval #3 in Table 1 or, if the increased wind resistance test is performed separately from the wind driven rain test, the “storm cap” shall be installed prior to test commencement.

<sup>2</sup> 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.

**11. Interpretation of Results**

**11.1 Wind-Driven Rain Testing**

11.1.1 For ridge vents installed directly over a ridge opening, successful completion of the test procedures outlined in Section 10.3 approves the product for installation up to and including a height of 75 feet.

11.1.2 For static vents, turbines or powered vents, which protrude from the roof level, successful completion of the test procedures outlined in Section 10.3 approves the product for installation up to and including a height of 33 feet.

**11.2 Increased Windspeed Testing**

11.2.1 For static vents, turbines, or powered vents, which protrude from the roof level and meet the size limitations set forth in Section 10.4.1, successful completion of windspeed increments noted in Table 2 relate to approval for product installation up to and including the heights noted in Table 3, below.

<b>Wind Speed (mph)</b>	<b>Height (feet)</b>
115	40
120	47
125	54
130	61
135	68
140	75

11.3 Maximum height of installation shall be noted in the product manufacturer's Roofing Component Product Approval based on testing in compliance with this Protocol.

11.4 Proposed installation of approved ventilation products over a height of 75 feet shall be based on written Approval from the Authority having Jurisdiction.

**12. Report**

12.1 The final test report shall include the following:

12.1.1 A description of the discontinuous roof system, including the manufacturer and type of underlayment; the manufacturer and type of prepared roof covering; the manufacturer, type and model number (if any) of the soffit ventilation; the manufacturer, type and model number (if any) of the ridge area ventilation system or ventilation unit; and the slope(s) at which the system was tested.

12.1.2 A detailed report of the method of construction, including a sketch of the test specimen; certification by a Professional Engineer or Registered Roof Consultant that the test specimen was constructed in compliance with the specifications of this Protocol and the manufacturers published application instructions, and, a copy of the published application instructions provided by the ridge area ventilation system or ventilation unit manufacturer.

12.1.3 A description of the method of conditioning used.

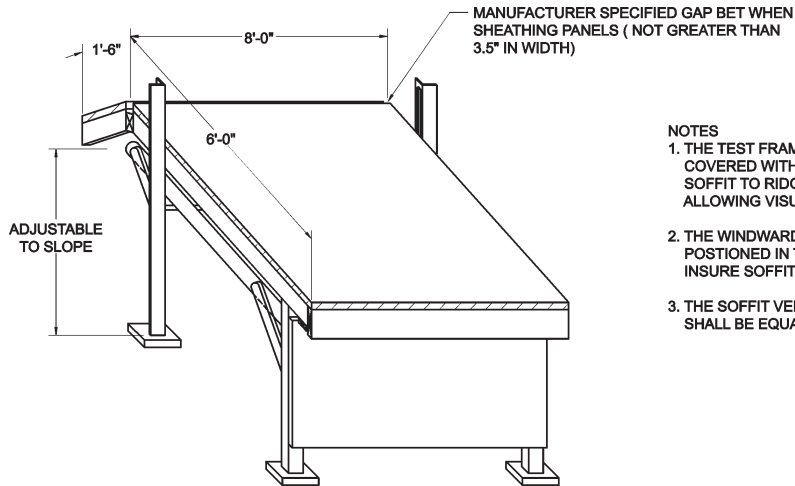
12.1.4 For Wind Driven Rain Testing

12.1.4.1 A description of the absorptive material used during the water distribution check. All windstream calibration data,

simulated rainfall and flow meter calibration data and calculations, and water distribution data and calculations.

- 12.1.4.2 Photographs of the underside of the soffit ventilation and ridge area ventilation system or ventilation unit immediately prior and subsequent to commencement and termination of testing, respectively. Also include photographs of any visible, unusual occurrences at the soffit ventilation and ridge area ventilation or ventilation unit during the test.
- 12.1.4.3 Detailed observations of any water infiltration through the soffit ventilation and/or the ridge area ventilation system or ventilation unit and approximate times and locations of water infiltration.
- 12.1.4.4 The total volume of water (if any) which infiltrated the soffit ventilation and/or the ridge area ventilation system or ventilation unit.
- 12.1.4.5 The calculated percentage of water which infiltrated the ridge area ventilation system or ventilation unit based on the total amount of water sprayed at the test deck.
- 12.1.4.6 Any test specimen which exhibits water infiltration through the ridge area ventilation system or ventilation unit in excess of 0.05% of the total water sprayed at the test deck shall be considered as failing the wind driven rain test.
- 12.1.5 Increased Windspeed Resistance Testing - Report shall include all requirements noted in Section 11.1.4 if the increased windspeed resistance testing is performed as a continuation of wind driven rain testing. If the increased windspeed resistance testing is performed as a separate test, only the following need be reported.
  - 12.1.5.1 All windstream calibration data.
  - 12.1.5.2 A description of any occurrences at the ventilation unit and to the discontinuous roof system during each wind speed interval.
  - 12.1.5.3 Photographs of the ventilation unit immediately prior and subsequent to commencement and termination of testing, respectively. Also include photographs of any visible, unusual occurrences at the ventilation unit during the test.
  - 12.1.5.4 A video record of the test intervals noted in Table 2.
  - 12.1.5.5 The windspeed interval, and time therein, at which damage (if any) leading to test termination occurred and a description and photographic record of the damage.





- NOTES
1. THE TEST FRAME UNDERSIDE SHALL BE COVERED WITH PLEXIGLASS TO INSURE SOFFIT TO RIDGE AIRFLOW WHILE STILL ALLOWING VISUAL INSPECTION OF UNDERSIDE
  2. THE WINDWARD EAVE EDGE SHALL BE POSITIONED IN THE WINDSTREAM TO INSURE SOFFIT TO RIDGE AIRFLOW
  3. THE SOFFIT VENTILATION NET FREE AREA SHALL BE EQUAL TO 72 +/- 5 SQ. IN.

FIGURE 1A  
WIND DRIVEN RAIN TEST FRAME, FRONT VIEW

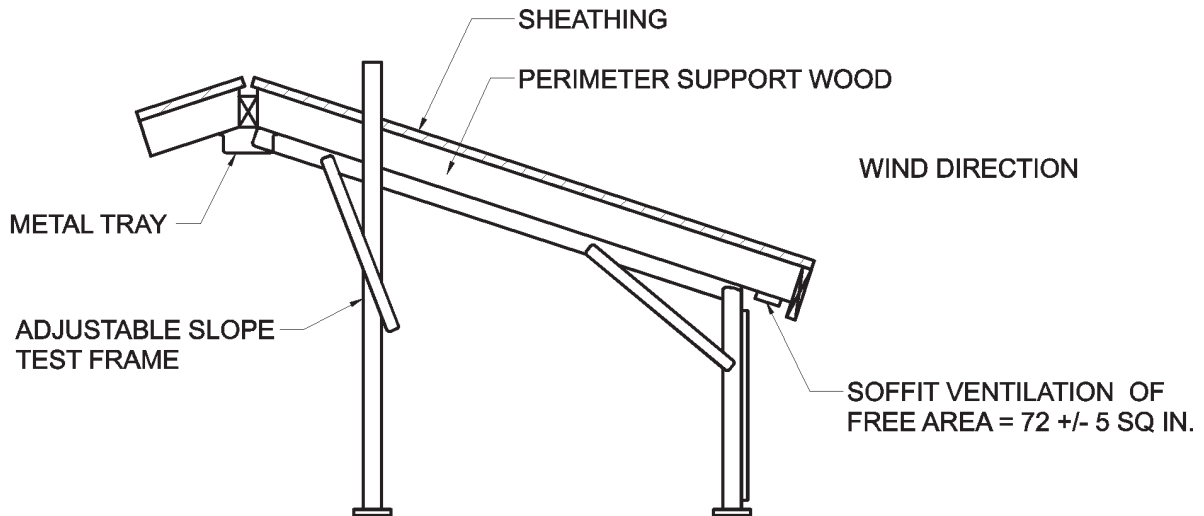


FIGURE 1B  
WIND DRIVEN RAIN TEST FRAME, SIDE VIEW

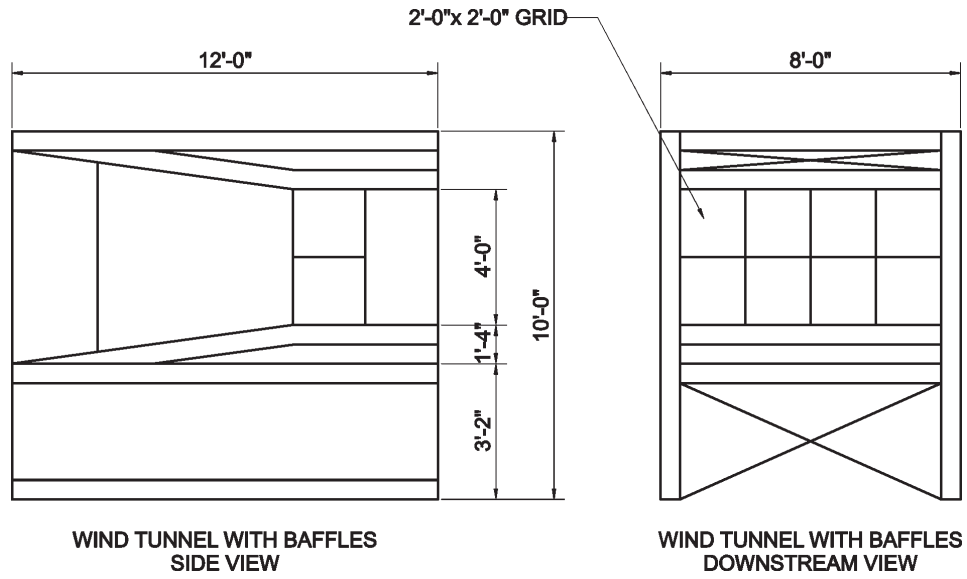


FIGURE 2  
WIND DRIVEN RAIN WIND TUNNEL