STANDARD

ANSI/AMCA Standard 550-22

Test Method for High Velocity Wind Driven Rain Resistant Louvers

An American National Standard
Approved by ANSI on April 13, 2022

ANSI Accredited Standards Developer

Air Movement and Control Association International

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Test Method for High Velocity Wind Driven Rain Resistant Louvers

1. Purpose

This standard establishes uniform laboratory test methods and performance requirements for water rejection capabilities of louvers intended to be used in high velocity wind driven rain conditions.

2. Scope

Tests conducted in accordance with the requirements of this standard are intended to demonstrate the acceptability of the louver in which water infiltration must be kept to manageable amounts during a high velocity wind driven rain event. Passing this test keeps water infiltration to manageable amounts of water. Design considerations behind these louvers should include provisions for collecting and draining the water as well as proper waterproofing of all materials and equipment that reside behind these louvers. The test specimen can be approved in either an open or closed position as stated in Section 6.

3. Informative References

ANSI/AMCA Standard 500-L-12 (Rev. 2015), Laboratory Methods of Testing Louvers for Rating, Air Movement and Control Association International Inc., Arlington Heights, IL, USA

4. Definitions

4.1 Louver

A device comprised of multiple blades. When mounted in an opening, a louver permits airflow but inhibits the entrance of other elements.

4.2 Specimen

A representative sample of the louver model design, intended to evaluate the water rejection capability of the louver model.

4.3 Performance variables

4.3.1 Water infiltration
The amount of water passing through a louver during the test.

4.3.2 Wind-stream velocity
The movement rate of air generated during the test.

5. Units of Measurement

5.1 System of units

The International System of Units (*Le Systéme International d'Unités* or SI units) are the primary units employed in this standard, with inch-pound (I-P) units given as the secondary reference. SI units are based on the fundamental values of the International Bureau of Weights and Measures, and I-P values are based on the values of the National Institute of Standards and Technology, which are, in turn, based on the values of the International Bureau.

5.2 Basic units

The SI unit of length is the meter (m) or millimeter (mm); the I-P unit of length is the foot (ft) or the inch (in.). The SI unit of mass is the kilogram (kg); the I-P unit of mass is the pound mass (lbm). The unit of time is either the minute (min) or the second (s). The SI unit of temperature is either the degree Celsius (°C) or kelvin (K); the I-P unit of temperature is either the degree Fahrenheit (°F) or the degree Rankine (°R).

5.3 Airflow rate and velocity

5.3.1 Airflow rate

The SI unit of volumetric airflow rate is the cubic meter per second (m^3/s); the I-P unit of volumetric flow rate is the cubic foot per minute (cfm).

5.3.2 Airflow velocity

The SI unit of airflow velocity is the meter per second (m/s); the I-P unit of airflow velocity is the foot per minute (fpm).

5.4 Water flow rate

The SI unit of liquid volume is the liter (L); the I-P unit of liquid volume is the gallon (gal). The SI unit of liquid flow rate is the liter per second (L/s); the I-P unit is the gallon per minute (gpm).

5.5 Dimensionless groups

Various dimensionless quantities appear in the text. Any consistent system of units may be employed to evaluate these quantities unless a numerical factor is included, in which case units must be as specified.

5.6 Physical constants

The density of distilled water at saturation pressure shall be taken as 998.278 kg/m^3 (62.3205 lbm/ft^3) at 20°C (68°F). The density of mercury at saturation pressure shall be taken at 13,595.1 kg/m^3 (848.714 lbm/ft^3) at 0°C (32°F). The specific weights in kg/m^3 (lbm/ft^3) of these fluids under standard gravity in a vacuum are numerically equal to their densities at corresponding temperatures.

6. Test Specimen

One 1,000 mm x 1,000 mm (39.37 in. x 39.37 in.) core area louver test specimen—as defined in ANSI/AMCA Standard 500-L—shall be submitted for this high velocity wind driven rain test.

Test specimens shall be as built, unpainted, clean, degreased and without additional factory-applied coating on the specimens' surfaces that would enhance water shedding capability. All devices tested shall be without a screen across the air passages of the louver.

The test specimen is any fixed, operable, or combination (fixed and operable) blade louver. The test specimen also may have the following devices attached directly or indirectly to the louver during testing and all are considered part of the test specimen: additional louver(s), damper(s) and sleeves. Sill pan(s)/flashing(s) may be used during testing and are considered part of the test specimen. All types of seals on items, such as blades, jambs, head/sill, blade stops and caulking, are considered part of the test specimen, excluding sealing between the test specimen and test wall.

Items such as an actuator, lever arm, manual operating lever and/or turnbuckle used to keep operable louver/damper blades in the open/closed position are allowed during testing, and these items are considered part of the test specimen.

When all blades are in the full open position, the horizontal distance between blades of any device and adjacent louver/device shall not exceed 76.2 mm (3 in.). The back of the test specimen's frame/sleeve shall be at least 610 mm (24 in.) from the back of the test chamber. The exterior face of the test louver must be flush with the test frame per Figure 1.

6.1 Compliance of other sizes and variations

Manufacturing of sizes other than that which was tested shall utilize the same assembly methods of construction as it pertains to fasteners (e.g., types, sizes and spacing). The distances between components/devices shall be the same as the test specimen.

Testing of the louver specimen per this standard does not guarantee an equivalent test result for other sizes.

The pass/fail compliance of a louver model only applies to the specific test specimen setup. Therefore, alternate designs, components, devices, etc. (with the exception of actuators, lever arms, manual operating levers and/or turnbuckles used to keep an operable louver/damper blades in the open/closed position) to a previously tested louver model will require an additional complete test to this standard. Additions to the specific test specimen setup, such as bird or insect screens, blank-offs or security bars, do not void the compliance of a louver model.

7. Apparatus

7.1 Test frame

7.1.1 Test frame size

The test frame shall be constructed with a minimum size of 2.45 m x 2.45 m (8 ft x 8 ft) and a hole as shown in Figure 2 to allow the insertion of the louver.

A catch basin shall be constructed behind the louver, as shown in Figure 2, to catch the water that penetrates the louver.

7.1.2 Test frame finish

The test frame shall be painted to prevent water from penetrating the test apparatus.

7.1.3 Test frame support

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

7.2 Wind generator

7.2.1 Wind generator profile

The wind generator shall provide a constant wind profile over the entire face of the louver for the specified time period to a maximum wind stream velocity of 49 m/s (110 mph).

7.2.2 Wind generator baffles

If the wind generator is unable to provide the required constant profile as determined by wind stream calibration (Section 8.1), airflow from the wind generator shall be directed and smoothed by suitably shaped baffles (see Figure 2).

7.2.3 Wind generator device

The wind generator shall be a propeller, blade or centrifugal-style device and shall be driven by a piston engine or electric motor. Combustion jet engines (turboprop, turbofan, turboshaft or ramjet) shall not be used due to the amount of heat being applied to the air stream and test specimen.

7.3 Water supply

7.3.1 Water supply system

Water shall be supplied to the wind stream in a single vertical plane, per Figure 2, using a sprinkle pipe system mounted on a movable frame capable of simulating uniform rainfall of 16.6 L/min (4.39 gal/min) ±5% over the test specimen. Water distribution shall be calibrated as noted in Section 8.2.

Note: Reference Annex A for a conversion of flow meter reading to rainfall simulation intensity rate.

8. Calibration

8.1 Wind stream calibration

8.1.1 Grid square location
Grid squares as shown in Figure 3 shall be located on an imaginary vertical plane located 610 mm (24 in.) in front of the test frame (without the test specimen in place) with the lower 1.22 m (4 ft) dimension in line with the bottom edge of the test frame opening, and the vertical centerline in line with the vertical centerline of the test specimen. Grid squares shall have dimensions of 610 mm x 610 mm (24 in. x 24 in.). It is at the discretion of the test lab to conduct wind stream calibration with or without the test frame in place. If calibration is performed without the test frame, the test frame shall be placed 610 mm (24 in.) from the imaginary vertical plane for the specimen test.

8.1.2 Wind stream velocity measurement
The wind stream velocity shall be measured within each grid square, at any one point within a 457 mm (18 in.) diameter circle with the center point of each circle located at the center point of each grid square as shown in Figure 3. The measured wind stream velocity within each grid square shall not be more than ±10% of the required wind stream velocity as determined by Annex B.

8.1.3 Calibration settings
After the wind generator is calibrated for the needed wind stream velocities, the noted settings shall be used without modification until the next required calibration. Therefore, slight changes in air density (due to changes in temperature, relative humidity and atmospheric pressure) from the time of calibration to the time of testing shall be ignored.

8.1.4 Test frame to wind generator distances
Upon completion of the wind stream calibration, the distance from the test frame to the outlet of the wind generator and any necessary baffle configurations shall be noted and maintained while conducting the test as described in Section 9. These dimensions shall be noted in the test report under calibration data and calculations.

8.2 Water distribution calibration

A maximum of six months prior to conducting the test, the water distribution over the (1.22 m wide x 1.22 m high [4 ft wide x 4 ft high]) wall surface shall be calibrated using the method outlined herein. The water distribution system must introduce water into the wind stream so that it strikes the wall area.

The absorptive material (e.g., sorbent pad) should have a minimum absorptive capacity of 3.0 L/m^2 (0.074 gal/ft^2).

8.2.1 Absorptive material preparation
Prepare four 610 mm (24 in.) squares of the absorptive material (e.g., sorbent pad) and weigh each sample.

8.2.2 Absorptive material positioning
Lay out the four numbered squares of absorptive material (e.g., sorbent pad) as shown in Figure 4.

8.2.3 Wind and water introduction
Set the wind speed to 15.65 m/s (35 mph) and add water to the wind stream as indicated on the flow meter equal to 16.6 L/min (4.39 gal/min) ±5%, until the absorptive pad material is wetted between 25-75% of its capacity, at which time the wind and water flow shall be terminated. The duration of the spray time must be noted in the report.

8.2.4 Water weight determination
Remove squares from the wall and rapidly weigh the squares of wet absorptive material. Determine the weight of water absorbed by each square sample at the particular wind speed and flow meter setting. Calculate the average weight of water absorbed by the four square samples.

8.2.5 Water absorption tolerance
The weight of water absorbed by each individual square sample must be no more than +/-25% of the average weight of water absorbed by the four square samples. If this tolerance is not met, the water supply equipment must be adjusted and the water distribution calibration performed until satisfactory results are obtained. The configuration of the water supply equipment shall be noted and maintained while conducting the test as described in Section 9. The following information shall be recorded:

- Manufacturer name and part number of the absorptive material used
- Weight of each square, before and after being wetted
- Weight of water absorbed by each square
- Distance between the spray nozzles and the test frame
- Distance between the wind generator and the test frame
- Time being sprayed
- Wind speed
- Flow meter reading

8.2.6 Additional wind speed requirement

Repeat the steps in Sections 8.2.1-8.2.5 at a wind speed of 31.3 m/s (70 mph).

8.3 Instruments

Instruments used in this test shall be calibrated, by means of the manufacturer's specifications, a maximum of 12 months prior to conducting the test. The flow meter shall have an accuracy of not greater than 1%, and the weight scale shall have a readability (display resolution) of not greater than 0.02 kg (0.05 lb).

9. Test Procedures

9.1 Louver mounting

The louver to be tested shall be mounted and sealed as recommended by the manufacturer in the test frame to prevent any ingress of water other than through the louver blades.

9.2 Intervals

The wind stream velocity intervals shall be conducted as noted in Table 1.

9.3 Water addition

Water shall be added to the wind stream upon commencement of the initial wind stream velocity in an even spray at a rate equal to 16.6 L/min (4.39 gal./min) ±5%. Water flow shall be stopped and started in conjunction with the airflow intervals noted in Table 1.

9.4 Water collection

The water penetrating the louver shall be collected and measured at the end of intervals 2, 4, 6 and 8.

Table 1 — Wind Stream Velocity and Water Spray Intervals for High Velocity Wind Driven Rain Resistance Testing

Interval No.	Wind Speed m/s (mph)	Time minutes	Water Spray
1	15.6 (35)	15	On
2	0 (0)	5	Off
3	31.3 (70)	15	On
4	0 (0)	5	Off
5	40.2 (90)	15	On
6	0 (0)	5	Off
7	49.2 (110)	5	On
8	0 (0)	5	Off

10. Report and Results of Test

The test report shall be submitted in its entirety and shall include, at a minimum, the following:

1. Date of test, date of report and a unique identification number; the identification number shall be printed on each page
2. The name(s) of the author of the report
3. A record of the:
    a. Name and location of the facility performing the test and the name and address of the requester of the test
    b. Names of the individuals performing the test and any witnesses
4. Consecutive page numbers, with an indication of the total number of pages
5. The test standard designation, including the date of issue, and an explanation detailing any deviation from the standard
6. The test report shall be signed and sealed by a registered Professional Engineer employed or contracted by the testing laboratory
7. A description of the louver, including:
    a. Model number
    b. Any drawings and photographs of the louver
    c. A detailed report of the method of installation (including fasteners and caulk)
    d. If there is a damper or operable blade louver (if so, the position of operable blades shall be listed as fully open or fully closed)
    e. Any other items, such as a sill pan/flashing, including detailed dimensions and descriptions
    f. If used, a description of the component used to keep operable blades fully closed
8. Detailed drawings of the test specimen, showing dimensioned section profiles (including blade spacing), blade to frame connection details, frame-to-frame connection details (corners), fasteners and any other pertinent construction details
9. Any deviation from the drawings or any modifications made to the test specimen to obtain the reported values, which shall be noted on the drawings and in the report

   Note: The following items (items 10 -12) on the manufacturer-supplied drawing should be checked against the test specimen. Unverifiable items from this list must be documented in the report.

10. Full sample:
    a. Louver overall width
    b. Louver overall height
    c. Louver depth
    d. Blade spacing
    e. Number of blades
11. For head frame, jamb frame, sill, blades and other components, verify:
    a. Material (aluminum components are aluminum, steel components are steel, etc. Checking chemical composition is not necessary)
    b. Width of component
    c. Depth of component
    d. Thickness of component (check two locations on the component)
    e. Features and shape of component visually matches drawing
12. For connection details, verify:
    a. Blade-to-frame connections
    b. Sill-to-jamb connections

    c. Head-to-jamb connections
       (Verification shall consist of visually inspecting weld sizes and lengths and inspecting fastener diameters and lengths.)
    d. Other connections shown on manufacturer's drawings

13. Calibration data and calculations
    a. A calibration record of all instruments used shall be reported
    b. For the water distribution calibration record:
        i. Manufacturer name and part number of the type of absorptive material used
        ii. Weight of each square, before and after being wetted
        iii. Weight of water absorbed by each square
        iv. Distance between the spray nozzles and the test frame
        v. Distance between the wind generator/funnel discharge plane and the test frame
        vi. Time being sprayed
        vii. Wind speed
        viii. Flow meter reading
14. Detailed observations of any water infiltration. Observations should include the total volume of water that infiltrated the louver at each test speed.
15. The calculated percentage of water that infiltrated the louver based on the total amount of water sprayed. Total amount of water sprayed is calculated by converting the flow meter reading to liquid volume (i.e., converting a flow meter reading of gallons per minute to ounces of water is X gal./min * 128 oz/gal. * 50 min).
16. A determination of "pass—fully open," "pass—fully closed" or "fail" based on whether the test specimen exhibits water infiltration in excess of 1.00% (percentage rounded to two decimal places) of the total water sprayed.
17. A statement that the laboratory is in possession of a video recording of the test intervals (see Table 1). The video recording shall be retained by the laboratory for a minimum period of five years from the test report date.
18. Photographs of the front and rear of the louver after the test. Photographs can show a louver mounted or unmounted in the chamber opening.
19. All data not required herein but useful to a better understanding of the test results, conclusions or recommendations appended to the report.

11. Figures

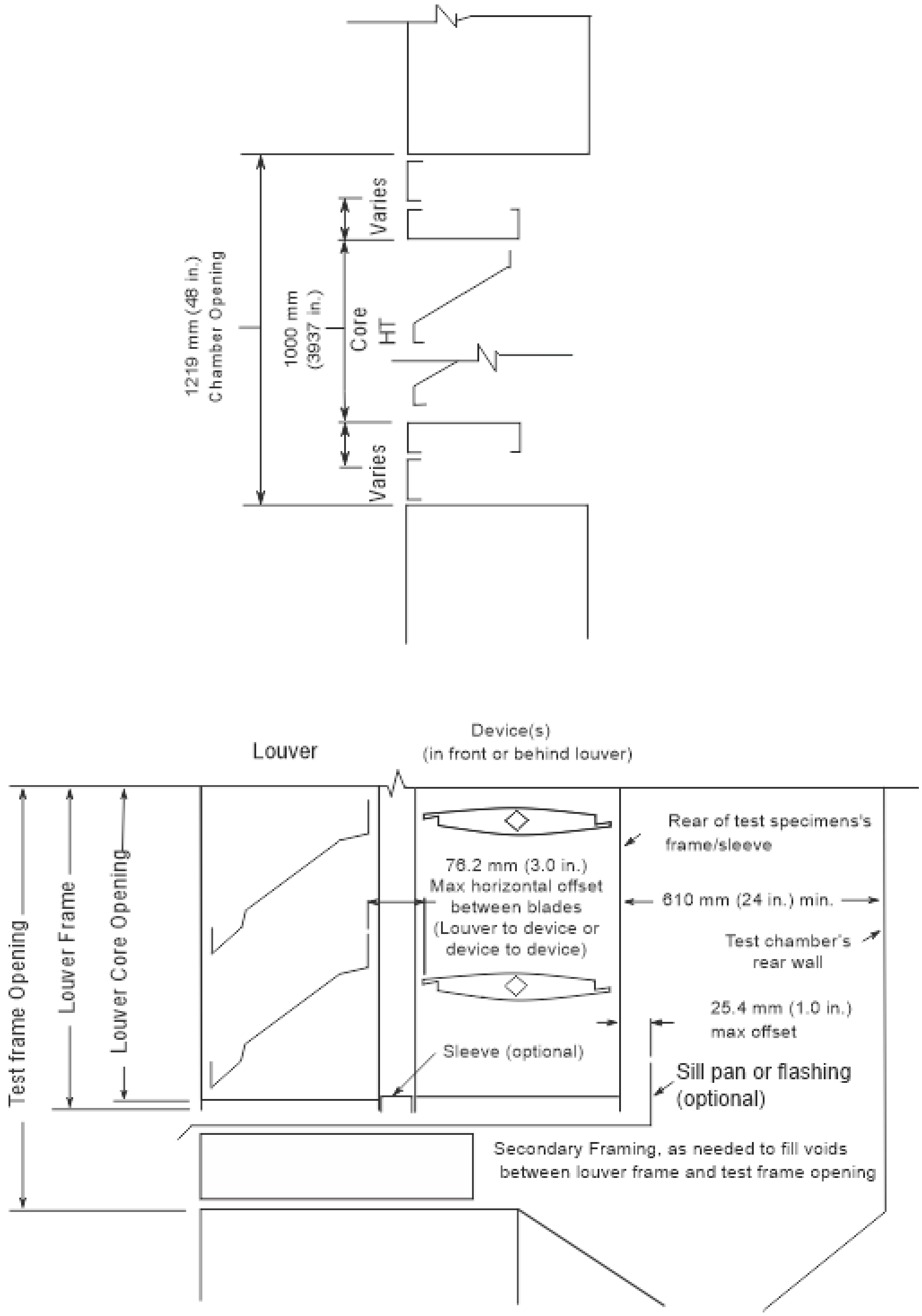


Figure 1 — Louver Setup

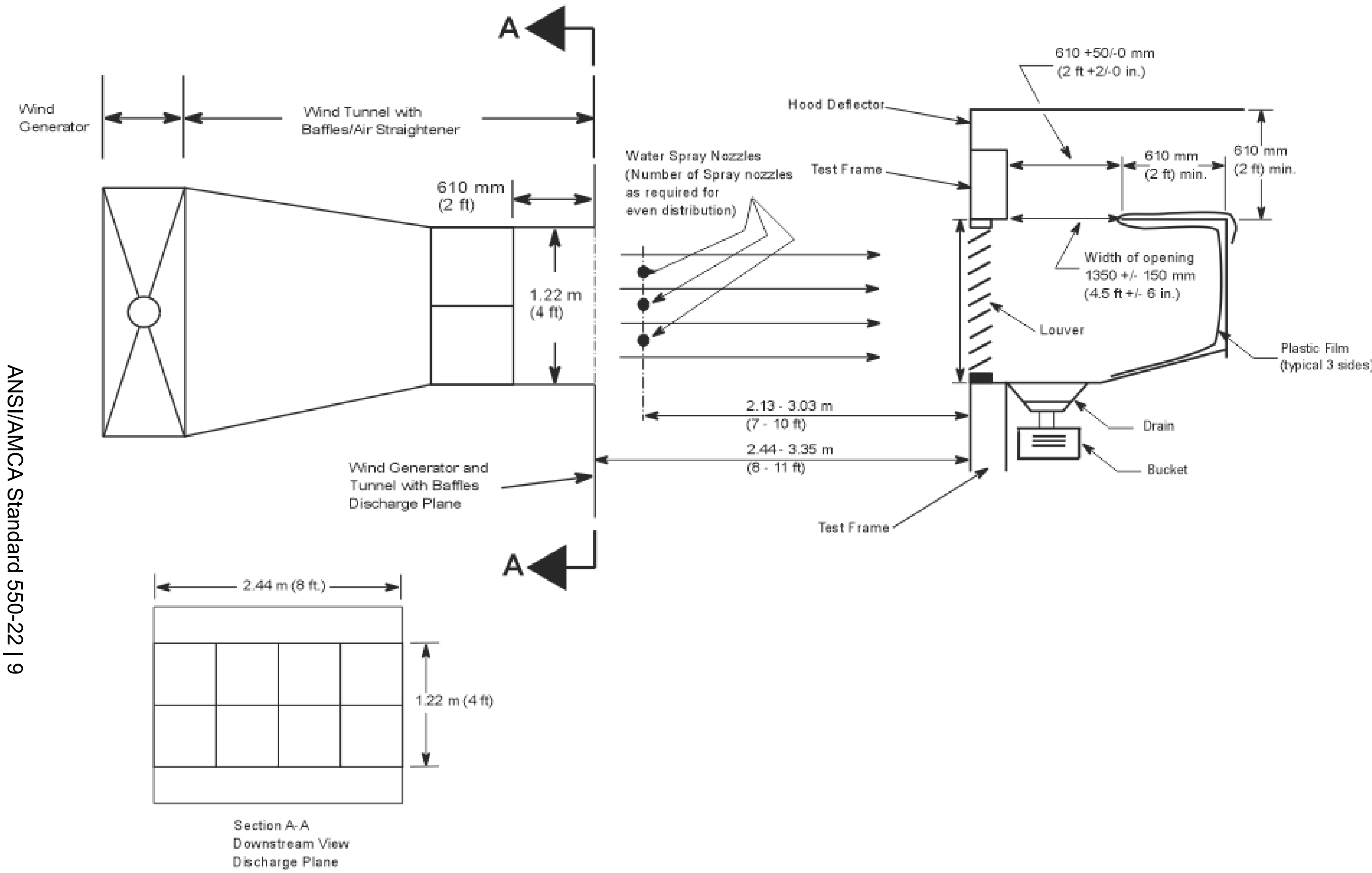
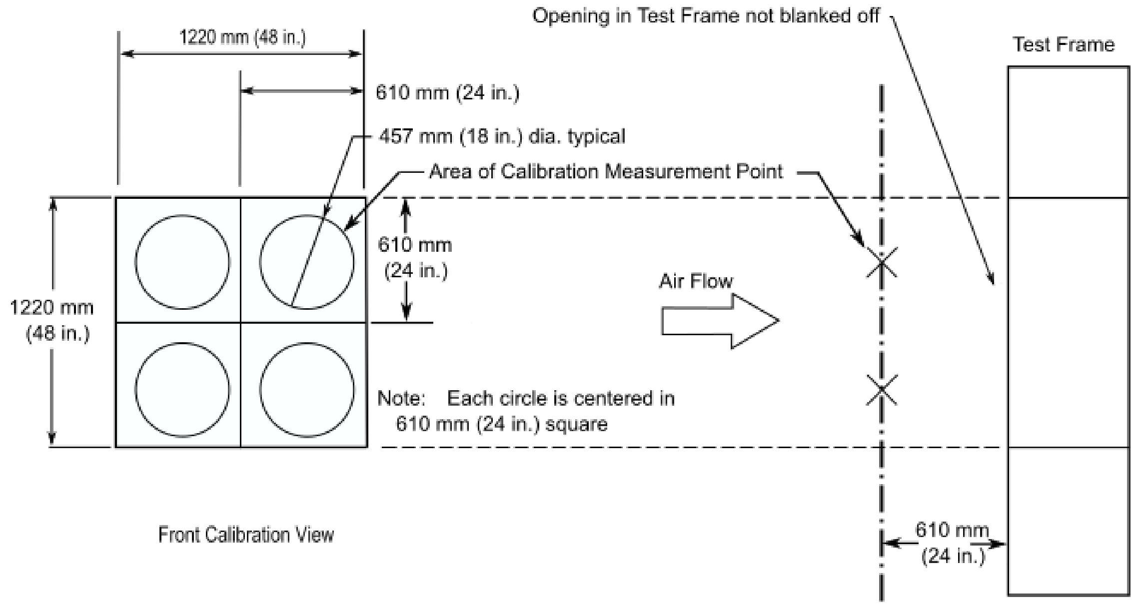


Image adapted from Checklist #0240 for the Approval of: Louvers (Includes Gable End Louvers), Department of Regulatory and Economic Resources, Miami-Dade County, FL, USA

Figure 2 – High Velocity Wind Driven Rain Test Setup



Note:
It is at the discretion of the test lab to conduct wind stream calibration with or without the test frame in place. If performed without the test frame the test frame must be set back 610 mm (24 in.) from the imaginary vertical plane during the test as mentioned in Section 7.1.1.

Figure 3 – Wind Stream Calibration Setup

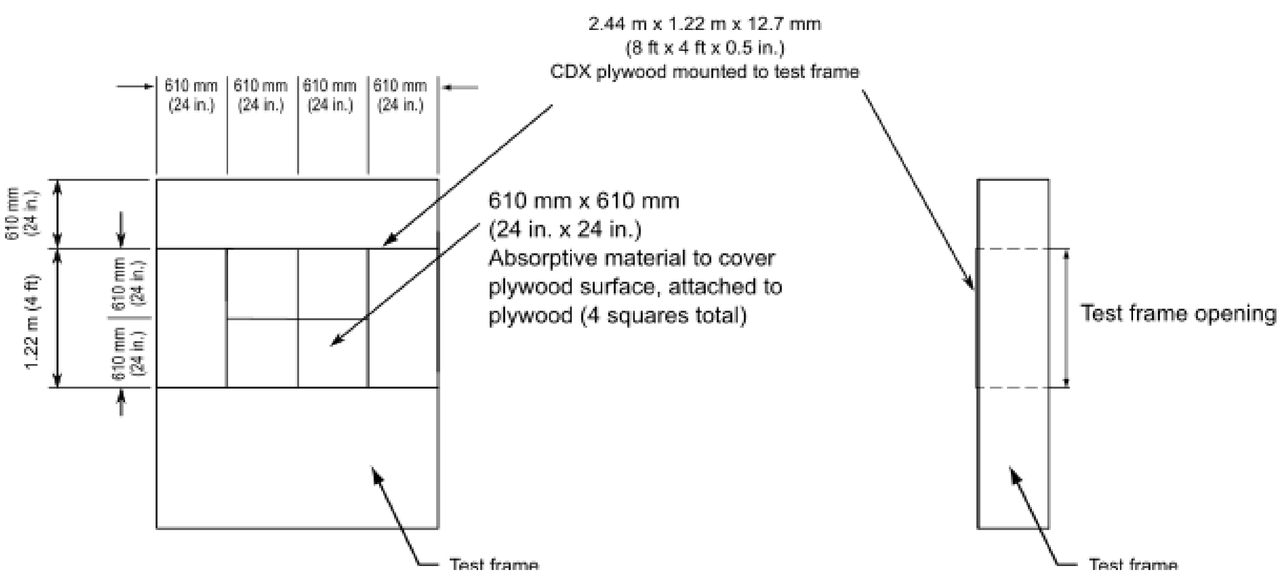


Figure 4 — Water Distribution Calibration Setup

Annex A
Conversion of Flow Meter Reading to Rainfall Simulation (Informative)

To convert the flow meter reading to rainfall simulation, use the following formula:

$$\left(\frac{\left(\frac{L}{min}\right) \times \left(\frac{60\ min}{1\ hr}\right) \times \left(\frac{1{,}000{,}000\ mm^3}{L}\right)}{4{,}459{,}346\ \mathrm{mm}^2}\right) = x\left(\frac{mm}{hour}\right) \quad \text{SI} \quad \text{Eq. A.1}$$

$$\left(\frac{\left(\frac{gal.}{min}\right) \times \left(\frac{60\ min}{1\ hr}\right) \times \left(\frac{231\ in.^3}{1\ gal.}\right)}{6{,}912\ \mathrm{in.}^2}\right) = x\left(\frac{in.}{hour}\right) \quad \text{I-P} \quad \text{Eq. A.2}$$

The target rainfall intensity is 223.5 mm/hr (8.8 in./hr).

Note:
For Equation A.1, SI, and Equation A.1, I-P, 4,459,346 mm^2 and 6,912 $in.^2$ (48 ft^2) refer to the expected projection area of the water that hits the wall.

Annex B
Wind Stream Velocity Tolerance Ranges (Normative)

Table B.1 provides the ±10% allowable tolerance range limits of the wind generator apparatus for each required wind stream velocity calibration.

Table B.1 — Wind Stream Velocity Tolerance Ranges

Wind Stream Velocity (*V*) m/s (mph)	±10% Allowable Range of Wind Stream Velocity (*V*) (anemometer)		Wind Stream Velocity Range Converted to a Pressure Drop (ΔP) Range (pitot tube)		
	m/s	(mph)	Pa	(in. of water)	(lb/ft^2)
15.6 (35)	14.0 – 17.2	(31.5 – 38.5)	120 – 181	(0.48 – 0.73)	(2.51 – 3.78)
31.3 (70)	28.2 – 34.4	(63.0 – 77.0)	487 – 725	(1.96 – 2.91)	(10.17 – 15.14)
40.2 (90)	36.2 – 44.2	(81.1 – 99.0)	803 – 1,198	(3.22 – 4.81)	(16.77 – 25.02)
49.2 (110)	44.3 – 54.1	(99.0 – 121.0)	1203 – 1794	(4.83 – 7.20)	(25.13 – 37.47)

Table B.1 pressure drop (ΔP) values use a conservative ground elevation factor (K_e) of 1.0, which represents a calibration test performed at sea level. The ground elevation factor shall be 1.0 for all elevations, or calculated using the actual elevation above sea level (*h*) of the wind generator apparatus at the time of calibration. Using a calculated ground elevation factor will adjust a calculated pressure drop value to account for the change in air density at the new elevation verses the air density at sea level.

Wind stream velocity measurement devices are allowed to assume that conditions at the time of calibration and at the time of testing are as follows; an elevation above sea level of 0 meters (ft), a sea level atmospheric pressure of 101.325 kPa (0.0765 lbm/ft^2), an air temperature of 15 °C (59 °F), and a relative humidity of 0%. All of these values result in an air density of 1.225 kg/m^3 (0.0765 lbm/ft^3), which can also be assumed at the time of calibration. The above conditions produce a conservative test setup, and/or match typical industry accepted values. However, actual condition values can be used during calibration if desired. If Table B.1 pressure drop range values are not used, then the pressure drop produced by a wind stream velocity shall be calculated by:

$$\Delta P = \left(0.613\ \frac{Pa-s^2}{m^2}\right) * K_e * V^2 \qquad \text{SI} \qquad \text{Eq. B.1}$$

$$\Delta P = \left(0.00256\ \frac{lb-hr^2}{ft^2-miles^2}\right) * K_e * V^2 \qquad \text{I-P} \qquad \text{Eq. B.2}$$

Where:
ΔP = pressure drop, change in pressure from ambient atmospheric pressure, Pa (lb/ft^2)
V = wind stream velocity, m/s (mph)
K_e = ground elevation factor, unitless

The ground elevation factor (K_e) is calculated by:

$$K_e = e^{-0.000119*h} \qquad \text{SI} \qquad \text{Eq. B.3}$$

$$K_e = e^{-0.0000362*h} \qquad \text{I-P} \qquad \text{Eq. B.4}$$

Where:
h = elevation above sea level of the calibration test, m (ft)

Note that K_e is a unitless number even though meters (feet) is used in calculating its value. The value used for elevation above sea level (h) can be approximated, but shall not be more than 200 m (656 ft) above the actual elevation. Any elevation below the actual elevation shall be allowed.

The below conversions shall be used as needed:

1 Pa = 0.0040146 in. of water
1 Pa = 0.0208854 lb/ft^2

Annex C

Example Report of Results (Informative)

Wind and Water Spray Settings				Water Sprayed		Water Collected		
Interval #	Wind Speed m/s (mph) [1]	Duration (minutes)	Water Spray	L	gal	kg	lb	Detailed Observations of Water Infiltration
1	15.6 (35)	15	On	250.63	66.21	0.03	0.07	Intermittant drops through blades.
2	0	5	Off					
3	31.3 (70)	15	On	254.30	67.18	0.20	0.45	Intermittant drops through blades.
4	0	5	Off					
5	40.2 (90)	15	On	249.19	65.83	2.54	5.61	Intermittant drops through blades.
6	0	5	Off					
7	49.2 (110)	5	On	83.85	22.15	2.17	4.78	Intermittant drops through blades and some water splash over sill.
8	0	5	Off					
			Overall Total	837.97	221.37	4.94	10.91	
				Total Water Collected		4.95 L (1.31 gal)		
				Water Infiltration (%)		**0.59%**		
				PASS / FAIL (Pass if ≤ 1.00%)		**PASS**		
				Blade Postion (Fully Open / Fully Closed)		**Fully Open**		

Note: Units shown are for example only. Each testing laboratory should show units per instruments used during testing.

998.278 kg/m³	SI Water density per ANSI/AMCA 550
1000.00 m³/L	SI Volume conversion
0.998278 kg/L	SI Water density
62.3205 lbm/ft³	I-P Water density per ANSI/AMCA 550
7.480519 ft³/gal	I-P Volume conversion
8.331040 lbm/gal	I-P Water density
3.78541 L/gal	Volume Conversion
0.453592 kg/lb	Weight Conversion

Annex D

References (Informative)

Checklist #0240 for the Approval of: Louvers (Includes Gable End Louvers), Department of Regulatory and Economic Resources, Miami-Dade County, FL, USA

NBS Special Publication 330, The International System of Units (SI):, National Bureau of Standards, Washington, D.C., USA

Testing Application Standard 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, Miami Dade County, FL, USA

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The Air Movement and Control Association International Inc. is a not-for-profit association of the world's manufacturers of air system equipment, such as fans, louvers, dampers, air curtains, airflow measurement stations, acoustic attenuators, and other air system components for the industrial and commercial markets.