Louver Selection and Application

Mr Tom Edwards, TRE Consulting
Email: tomedwards122@gmail.com | Mobile: +1 816 914 5819

Learning Objectives

1. Louver: Types and Functions
2. Louver Testing & Data
3. How to Specify AMCA-Certified Louvers





Louver Design and Construction

What exactly is a louver?

- ...Per AMCA publication 501
  - A louver is a device comprising of
    - a blade or blades
    - that permit the flow of air
    - but inhibits the entrance of water or other elements

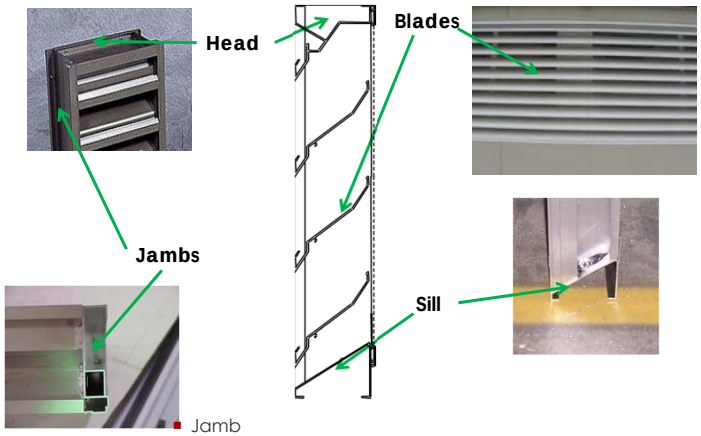


Louver Installations

- Where are louvers typically installed?
  - Exterior Wall
  - Interior Wall
  - Curtain Wall / Storefront
  - Roof (Penthouse)
  - Ductwork



Anatomy of a Louver



- Jamb
  - The vertical frame member on the sides of a louver.

Louver Types

- Basic Louver Types
  - Fixed Blade (Stationary)
  - Adjustable Blade
  - Combination


Stationary


Adjustable

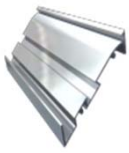

Combination

Blade Styles

- Blade Types
  - Architectural (Non-drainable)
    - J or K Blade
  - Drainable Blade
    - Single or Dual Drain

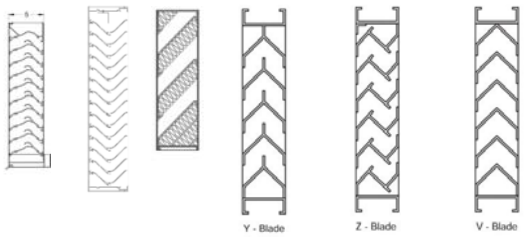

J Blade


K Blade


Drainable Blade

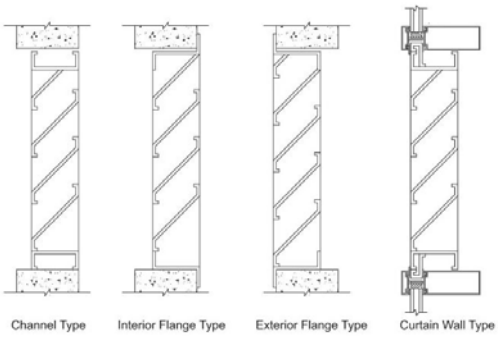
Specialty Louver Types

- Sightproof Louvers
  - Y Blade
  - Z Blade
  - V Blade
- Wind-Driven Rain Louvers
  - Horizontal Blade
  - Vertical Blade
- Hurricane Resistant Louvers
- Sand Louvers
- Acoustical Louvers
  - J Blade
  - Airfoil Blade



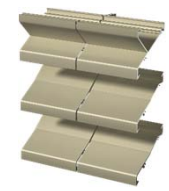
Louver Frame Styles

- Frame Types
  - Channel
  - Flange
    - Interior Flange
    - Exterior Flange
  - Glazing Adapter



Louver Design Features

- Mullion Types
  - Architectural
  - Recessed
  - Visible

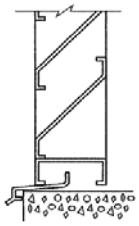

Architectural Mullion

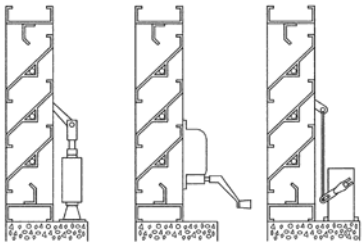

Recessed Mullion


Visible Mullion

Louver Accessories

- Screens
  - Bird or Insect
- Blank off panels
  - Non-insulated
  - Insulated
- Sill flashing / extensions
- Actuators


Sill Flashing


Pneumatic Operator

Hand Crank Operator

Motorized Operator

Aesthetics

- Specialty Shape – round, triangular,etc.
  - Performance - AMCA performance not valid unless specific shapes tested
- Finish Types
  - To match building construction elements
  - Primer, Baked Enamel, Powder Coat, Fluoropolymer and Anodize finishes most common

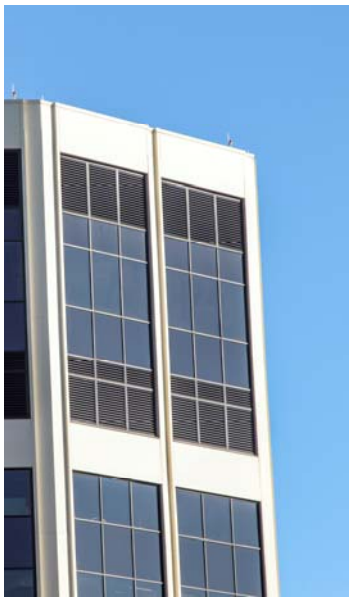
Job Examples





Job Examples





Job Examples





Aesthetic Examples





Job Examples



Job Examples



19

Louver Performance and Test Standards

Louver Performance Considerations

- When designing louvers, consideration should be given to the following performance criteria:
  - Free Area
  - Air Performance (Pressure Drop)
  - Water Penetration
    - Still Air
    - Wind Driven Rain
  - Sand Rejection
  - Structural Integrity
  - Noise

Test Standards & Publications



- AMCA Publication 501: Application Manual for Air Louvers
- ANSI/AMCA 500-L: Laboratory Methods of Testing Louvers for Ratings
  - Tests the following
    - Air Performance (Pressure Drop)
    - Water Penetration (still air)
    - Wind Driven Rain
    - Sand
    - Leakage (adjustable louvers)
- AMCA 511: Certified Ratings Program Product Rating Manual for Air Control Devices
- ANSI/AMCA 540: Test Method for Louvers Impacted by Wind Borne Debris
- ANSI/AMCA 550: Test Method for High Velocity Wind Driven Rain Resistant Louvers

AMCA 500-L

- 500-L consists of five different testing protocols for testing louvers
  - Pressure Drop
  - Airflow Leakage
  - Water Penetration
  - Wind-Driven Rain
  - Wind-Driven Sand



AMCA 500-L gives you the testing parameters for testing louvers and confirms performance, AMCA 511 was written to give guidance on how to certify the louvers that are tested

23

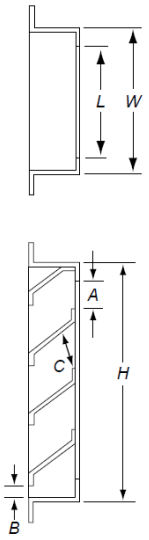
AMCA 500-L

- Upon testing, manufacturers can show that their louver has been part of AMCA's certified ratings program (CRP)
  - Important because not all manufacturers certify product
- Manufacturers can identify which tests have been independently conducted by AMCA with a CRP marking on their submittal page

24

Free Area

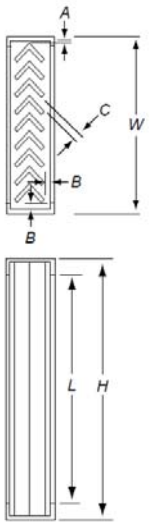
- The minimum area through which air can pass
  - Free Area = $L[A + B + (NXC)]$
  - Percent Free Area = $\frac{L[A+B+(N*C)]100}{W*H}$
- Horizontal Blade Louvers:
  - A = Minimum distance between the head and top blade
  - B = Minimum distance between the sill and bottom blade
  - C = Minimum distance between adjacent blades
  - N = Number of "C" openings in the louver
  - L = Minimum distance between louver jambs
  - W = Actual louver width
  - H = Actual louver height



Horizontal Blade

Free Area

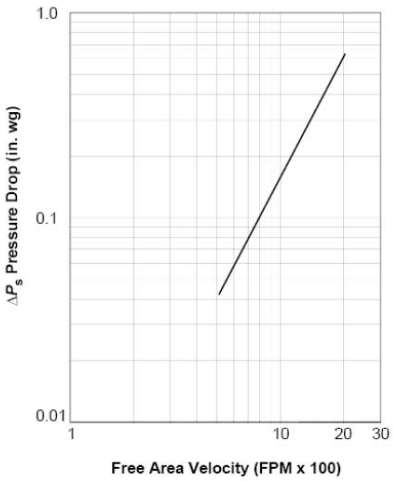
- The minimum area through which air can pass
  - Free Area = $L[A + B + (NXC)]$
  - Percent Free Area = $\frac{L[A+B+(N*C)]100}{W*H}$
- Vertical Blade Louvers:
  - A = Minimum distance between the left jamb and left blade
  - B = Minimum distance between the right jamb and right blade
  - C = Minimum distance between adjacent blades
  - N = Number of "C" openings in the louver
  - L = Minimum distance between head and sill
  - W = Actual louver width
  - H = Actual louver height



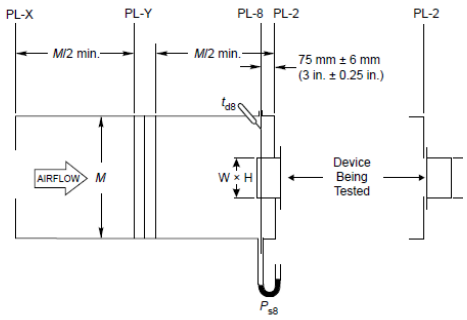
Vertical Blade

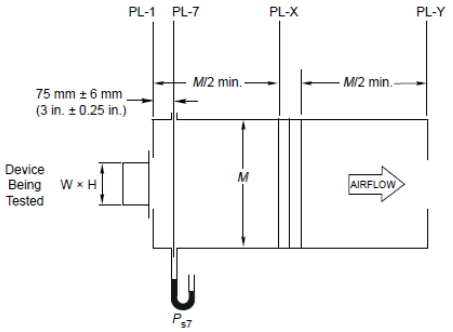
Air Performance

- Airflow/Volume
  - The measurement of the rate of airflow that passes through a louver (measured in cfm or m^3/s)
- Pressure Drop
  - The resistance to airflow across an open louver (stated in inches of water/kpa)
- Free Area Velocity
  - Rate of airflow that passes through the free area of a louver (expressed in fpm or m/s).



AMCA Test Figure 5.4 & 5.5





Louver Sizing Criteria: ASHRAE Recommendations

- 2012 ASHRAE HVAC Systems & Equipment:
  - Intake:
    - 7,000 cfm (3.3 CMS) and greater = 400 fpm (2.02 m/s)
    - Less than 7,000 cfm (3.3 CMS) = see Fig.14
  - Exhaust
    - 5,000 cfm (2.36 CMS) and greater = 500 fpm (2.54 m/s)
    - Less than 5,000 cfm (2.36 CMS) = see Fig.14

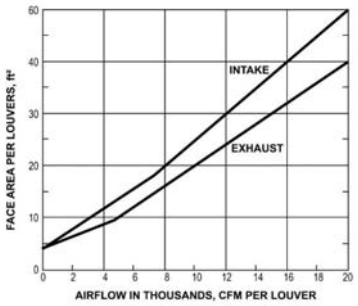


Fig. 14 Criteria for Louver Sizing

Parameters Used to Establish Figure	Intake Louver	Exhaust Louver
Miniumum free area (48 in. square test section), %	45	45
Water penetration, oz/ft² · 0.25 h)	Negligible (less than 0.01)	N/A
Maximum static pressure drop, in. of water	0.15	0.25

- 2009 ASHRAE Fundamentals:
  - 4.7: Outside Air Intakes: selected louver should offer minimum pressure loss, preferably not more that 0.10" w.g.

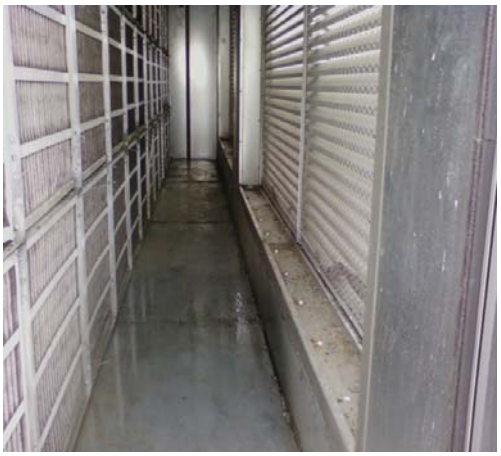
Water Infiltration





Traditional Louvers

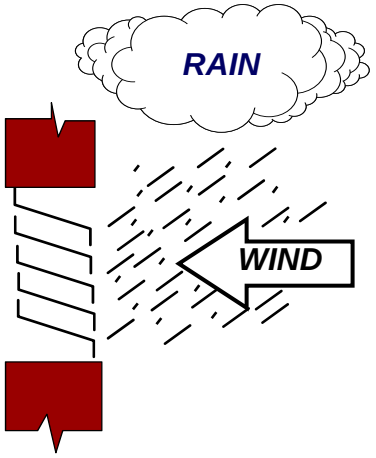
- Typically sized at 600 to 800 fpm (3.05 to 4.06 m/s) intake velocity
- Drainable blades for intake applications
- Some very high performing traditional models
- How much water is allowed?
  - Adequate drainage
  - Equipment that needs to be kept dry



31

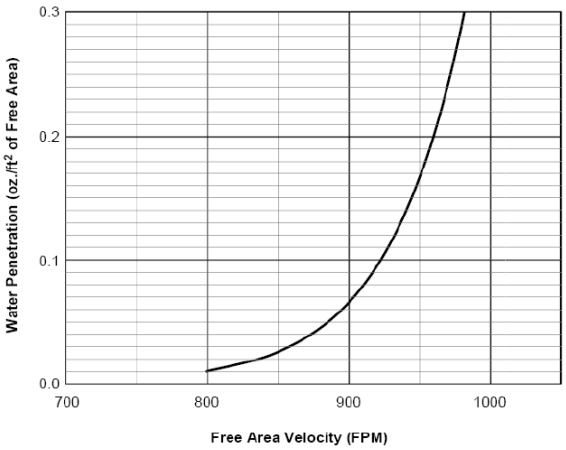
Rain Defense

- Prevents Damage
  - Mechanical Rooms, Generators, Production Plants, Electrical switchgear areas…
- Protects interior finishes & contents.
  - Exhibition Halls, Warehousing, Museums…



AMCA 500-L Water Penetration Test
Water Penetration (still air)

- Defines the point of beginning water penetration at a specific intake air velocity.
- The beginning point of water penetration is $0.01 oz/ft^2$ (0.026g/m²) of free area.



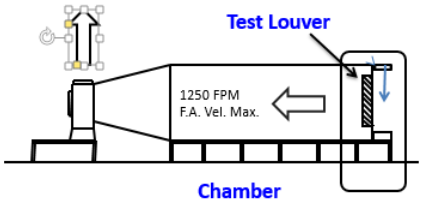
Still Air Test

- Test Conditions
  - 4" per hour rain - light vertical rain
  - 1250 fpm max free area velocity
  - Approx. 14 mph
  - Tested for beginning point of water penetration based on free area velocity
  - 48" x 48" sample size
  - No screen



34

Still Air Test



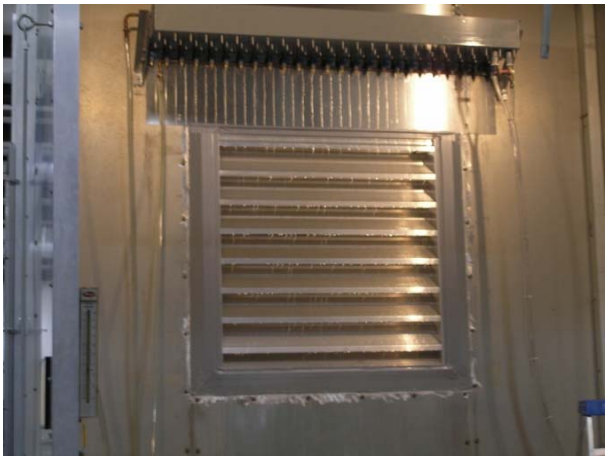
Still Air

Beginning Point of Water penetration-
.01 oz. of water per sq/ft. at X FPM F.A. Vel.

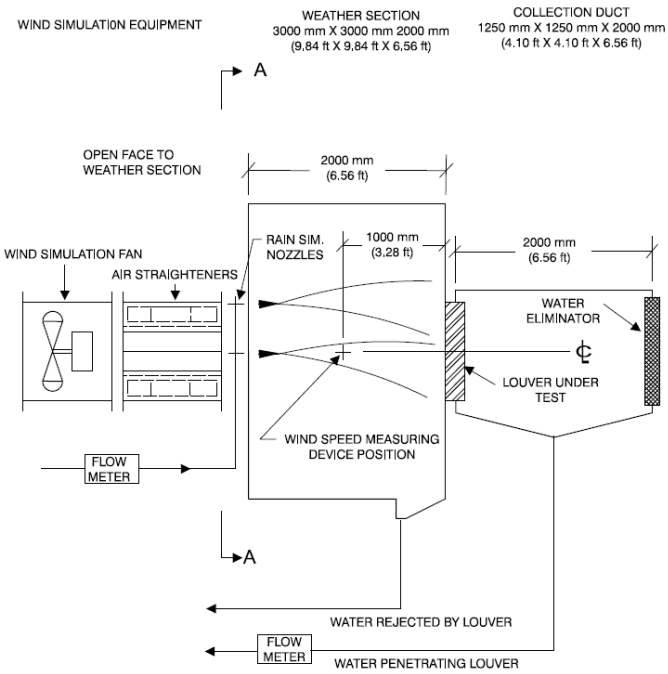


35

Louver Still Air Test



AMCA Test Figure 5.11



Traditional Louver Technology

- Design Characteristics
  - Wide Blade Spacing
  - High Free Area
  - Low Cost
  - Low Pressure Drop
  - Not Effective In Storms





38

Wind Driven Rain Louver Technology

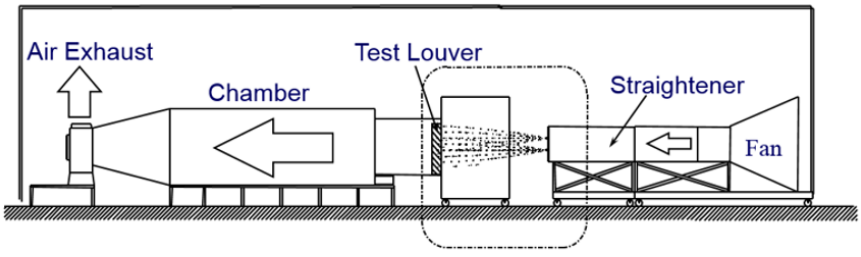
- Design Characteristics
  - Close Blade Spacing
  - Lower Free Area
  - Greater Velocities
  - Higher Pressure Drop
  - Effective water rejection in storm conditions



39

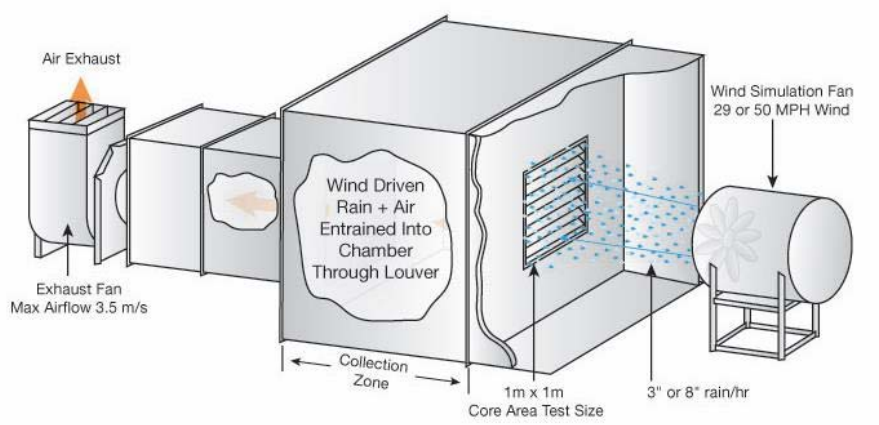
AMCA 500-L Wind-Driven Rain Test for Louvers

- The chamber behind the louver is fully pressurized with an exhaust fan trying to draw water through the louver's blades during the testing procedure (30 minute testing period)
  - Test values are noted at regular intervals and are not more than 10 minutes apart
  - The test procedure is completed when a minimum of 4 consecutive readings within the steady state of tolerance has been noted



40

AMCA 500-L Wind-Driven Rain Test



WDR Test



Wind Driven Rain

- Measures the performance by establishing an effectiveness rating of louvers subjected to both rain and wind pressure, both with and without airflow through the louver.
- 2 conditions
  - 3in of rain/hour @ 29 mph wind vel.
  - 8 in of rain/hour @ 50 mph wind vel.
- Effectiveness Ratings
  - A = 99.9% to 99%
  - B = 98.9% to 95%
  - C = 94.9% to 80%
  - D = Below 80%

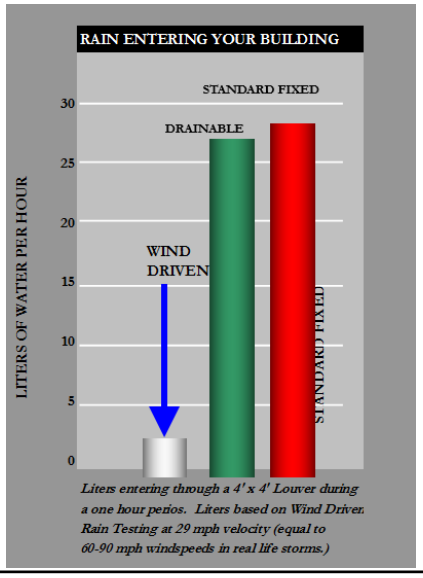
Rainfall Rate: 3 in./hr
Wind Velocity: 29 mph

Core Velocity (fpm)	0	106	218	286	386	499	586	686	761	853	987
Effectiveness (%)	99.7	99.4	99.1	98.3	96.9	93.9	91.6	86.2	84.4	81.5	75.2
Penetration Class	A	A	A	B	B	C	C	C	C	C	D

Rainfall Rate: 8 in./hr
Wind Velocity: 50 mph

Core Velocity (fpm)	0	128	214	300	401	498	586	667	772	861	973
Effectiveness (%)	98.5	98.4	98.3	98.7	96.9	96.4	95.5	93.6	93.3	88.2	80.1
Penetration Class	B	B	B	B	B	B	B	C	C	C	C

Still Air VS WDR



AMCA Wind Driven Rain test

***Based on* Wind Driven Rain test- 3" per hour at 29 mph wind velocity, wind tunnel pulling 1300 FPM**

29 liters



44

Sizing Tips

- Free area not necessarily the most important characteristic
- Pressure drop generally becomes the limiting factor
  - Low free area can be offset by low pressure drop
  - Still area louvers require a (**15% to 25%)** safety factor – WDR louvers do not
  - At **10,000 CFM (4.72 CMS)** a 6" still air louver with 860 fpm fav requires a **48" x 60" (1219 x 1524mm)** louver – A 6" vertical WDR with 2019 fpm (10.3 m/s) fav requires a **42" x 42" (1067 x 1067mm)** louver
  - A difference if 7.75 sq. ft (0.72 m^2).. face area.

45

Sizing Louvers – 1 sq M

6" Horizontal Still Air

- Free Area: 9.08 ft^2 (0.84m^2)- 57%
- F.A. Vel.: 870 fpm (4.42m/s)
- Volume: 7,900 cfm (3.73cms)
- .13" (32.5pa) Δp
- No WDR resistance
- Best Still Air 65% @ 3" 29mph (46.7 km/h)





6" Vertical WDR

- Free Area: 6.80 ft^2 (0.63m^2)- 43%
- F.A. Vel.: 2175 fpm (11.05m/s)
- Volume: 14,790 cfm (6.98cms)
- .35" (87.5pa) Δp
- 99.8% Rain Resistance (50 mph or 80 Km/h /8" hr)
- *87% More Volume!*

Louver - Wind-Driven Rain Test



Sand Louver Application

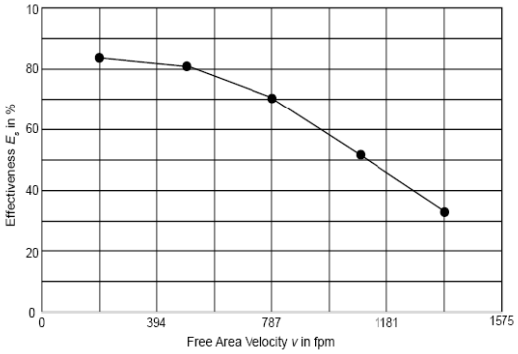






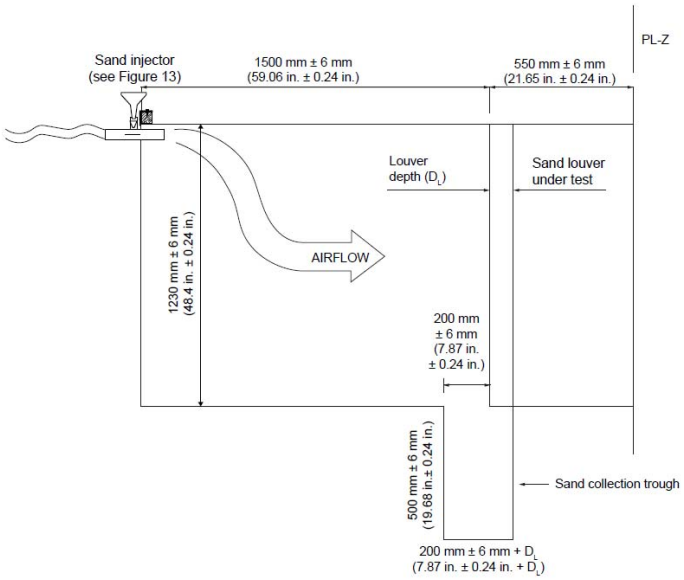
Wind Driven Sand

- Measures the sand rejection performance subject to airborne dry sand particles at different airflow rates through the louver
- Test procedure and certification launched January 13, 2016
- Primarily a concern for Middle East region
  - Could be applicable in construction near beaches and other sandy regions worldwide
- Effectiveness Ratings
  - A = 100% to 90%
  - B = 89.9% to 80%
  - C = 79.9% to 70%
  - D = Below 70%



Free area velocity (fpm)	197	492	787	1083	1378
Weight of sand (lbm)	2.204	2.204	4.41	4.41	4.41
Discharge duration (s)	200	75	100	70	60
Sand feed rate (lbm/s)	0.011	0.029	0.044	0.064	0.073
Effectiveness (%)	98	91	83	75	69
Penetration class	A	A	B	C	D

AMCA Test Figure 5.12



Sound Performance

- ASTM E90-99: Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

Octave Band (Hz)	2 (125)	3 (250)	4 (500)	5 (1000)	6 (2000)	7 (4000)
Free Field Noise Reduction	10	10	13	16	18	16

Extreme Weather

- ANSI/AMCA 540: Test Method for Louvers Impacted by Wind Borne Debris
  - Intended to demonstrate the structural capabilities of the louver in the event the louver were to be impacted by wind borne debris
  - Large missile impact test as described in ASTM E 1996-04 and E 1886-05
- ANSI/AMCA 550: Test Method for High Velocity Wind Driven Rain Resistant Louvers
  - 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
  - Pass / Fail
  - Equivalent to FBC TAS 100A

ANSI/AMCA 540-Test Method of Louvers Impacted by Wind Borne Debris

- Test procedure measures a products capacity to withstand impact from wind borne debris in hurricane wind velocities
  - Test Missile: 9 lb 2 x 4
  - Distance: 12-feet (9 ft.. long missile)
  - Impact Velocity:
    - 3 units tested
    - Shortest blade span
    - Longest unsupported span
    - Mullion location



53

Structural Integrity

- Windloads:
  - American Society of Civil Engineers (ASCE) formula
  - Hidden or Visible supports
  - Effective Wind Speed (mph)
  - Louver panel size
    - Blade Span (Span tables)
    - Intermediate bracing
- Impact Testing:
  - AMCA Standard 540

AMCA Testing Standards - 540

AMCA 540
Pass/Fail Criteria

- No penetration of the blade material by the excepting fragments
- Fragments produced by the missile shall not exceed five per cent of the missile's weight
- Louver must remain attached to adjacent parts or components







AMCA Testing Standards - 540

- AMCA 540
  - Minimum of three specimens impacted
    - Requires the minimum and maximum sections to be tested
    - Can be one single-section and one multi-section

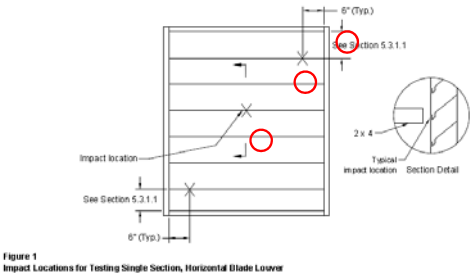


Figure 1
Impact Locations for Testing Single Section, Horizontal Blade Louver

Horizontal

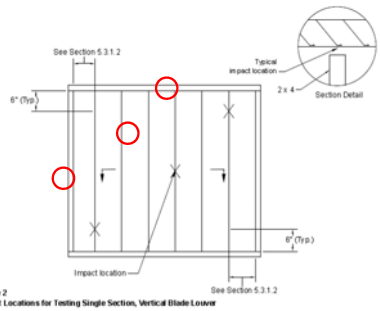
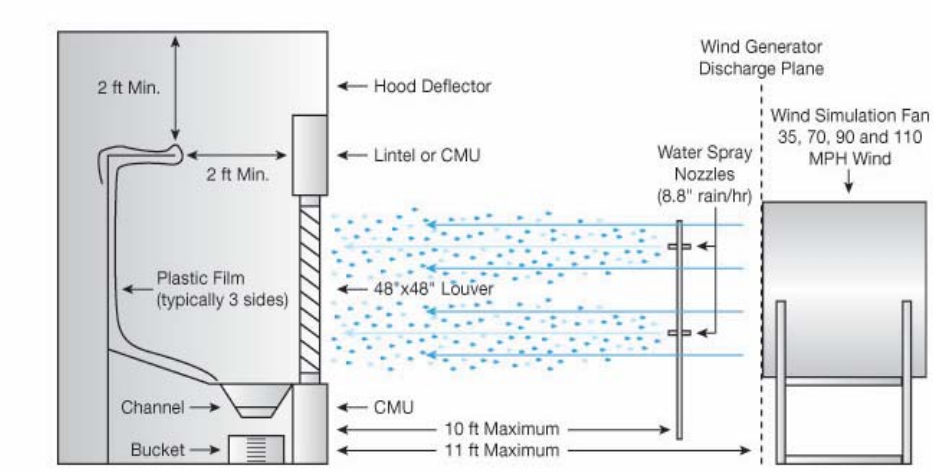


Figure 2
Impact Locations for Testing Single Section, Vertical Blade Louver

Vertical

ANSI/AMCA 550-Test Method for High Velocity Wind Driven Rain Resistant Louvers



57

AMCA Listing Standards - 550

- AMCA 550
  - Water shall be supplied to the wind stream using a sprinkle pipe system simulating a uniform 8.8 inches/hour (223.5 mm/hour) over the test specimen
  - Eight intervals of testing
    - Five to fifteen minutes
    - Wind Speeds from 0 mph to 110 mph (0 to 177km/h)
  - Pass/Fail is determined by whether or not the louver exhibits water infiltration in excess of 1% of the total water sprayed

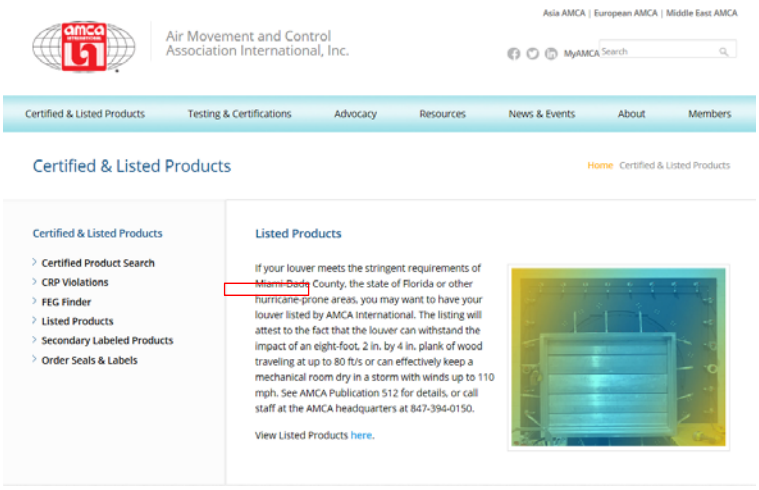


Typhoon Conditions – AMCA 550

- Louver test specimen size must exhibit a 1m x 1m "core" area
- No more than **1%** of the total sprayed water volume may penetrate the louver to pass

Interval	Wind Speed	Duration	Water Spray
1	35 mph	15 min	On
2	0 mph	5 min	Off
3	70 mph	15 min	On
4	0 mph	5 min	Off
5	90 mph	15 min	On
6	0 mph	5 min	Off
7	110 mph	5 min	On
8	0 mph	5 min	Off

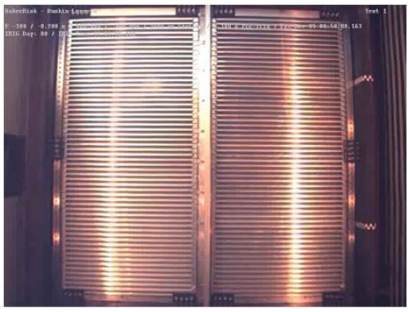
Searching for AMCA 540/550 louvers



Source: http://www.amca.org/certified-listed/listedproducts.php

Blast Resistant Louvers

- Blast Resistance – GSA Solutions
- Government installations
- 10 psi tested performance
- Proven installed design





Blast Resistant Louvers



Finishes



How to Specify AMCA-Certified Louvers

AMCA International

- How do you know the product you want to specify is licensed by AMCA International?
  - Visit AMCA website — www.amca.org and click on Certified and Listed Products; select Search for Licensed Products from dropdown menu
  - Check the manufacturer's catalogs
  - Look for AMCA International's Certified Ratings Seal on the product (seals are optional)
  - Contact AMCA International's Certified Ratings Program Department — certified@amca.org

Standard 511 CRP Manual for Louvers

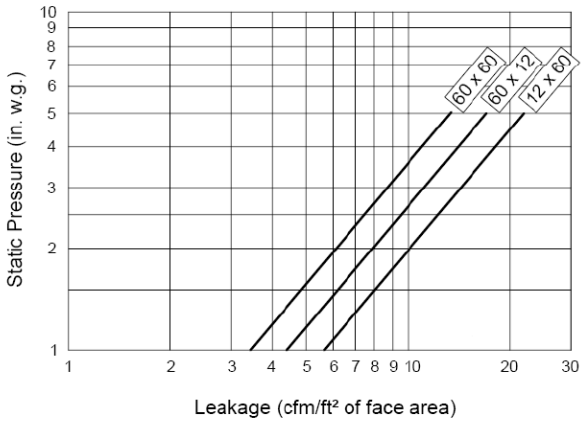
- AMCA CRP seals for one or more licenses; licenses can be combined into one seal:
  - Water Penetration, Air Performance
  - Air Leakage
  - Air Performance, Wind Driven Rain
  - Wind Driven Rain
  - Water Penetration, Air Performance, Wind Driven Rain
  - Sound
  - Wind Driven Sand (new!)





Air Leakage Rate for Combination/Movable louvers

- Measures the relationship between airflow leakage rate and static pressure.



How Should AMCA-Certified Products Be Specified?

- AMCA publications provide guidance or outline the rules of the AMCA Certified Ratings Program
- Consider the following exemplary language for your specification
- "Louvers shall be licensed to bear the AMCA Certified Ratings Program seal for, air performance, wind-driven rain resistance in compliance (as applicable) with AMCA Publication 511"
  - Or sand rejection, air performance, sound performance, etc.

What is the AMCA Seal?

What **DOESN'T** This Seal Mean?

≠ "Tested in accordance with AMCA Standard 500-L"

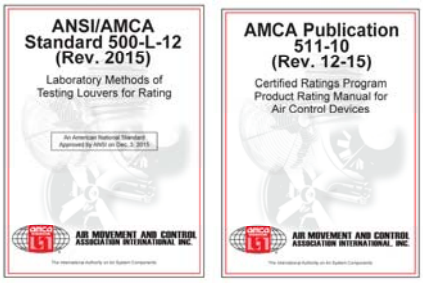
What is the AMCA Seal?

What **DOESN'T** This Seal Mean?

≠

AMCA Resources

- AMCA 500-L: Laboratory Methods of Testing Louvers for Rating
- AMCA 501: Application Manual for Air Louvers
- AMCA 511: Certified Ratings Program Product Rating Manual for Air Control Devices
- www.amca.com



AMCA International Resources

- Free white papers on AMCA Certified Ratings Program:
  - Introducing the AMCA Certified Ratings Program
  - Guideline Specifications for AMCA-Certified Products
  - How to Ensure AMCA-Certified Products are Installed
  - All free at www.amca.org/whitepapers

Louver Presentation Summary

- Today we discussed…
  - Louver types, definitions and terms
  - Louver performance, test standards/methods and performance data
  - Traditional louver's offer high FA and low pressure drop but do not provide WDR performance
  - WDR louvers stop water penetration and allow greater FA velocities
  - WDR allows for smaller footprint of louver sizes
  - WRD louvers do not require a safety factor
  - How to specify louvers and AMCA-certified louvers