

An Introduction to Louver Selection



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Arrow United Industries

450 Riverside Drive

Wyalusing, PA 18853



Course Number: Louvers 101

Learning Units: **1.0 LU/HSW Hour**

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Learning Objectives

At the end of this program, participants will be able to:

- identify the various louver types and determine their appropriate applications
- recognize the meaning and implications of free area, pressure drop, water penetration, and airflow when selecting louvers, their accessories, and options
- select and size the appropriate louver type for various situations, and
- recognize when and where hurricane rated or wind-driven rain (WDR) louvers are necessary.



Introduction: Louver Basics

What is a Louver?

A louver is a device composed of multiple blades which, when mounted in an opening, permits the flow of air but inhibits the entrance of water and/or other elements.

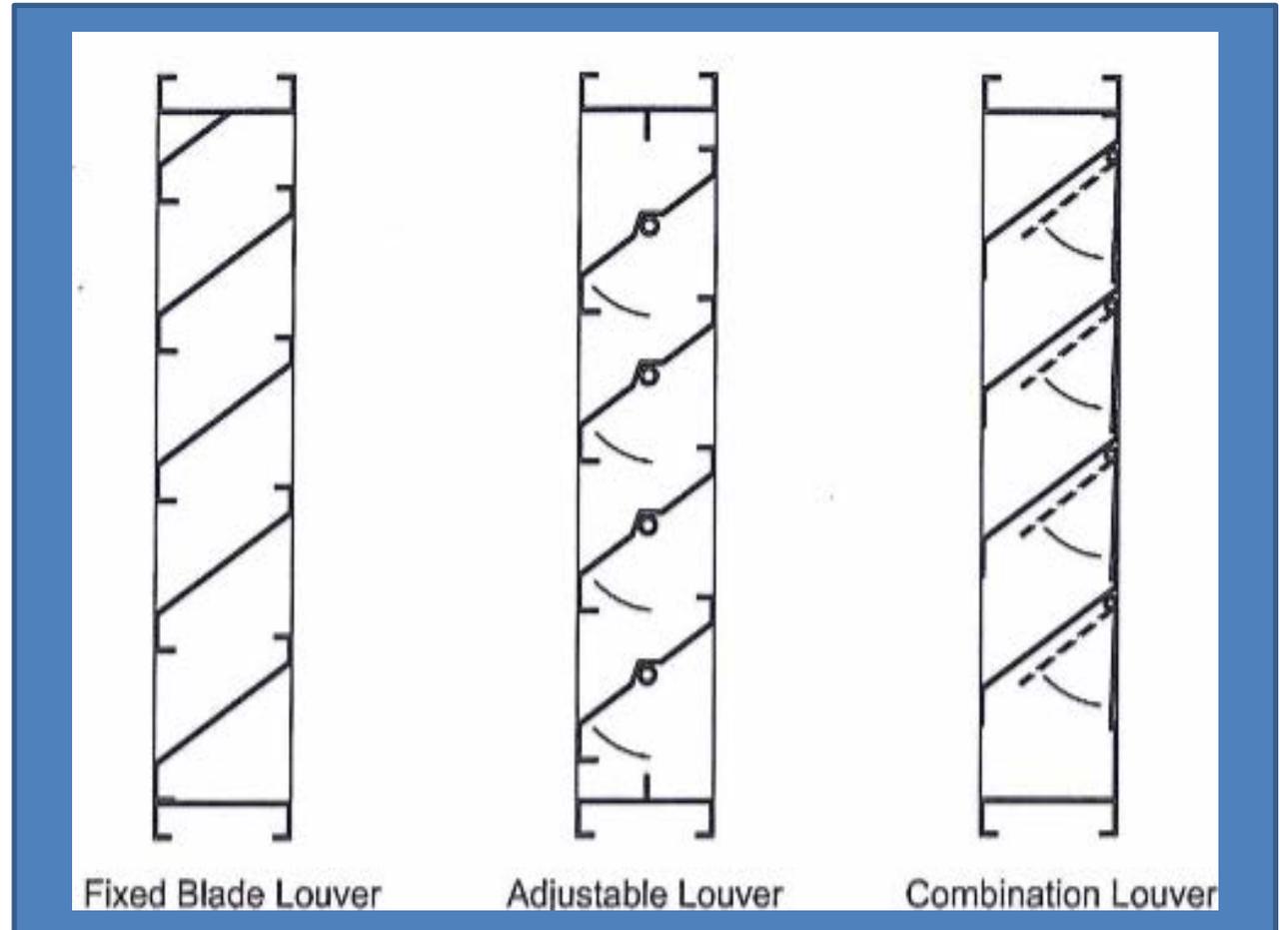


Basic Louver Types

Fixed: Blades are firmly secured in open position.

Adjustable: Blades may be operated manually, electrically or pneumatically.

Combination: Louvers have a combination of the above.



Adjustable and Combination Louvers

Adjustable louvers:

- Add operable blades for greater flexibility
- Save space in HVAC systems
- Rotate blades from fully open to fully closed positions

Combination louvers:

- Have front fixed blade and an adjustable rear blade



Acoustical Louvers

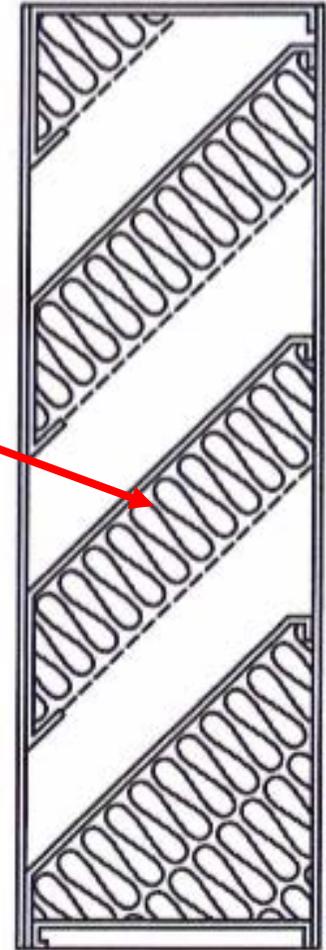
Permit ventilation while decreasing the transmission of sound

May reduce sound transmission by 4 to 12 decibels

Sacrifice pressure drop and free area

Are tested according to ASTM Standard E90

acoustical
insulation



Sight Proof or Equipment Screens

Have vertical or horizontal blades which cannot be seen through from any direction

Are used to screen HVAC, electrical, or mechanical equipment from view



Wind Driven (WDR) Louvers

Have horizontal or vertical blades

Greatly reduce water penetration into a building during rain accompanied with winds

Have two basic tests:

- **AMCA 500-L:** 3 in/hr. rainfall with 29 mph. wind velocities or 8 in/hr rainfall with 50 mph. wind velocity
- **AMCA 550:** 8.8 in/hr. with wind velocities of 15.65, 35, 70, 90, and 110 mph.



Hurricane Louvers

Are tested for:

- Impact resistance: a 9 lb. wooden 2" x 4" missile is fired from a cannon at either 50 ft./sec. or 80 ft./sec.

And

- Optionally, high-velocity wind-driven rain resistance



Shaped Louvers

Can be made from many louver types

Usually decrease louver performance, especially in corners

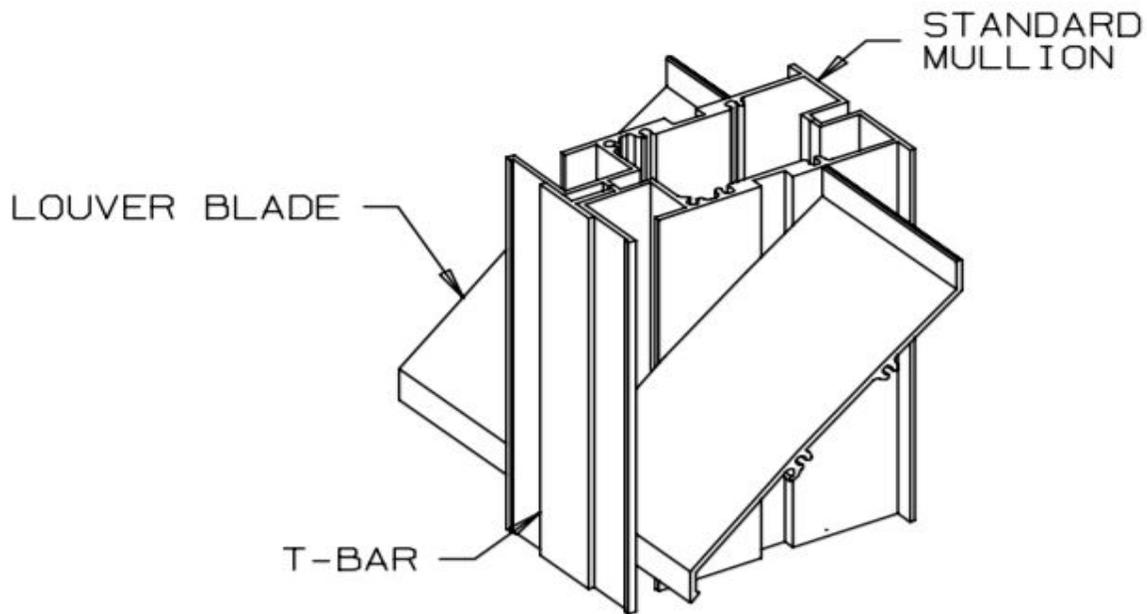


Penthouses

A roofed structure incorporating louvers or louver blades in all or part of the walls

Are usually installed on the roof



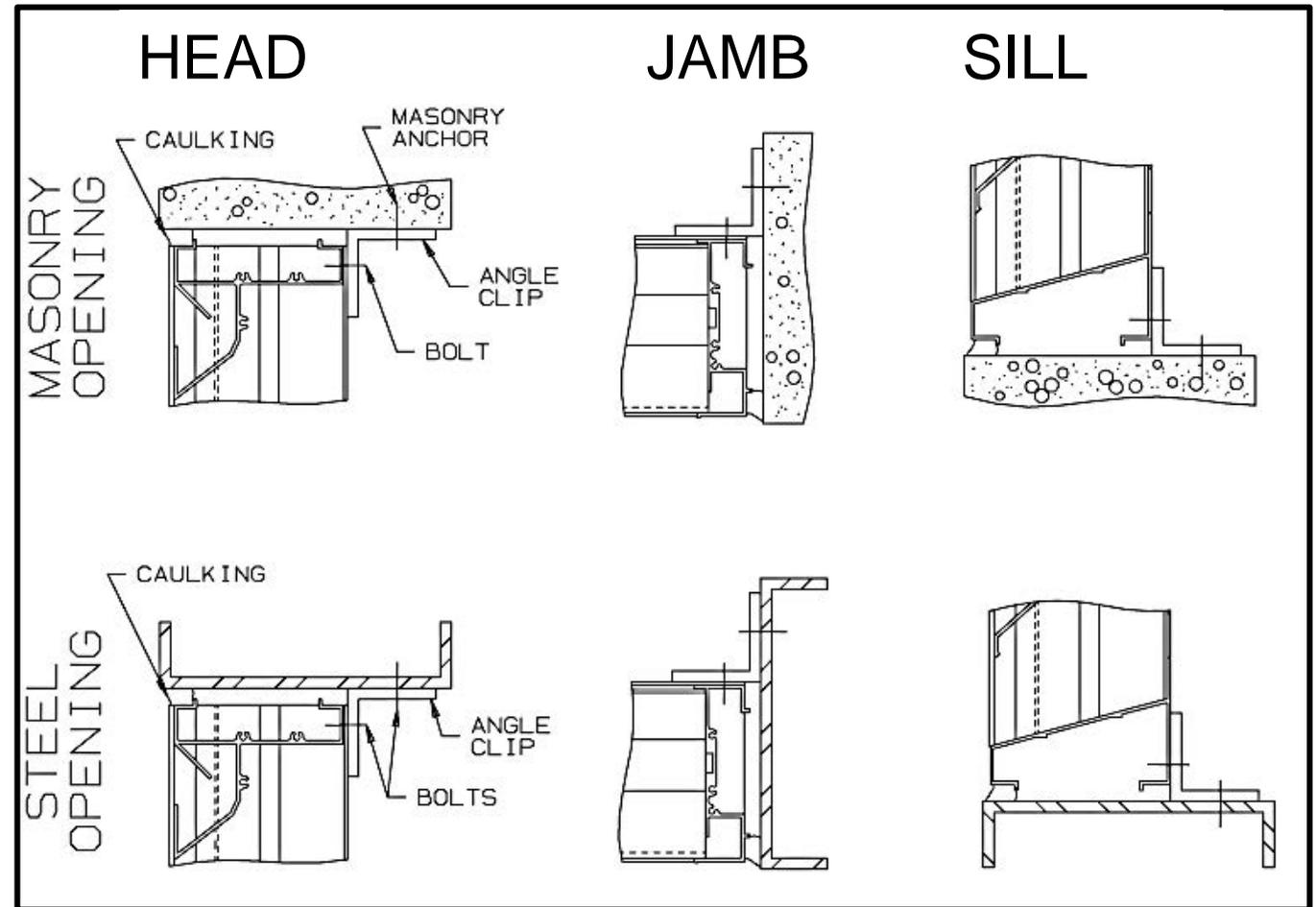


Louver Components

Louver Components

Include:

- **Head:** upper or highest horizontal frame member
- **Jamb:** vertical frame member on the sides
- **Sill:** bottom or lowest horizontal frame member

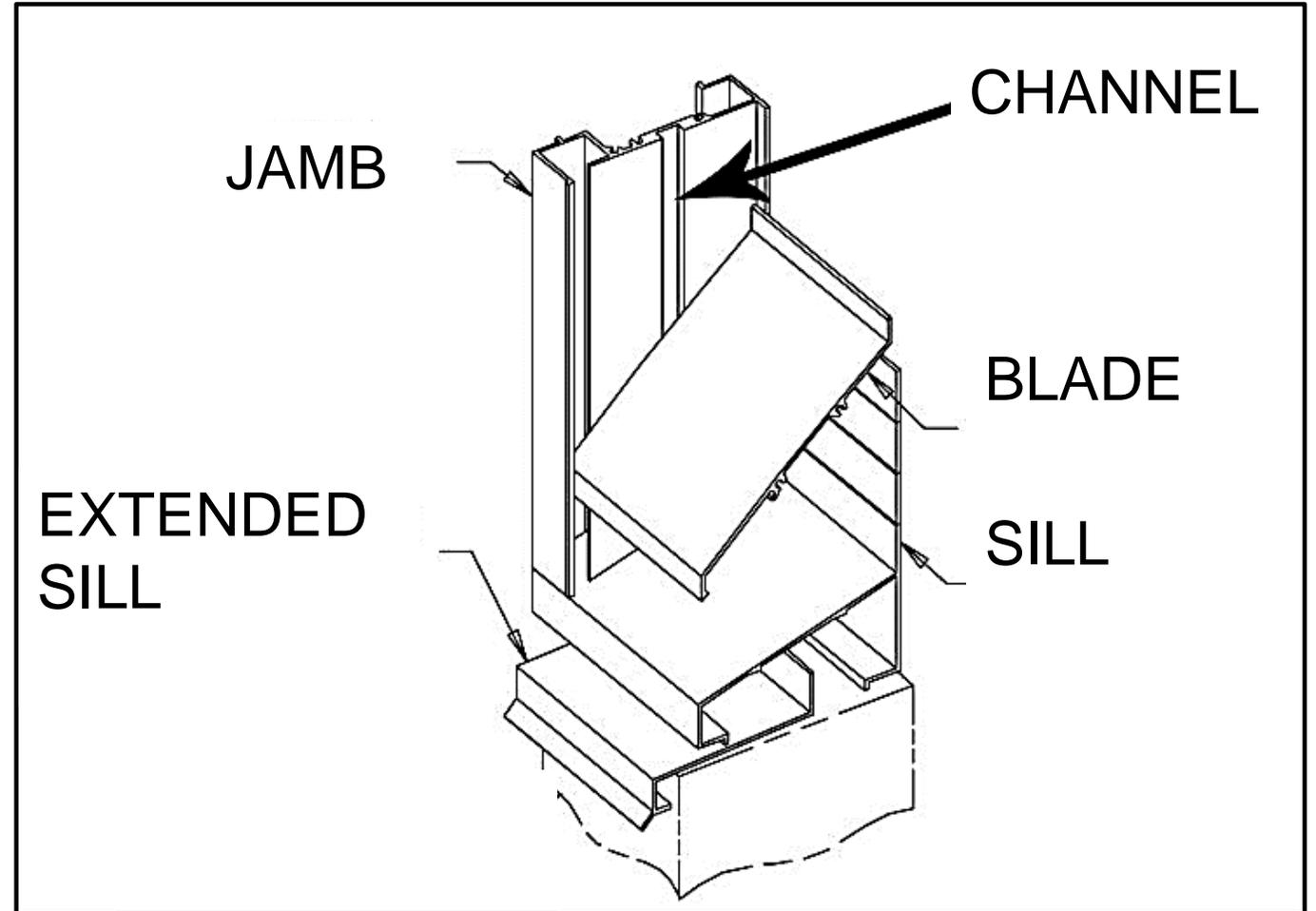


Louver Frames

The outermost structure of a louver assembly

Generally classified as channel (illustrated), flange, or curtain wall type

Are made from aluminum extrusions, formed aluminum, formed cold rolled steel, galvanized steel, and stainless steel

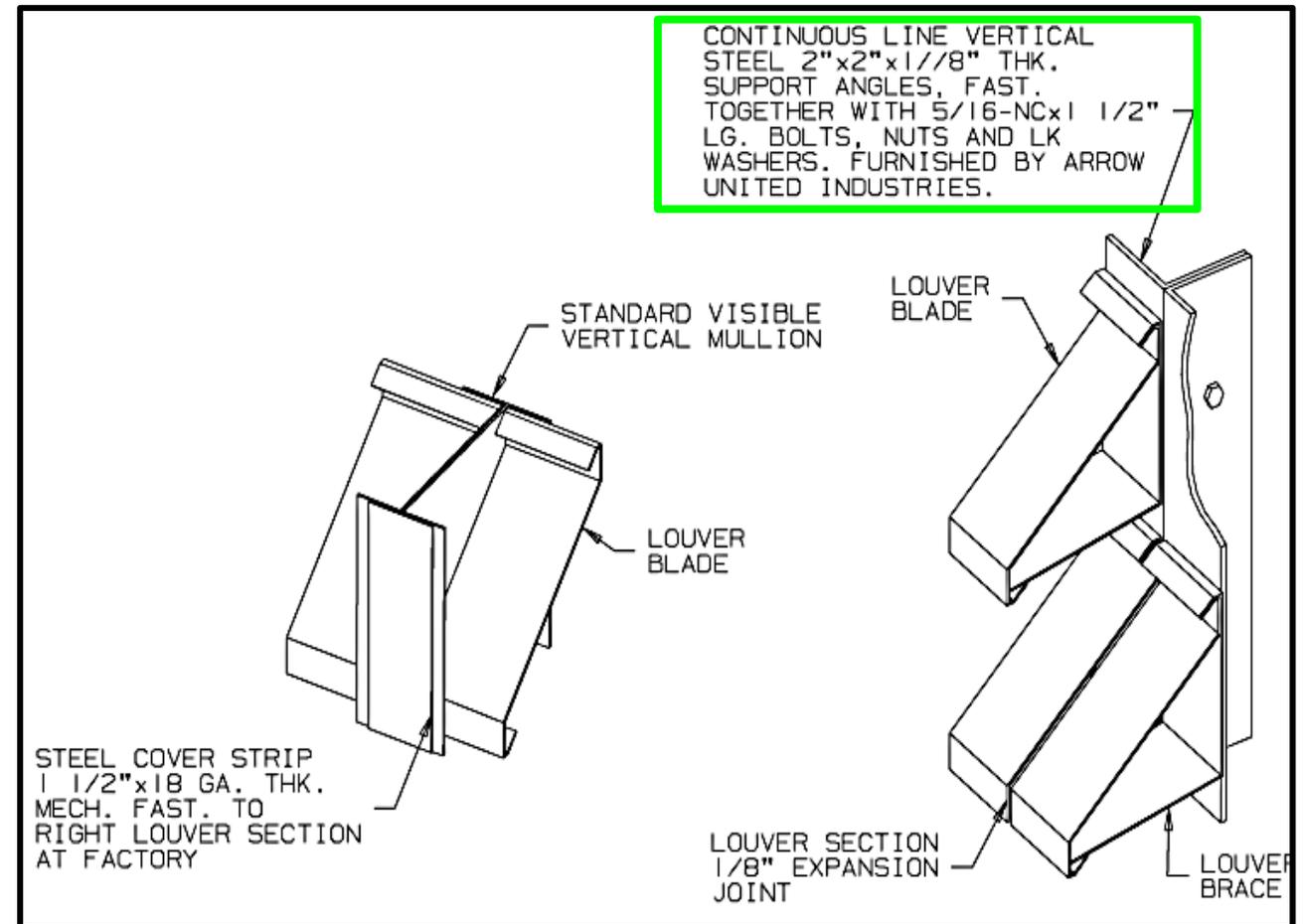


Louver Blades

Bars, slats, or vanes within a frame; normally provided in multiple quantities

Are installed vertically or horizontally

A **continuous line blade** presents uninterrupted horizontal or vertical lines to complement or enhance architectural features.

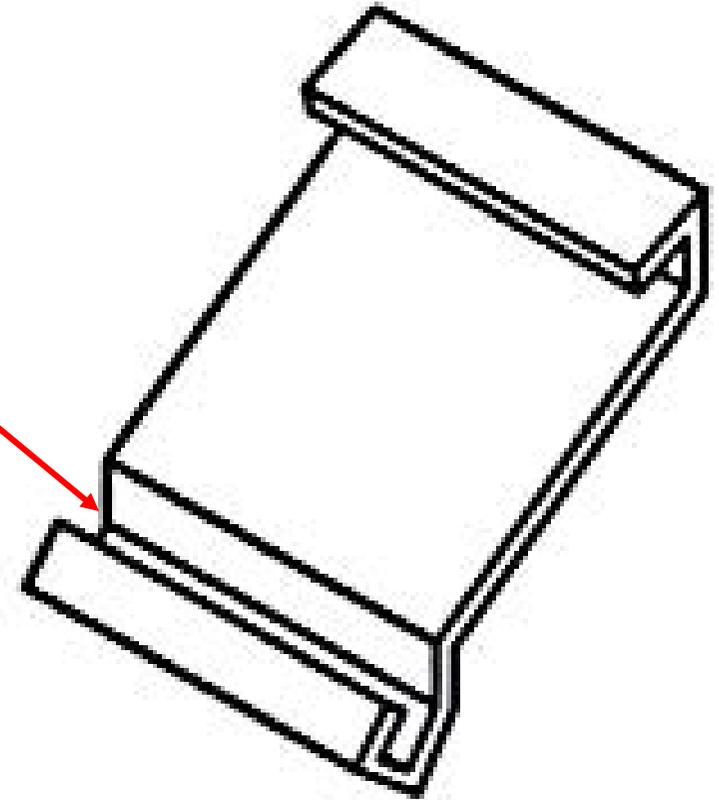


Drainable Blades

Utilize a gutter or rain trough at the leading edge to channel water to the jambs

Should not exceed 10 ft. in length

Are not suitable for continuous line louvers without special provisions

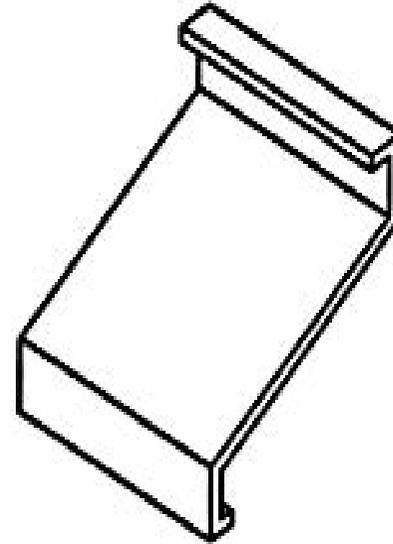


Non-drainable Blades

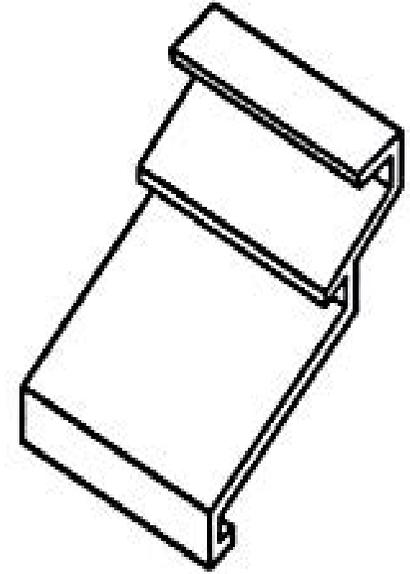
Have various profiles

Can be positioned at various angles and spacing

Are typically used for architectural or intake/exhaust applications



J - Blade



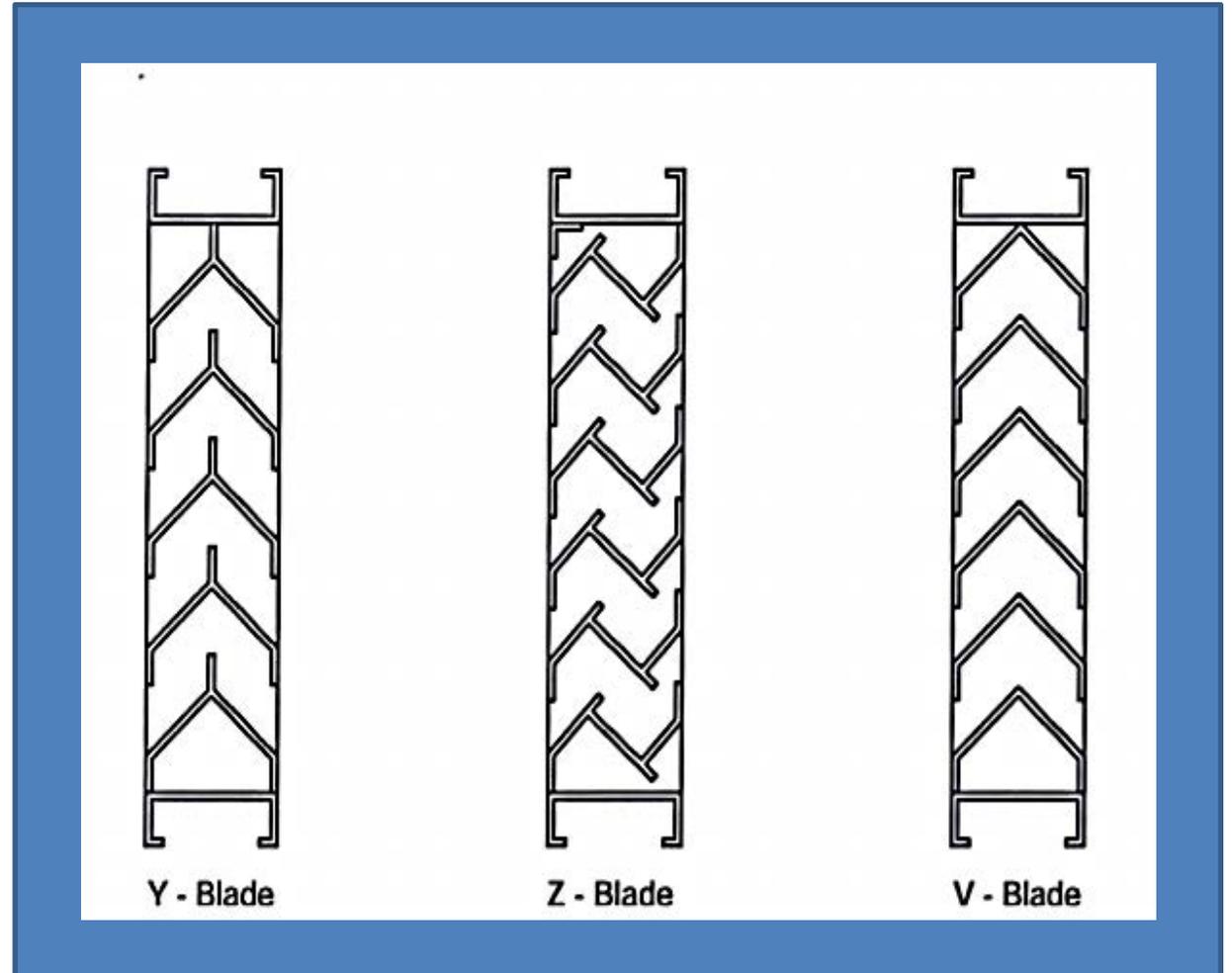
K - Blade

Chevron Blades

Are designed so that they cannot be seen through

Are also used in severe weather louvers

Have various styles



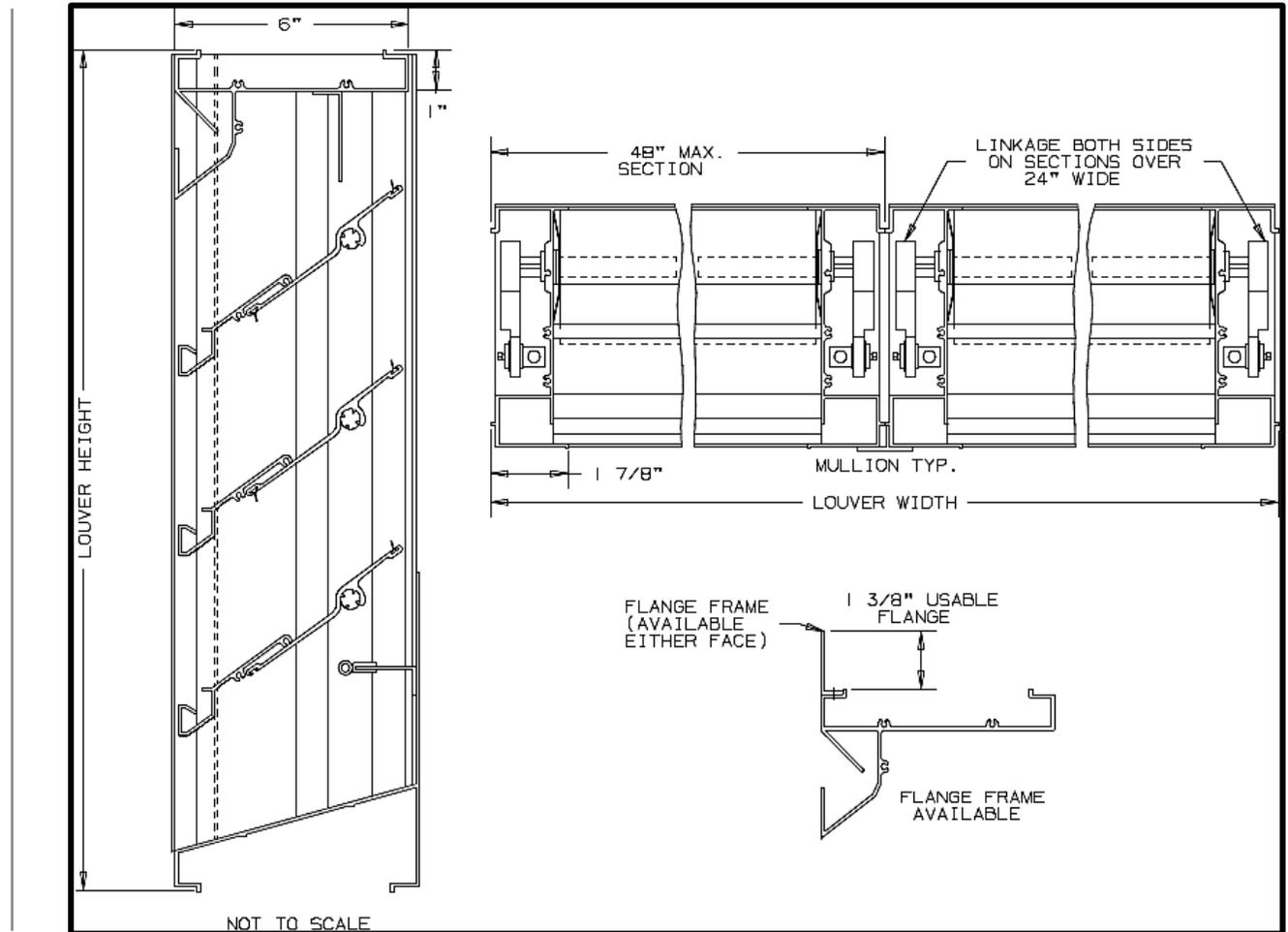
Operable Blades

Are used in adjustable/combination louvers

Save space in place of a separate damper and louver

Rotate within louver frame

Can be rotated manually or by powered means

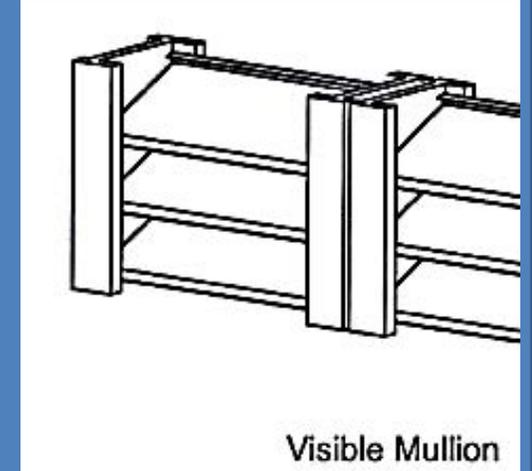
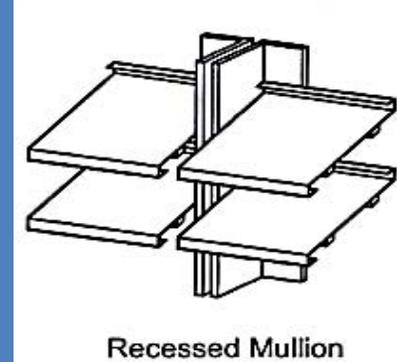
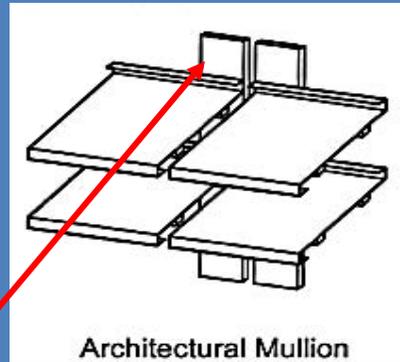


Louver Mullions

Are the vertical elements that support the louver blades

Have three basic styles

Are placed behind the blade when providing a continuous blade appearance.





Louver Considerations and Calculations

Structural Considerations

Include wind loads, thermal expansion, and in some cases, seismic loading.

Building openings should be self-supporting and not impose any loads on the louver.



Seismic and Thermal Considerations

Seismic considerations are required in geographical locations with earthquake potential.

Thermal considerations must be made for thermal expansion/contraction.



Wind Load Considerations

Should be based on the relevant building codes and should specify code along with loading requirement

Louver structure must be designed for both positive and negative pressure caused by a change of wind direction.

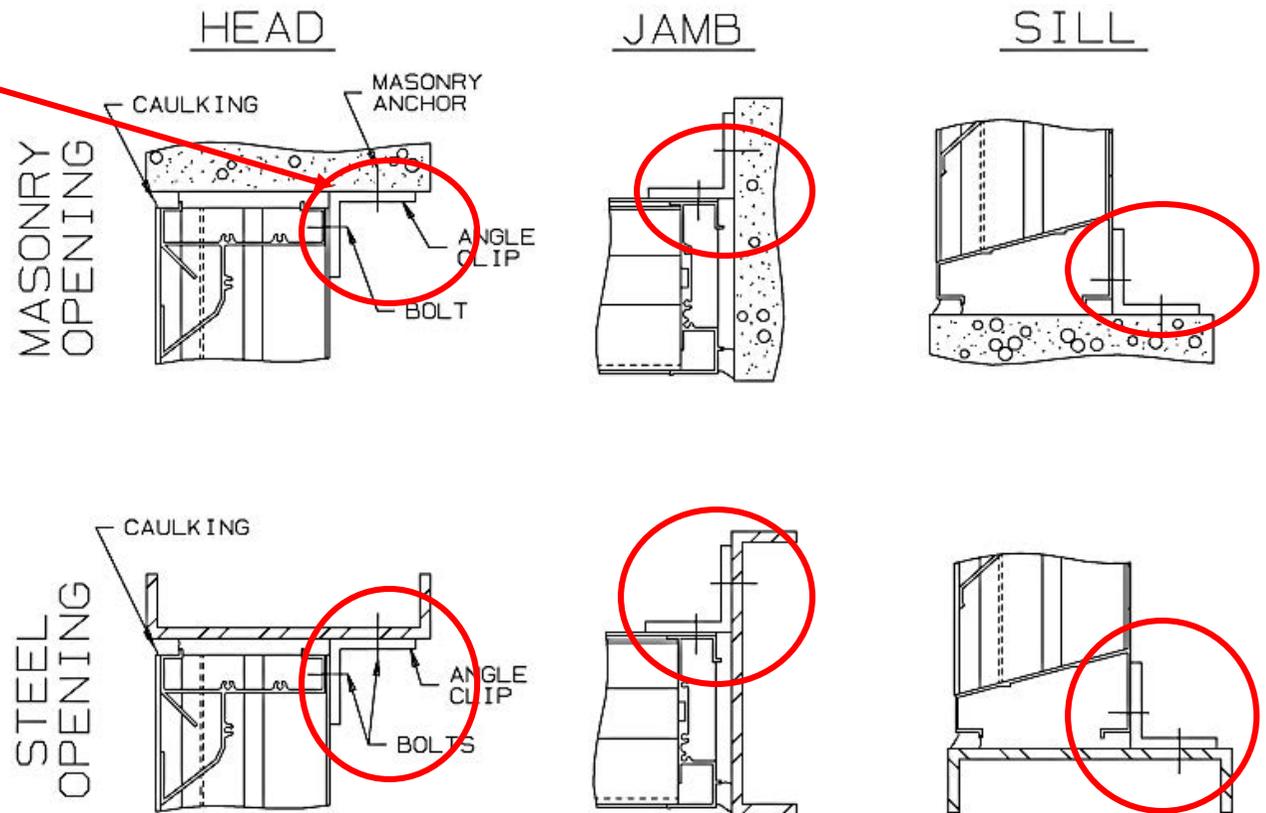


Fastener Considerations

Fasteners secure louvers in the opening

Number and placement depend on total load on the louver section

Should be selected for resistance to corrosion and compatibility with louver material and adjoining structure



Snow Load Considerations

Loading requirements for louvers and penthouses are based on the governing codes.

Drifting, roof angles and roof temperatures are major considerations.

There may be other factors, such as ice, acting concurrently.

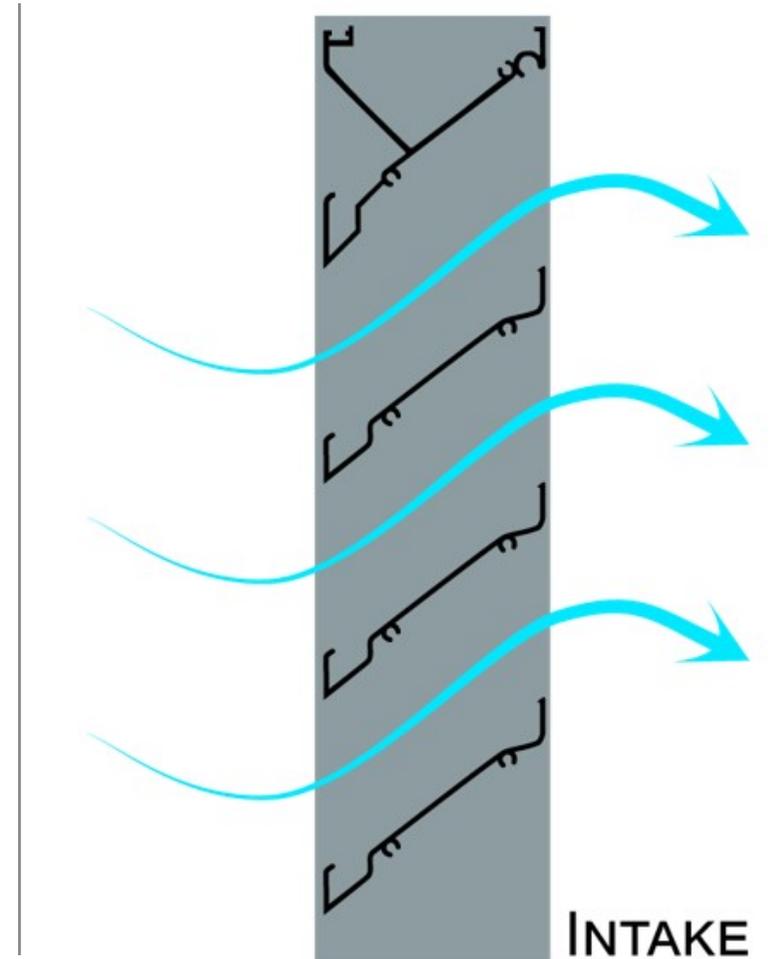


Louver Considerations

Intake/Exhaust: One of the most common application for louvers is for HVAC intake and exhaust systems, or general ventilation.

Free Area: The minimum area through which air can pass. Free area is used to calculate the pressure drop and the beginning point of water penetration.

Pressure Drop: The air performance of a louver is described by the pressure drop across the louver for a given flow rate of air through the free area.



Louver Considerations

Air Leakage: Air leakage for adjustable/combination louvers is measured in the closed position. Adding seals (gaskets) and weather stripping on blades and jambs reduces leakage.

Water Penetration: Water penetration is one of the most important considerations in louver selection and is extensively tested for every louver design.



Louver Testing and Certification

AMCA (Air Movement and Control Association), an international, not-for-profit association, maintains a reliable, independent protocol for testing HVAC equipment and louvers etc.



AMCA

- ✓ Develops the science and art of engineering
- ✓ Promotes business practices
- ✓ Develops and maintains standard testing methods of testing and implements Certified Ratings Programs
- ✓ Encourages the publishing of non-certified ratings
- ✓ Develops standard definitions etc. to facilitate communication
- ✓ Provides authoritative information and recommended practices

- ✓ Represents and speaks for the industry
- ✓ Communicates and promotes AMCA International's standards, services, and programs
- ✓ Acts as a technical resource center for the industry
- ✓ Maintains a sufficient organization and staff to deal effectively with the business of the association
- ✓ Collects, compiles, and publishes statistical data

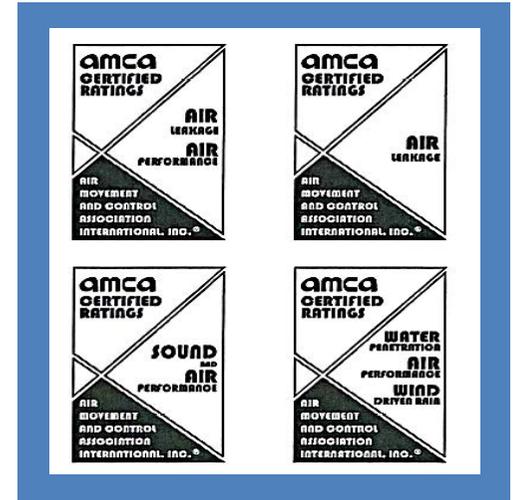
AMCA Testing

Manufacturers test products in an AMCA lab with results verified by the AMCA staff.

After obtaining AMCA license manufacturers offer products bearing AMCA seal (see adjacent samples).

An AMCA seal offers assurance that product will perform in accordance with the manufacturer's published test data.

Certified Ratings Program certifies product performance ratings: data generated from tested products is used to derive certified and published information.



AMCA Testing

Separate testing and rating requirements for each air control device and certification type.

The following data is submitted:

- Results of the test(s), corrected to standard air density, where applicable
- Photograph of each test setup
- Performance curve(s) of the test results, with test points identified
- Dimensional drawings and additional drawing for all louvers including those tested with a drain pan.

“[Licensee’s name] certifies that the [product designation] shown hereon [or herein] is licensed to bear the AMCA seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 511 and comply with the requirements of the AMCA Certified Ratings Program.”

The above statement is applied beside the seal to every tested product.

AMCA Testing

AMCA Standard 500-L, *Laboratory Methods of Testing Louvers for Rating*, establishes uniform test methods for determining pressure drop, water penetration, air leakage, and penetration of wind-driven rain.

All louvers tested for air performance are products as-built, unpainted, cleaned, degreased, and without additional factory applied coating on the product surfaces.

All devices tested are in the full open position without a screen across the air passages of the louver.





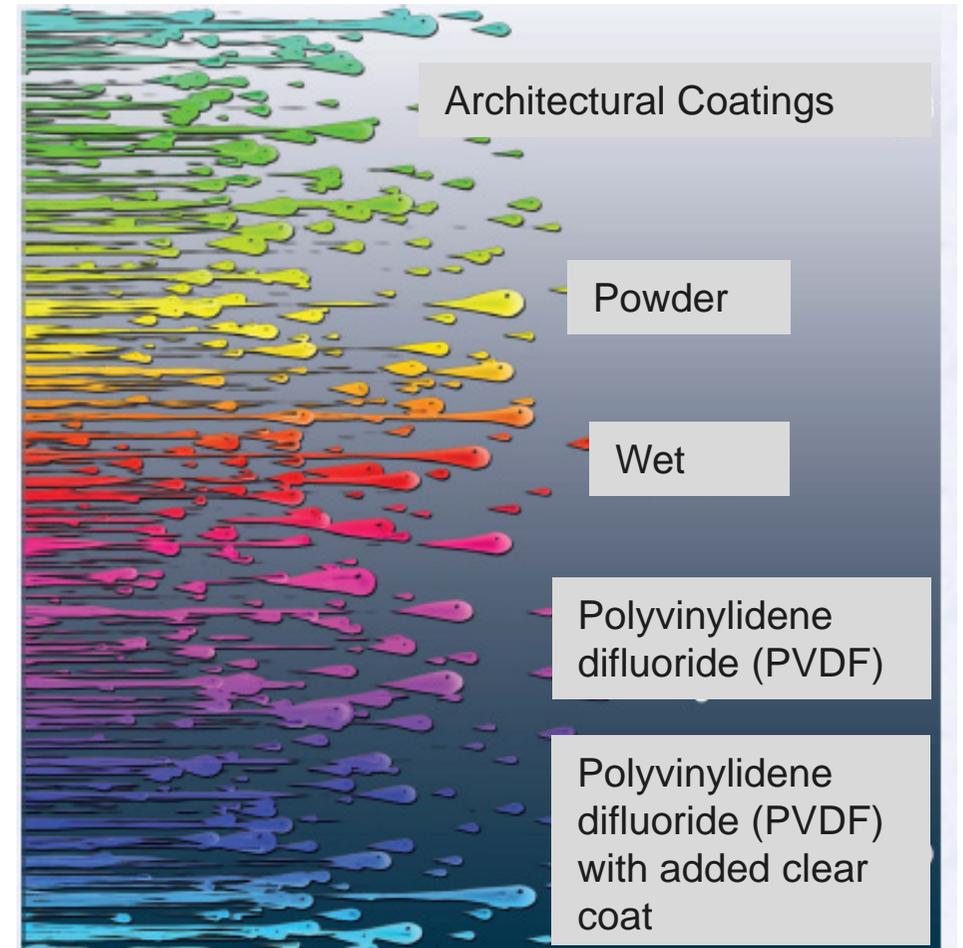
Louver Options and Accessories

Finishes

Finishes enhance appearance and provide extended resistance to weathering.

Some industrial applications require finishes to resist a wide variety of conditions such as temperature extremes and chemical reagents.

A variety of finishes are available at the factory or for field application when desired.



Finish Options

Mill finish: finish of natural aluminum or galvanized steel. Louvers with mill finish can be field painted or left in natural state.

Clear anodizing: an electro-chemical treatment of the aluminum surface to provide a uniform finish not easily affected by natural oxidizing from weather and smog etc.

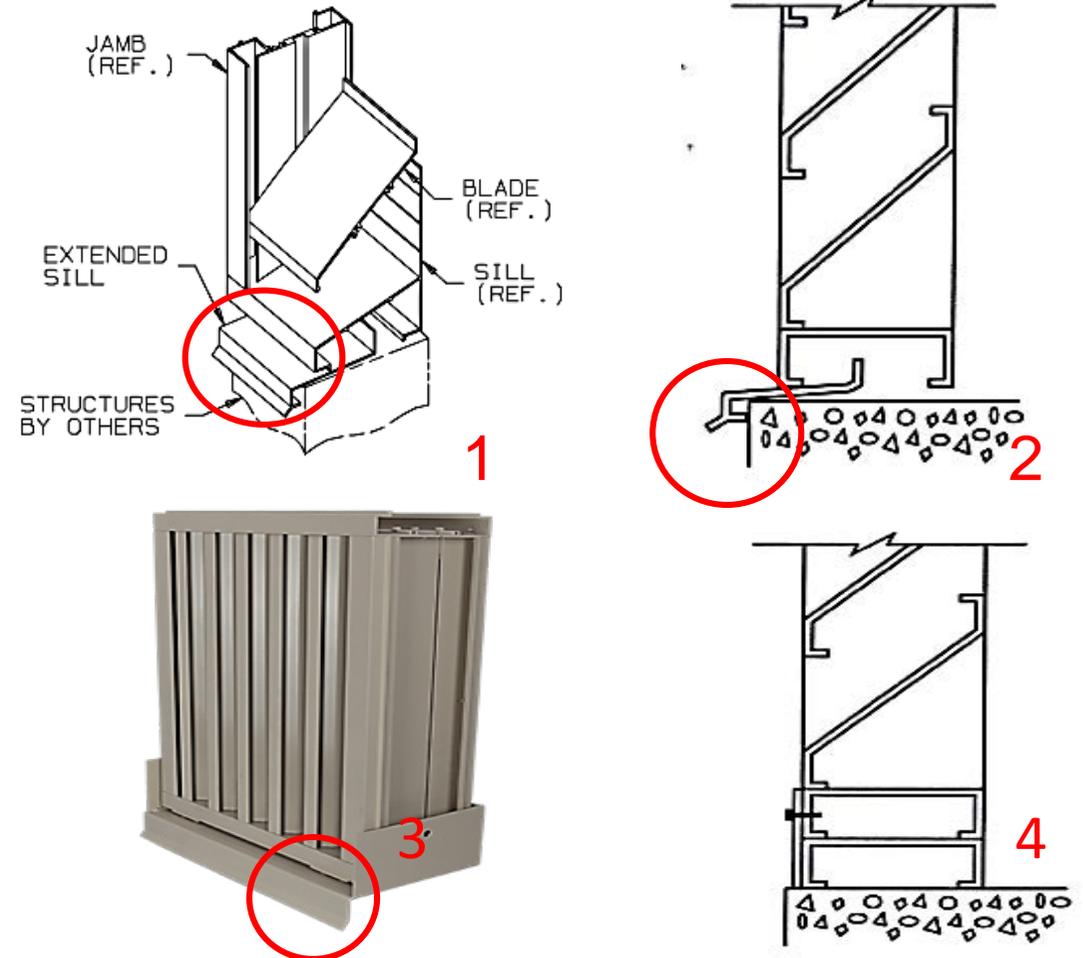
2604-02: Powder Prime Coat, Polyester, and Epoxy coating in a number of colors and finishes that meets salt spray performance tests.

2605-02 High Performance Fluoropolymer Thermosetting Resin: A powder paint with high surface hardness, and mar and abrasion resistance that meets a more stringent salt spray performance test.

Louver Accessories

Accessories are auxiliary components that implement louver function, facilitate installation, and/or enhance louver use.

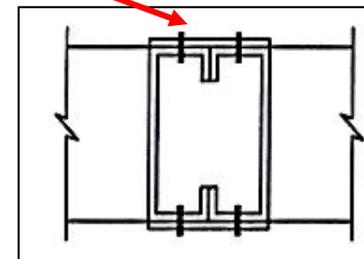
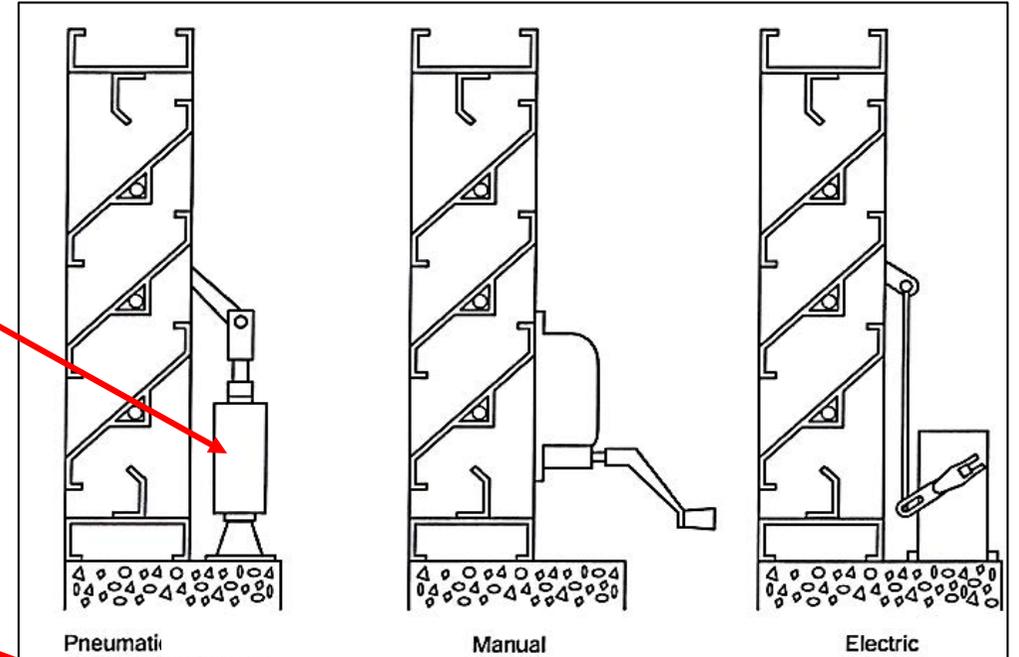
- **Sill extensions and flashings (1,2,3)** deflect and direct water away from opening and provide transition between the louver and adjacent structures.
- **Subframes (4)** are often used as an auxiliary frame around a louver. With appropriate hardware, louvers can be removable, hinged, latched, and sometimes restrained.



Louver Accessories

Actuators/operators move the blade(s) to an open, closed or intermediate position.

Mullion covers/batten plates are used to cover, conceal, or strengthen the joints between adjacent louvers or other structures.



Louver Accessories

- **Screens** prevent the passage of undesirable elements, such as insects and birds, through the louver while maintaining maximum airflow.
- **Blank-off panels** control the airflow while still keeping the louver's look. There are two types of panels: a single metal sheet, or an insulated sandwich panel.
- **Drain pans** are positioned under the louver sill to collect any penetrating water and drain it away before it enters ductwork or damages the opening.



Selecting and Sizing a Louver

Louver Selection Considerations

Louvers should:

- Be attractive and complement the surrounding architecture
- Inhibit undesirable elements (including sand) from entering the structure
- Offer low air resistance, thereby minimizing energy losses.

Consider:

- Pressure drop, water penetration, air leakage, sound transmission loss, wind-driven rain, and hurricane resistance

Specify:

- Who sizes and provides louver structural supports, anchorages, and fasteners
- Loading (in lbs./sq./ft. or metric equivalent)
- The pertinent governing building code(s)
- Whether structural calculations are required to be submitted, and/or if calculations and drawings must be approved and stamped by a professional engineer.

Louver Selection Considerations

System Effects

- System effects are local conditions that will influence the final performance of the louver. They are categorized inlet conditions, outlet conditions, accessories, and wind velocities.

Inlet and Outlet Conditions

- Inlet performance can be altered by overhangs, projections, obstructions, or adjacent walls which can cause air currents that alter or disrupt louver purpose and performance.
- Outlet conditions can be affected by improper ducting (elbows close to the louver) which vary the velocity profile across the louver.

Louver Sizing: Information Required

Louver type

Louver blade style

Blade angle and spacing

Louver depth

Louver construction material

Special performance requirements

Air volume, face velocity

Airflow: intake and exhaust

Screen type

Finish type and color

STATIONARY EXTRUDED ALUMINUM LOUVERS REFERENCE CHART												
MODEL	A M C A	LOUVER DEPTH	BLADE STYLE	BLADE ANGLE	BLADE SPACING	% FREE AREA 48" x 48"	JAMB SPLICE DETAIL	VERT. MULL. DETAIL	HORIZ. MULL. DETAIL	VERT. ANGLE SPLICE DETAIL	SPLICE INT. DETAIL	SUP. ANGLE DETAIL
EA-150		1 1/2"	BAFFLE	30°	1 1/2"	45%	3	1	5	4	7,8	6
EA-200	*	2"	BAFFLE	45°	2 3/4"	45%						
EA-210-D	*	2"	CHEVRON		1"	43%						
EA-215-D	*	2"	DRAIN	45°	2 3/4"	45%						
EA-331-VSL	*	3"	CHEVRON		13/16"	44%						
EA-400	*	4"	STANDARD	45°	4"	57%						
EA-400 CONT.			STANDARD			57%		2				
EA-405	*		BAFFLE			56%						
EA-405 CONT.			BAFFLE	45°	4"	56%		2				
EA-410	*		STANDARD	37°	3 1/2"	57%						
EA-410 CONT.			STANDARD					2				
EA-415-D	*		DRAIN									
EA-415 CONT.				37°	3 1/2"	57%		2				
EA-425-DD	*			45°	4"	52%						
EA-425 CONT.			DRAIN	45°	4"	52%		2				
EA-430			BAFFLE	30°	3"							
EA-430 CONT.			BAFFLE	30°	3"			2				
EA-445	*		DRAIN	45°	5"	51%						
EA-445 CONT.			DRAIN	45°	5"	51%		2				
EA-475-OH	*		CHEVRON		1 5/8"	47%						
EA-475-DV	*		CHEVRON		1 5/8"	47%						
EA-22	*	4"	DRAIN	45°	4"	52%						
EA-520-D	*	5"	CHEVRON		2"	44%						
EA-522	*	5"	CHEVRON		2 1/4"	48%						
EA-52	*	5"	CHEVRON		2"	44%						
EA-605	*	6"	STANDARD	45°	5 3/8"	55%						
EA-605 CONT.			STANDARD	45°	5 3/8"	55%		2				
EA-615-D	*		DRAIN		4 1/2"	56%						
EA-615 CONT.			DRAIN		4 1/2"	56%		2				
EA-620	*		STD/DRAIN	37°	3 1/2"	44%						
EA-620 CONT.			STD/DRAIN	37°	3 1/2"	44%		2				
EA-625-DD	*		DRAIN		4 1/2"	56%						
EA-625 CONT.			DRAIN		4 1/2"	56%		2				
EA-640-DR	*		DRAIN		5 3/8"	53%						
EA-662-VSL	*		CHEVRON		1 5/8"	53%						
EA-32	*		DRAIN	35°	4"	58%						
EA-64	*		DRAIN	35°	4"	58%						
EAV-56	*	6"	CHEVRON		1 5/8"	49%						
EA-725-D	*	7"			2 1/4"	45%						
EA-925-D	*	8"			2 1/4"	56%						

Louver Sizing: Calculating Free Area

Required free area used to size a louver for pressure drop or water penetration. Each louver design has its specific free area velocity value based on tests performed in accordance with ANSI/AMCA 500-L.

Recommended free area velocity for a louver depends on the acceptable pressure drop or water penetration velocity for the application.

$$FREE\ AREA = \frac{\text{design flow}}{\text{selected louver free area velocity}}$$

Example Louver Free Area Chart

		WIDTH m (in.)							
		0.30 (12)	0.61 (24)	0.91 (36)	1.22 (48)	1.52 (60)	1.83 (72)	2.13 (84)	2.44 (96)
HEIGHT m (in.)	0.30 (12)	0.02 (0.19)	0.05 (0.51)	0.08 (0.83)	0.11 (1.14)	0.13 (1.42)	0.16 (1.74)	0.19 (2.06)	0.22 (2.38)
	0.61 (24)	0.06 (0.62)	0.15 (1.63)	0.25 (2.64)	0.34 (3.66)	0.42 (4.54)	0.52 (5.55)	0.61 (6.57)	0.7 (7.57)
	0.91 (36)	0.09 (1.00)	0.24 (2.62)	0.39 (4.25)	0.55 (5.87)	0.68 (7.30)	0.83 (8.92)	0.98 (10.55)	1.13 (12.17)
	1.22 (48)	0.13 (1.43)	0.35 (3.76)	0.57 (6.09)	0.78 (8.42)	0.97 (10.46)	1.19 (12.78)	1.4 (15.11)	1.62 (17.44)
	1.52 (60)	0.17 (1.81)	0.44 (4.75)	0.71 (7.69)	0.99 (10.63)	1.23 (13.20)	1.5 (16.14)	1.77 (19.08)	2.05 (22.02)
	1.83 (72)	0.21 (2.24)	0.55 (5.88)	0.88 (9.51)	1.26 (13.51)	1.52 (16.33)	1.86 (19.97)	2.19 (23.60)	2.53 (27.24)
	2.13 (84)	0.25 (2.65)	0.64 (6.94)	1.04 (11.23)	1.44 (15.52)	1.79 (19.28)	2.19 (23.57)	2.59 (27.86)	2.99 (32.15)
	2.44 (96)	0.28 (3.05)	0.74 (7.99)	1.2 (12.94)	1.66 (17.81)	2.06 (22.20)	2.52 (27.15)	2.98 (32.09)	3.44 (37.03)

Louver Sizing: Calculating Free Area

Free Area can be measured in ft².*

Selected Free Area Velocity in that case is the recommended flow rate from the selected louver in fpm.

** all charts and calculations are available in both metric and imperial units ...*

$$FREE\ AREA = \frac{\text{design flow}}{\text{selected louver free area velocity}}$$

Example Louver Free Area Chart

		WIDTH							
		m (in.)							
		0.30 (12)	0.61 (24)	0.91 (36)	1.22 (48)	1.52 (60)	1.83 (72)	2.13 (84)	2.44 (96)
HEIGHT m (in.)	0.30 (12)	0.02 (0.19)	0.05 (0.51)	0.08 (0.83)	0.11 (1.14)	0.13 (1.42)	0.16 (1.74)	0.19 (2.06)	0.22 (2.38)
	0.61 (24)	0.06 (0.62)	0.15 (1.63)	0.25 (2.64)	0.34 (3.66)	0.42 (4.54)	0.52 (5.55)	0.61 (6.57)	0.7 (7.57)
	0.91 (36)	0.09 (1.00)	0.24 (2.62)	0.39 (4.25)	0.55 (5.87)	0.68 (7.30)	0.83 (8.92)	0.98 (10.55)	1.13 (12.17)
	1.22 (48)	0.13 (1.43)	0.35 (3.76)	0.57 (6.09)	0.78 (8.42)	0.97 (10.46)	1.19 (12.78)	1.4 (15.11)	1.62 (17.44)
	1.52 (60)	0.17 (1.81)	0.44 (4.75)	0.71 (7.69)	0.99 (10.63)	1.23 (13.20)	1.5 (16.14)	1.77 (19.08)	2.05 (22.02)
	1.83 (72)	0.21 (2.24)	0.55 (5.88)	0.88 (9.51)	1.26 (13.51)	1.52 (16.33)	1.86 (19.97)	2.19 (23.60)	2.53 (27.24)
	2.13 (84)	0.25 (2.65)	0.64 (6.94)	1.04 (11.23)	1.44 (15.52)	1.79 (19.28)	2.19 (23.57)	2.59 (27.86)	2.99 (32.15)
	2.44 (96)	0.28 (3.05)	0.74 (7.99)	1.2 (12.94)	1.66 (17.81)	2.06 (22.20)	2.52 (27.15)	2.98 (32.09)	3.44 (37.03)

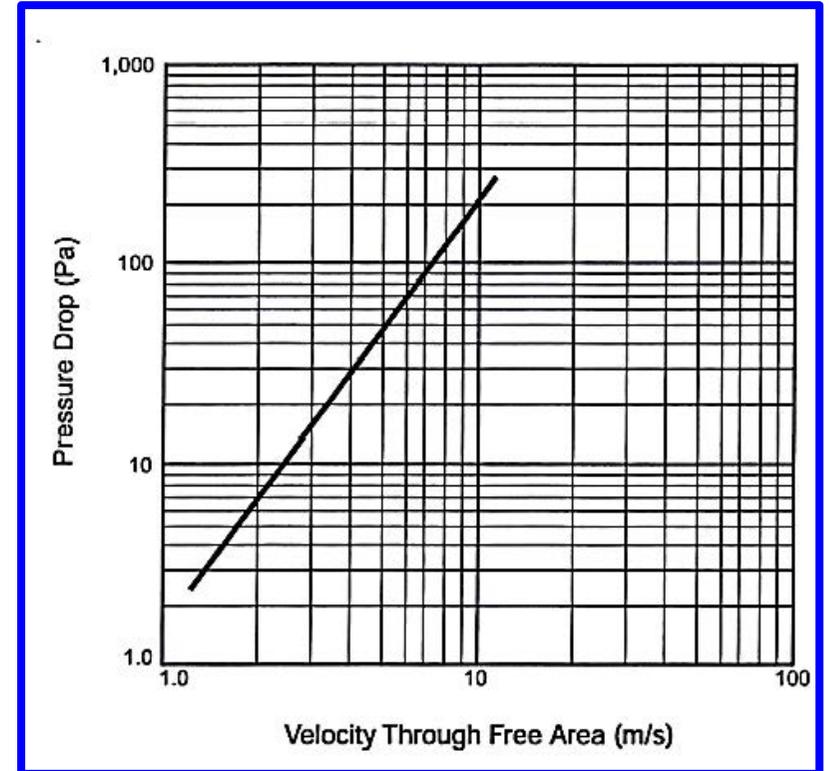
Louver Sizing

Free area based on air performance pressure drop

For a desired airflow of 13,500 cfm the velocity through free area charts recommend a velocity of 940 fpm for a pressure drop of 0.17 in. wg.

$$\text{FREE AREA} = \frac{7946}{4.78} = 1.33 \text{ m}^2 \quad \text{SI} \qquad \text{FREE AREA} = \frac{13,500}{940} = 14.36 \text{ ft}^2 \quad \text{I-P}$$

Minimum free area of 14.36 sq. ft. is required.
Solution: Louver 48 inches by 84 inches could meet this criteria.



Louver Sizing

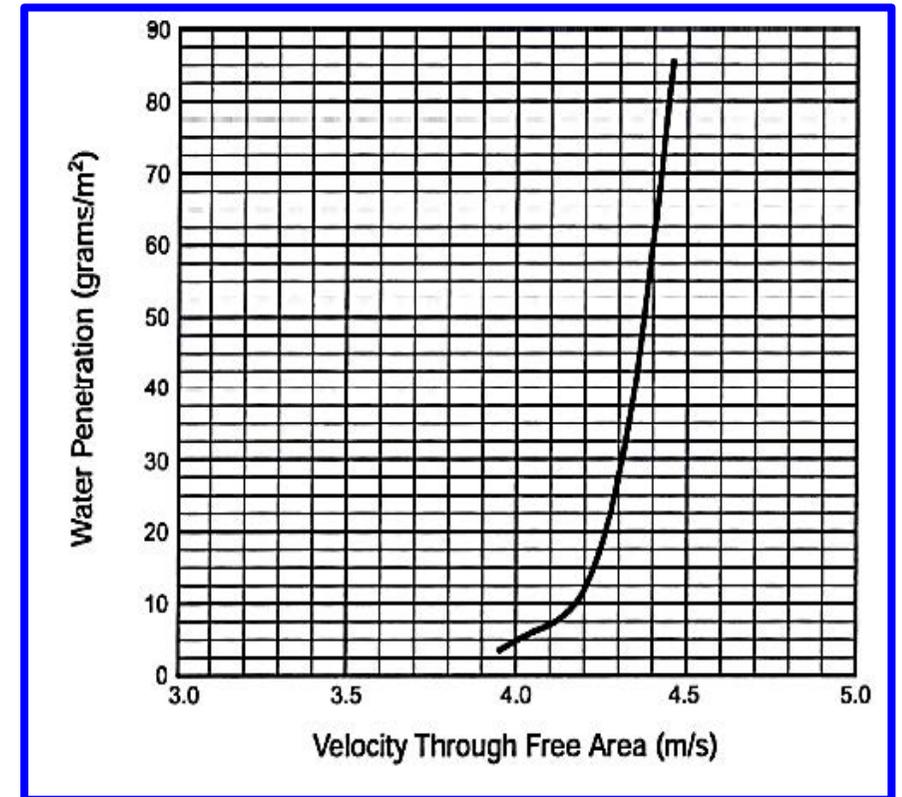
Free area based on water penetration

To provide 13,500 cfm, size the intake louver for minimum still air water penetration at 13,500 cfm.

The water penetration suggests 775 fpm. is the beginning point of water penetration.

$$\text{FREE AREA} = \frac{6.37}{3.81} = 1.67 \text{ m}^2 \quad \text{SI} \qquad \text{FREE AREA} = \frac{13,500}{750} = 18 \text{ ft}^2 \quad \text{I-P}$$

Solution: Louver sized 60 inches by 84 inches with a pressure drop of (0.09 in wg. is suggested as suitable.



Louver Sizing

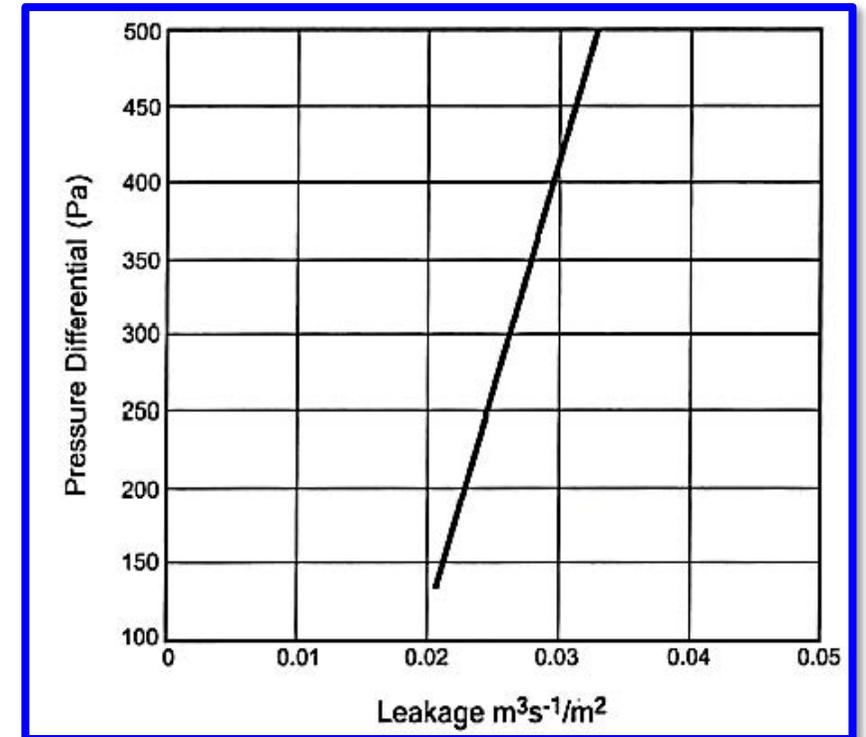
Free area based on air leakage

Air leakage rate at a specified pressure differential at a stated torque with the device in the closed position.

Example: Determine total air leakage through a 36 in x 48 in louver with a 0.6 in. wg. pressure differential.

A 36 in x 48 in louver has. 6.09 ft² of louver gross area. The adjacent chart indicates air leakage of .4 cfm/ft² of louver gross area at 0.6 in wg pressure differential.

Total air leakage at 0.6 in wg pressure differential= 4.4 cfm/ft² x 6.09 ft² = 26.8 cfm.



Louver Sizing

Free area based on air volume measured in Cubic Feet per Minute (CFM)

Beginning point of water penetration is located under the WATER PENETRATION CHART, or LOUVER PERFORMANCE STATEMENT.

Sizing Calculation (using beginning point of water penetration of 868 fpm) :

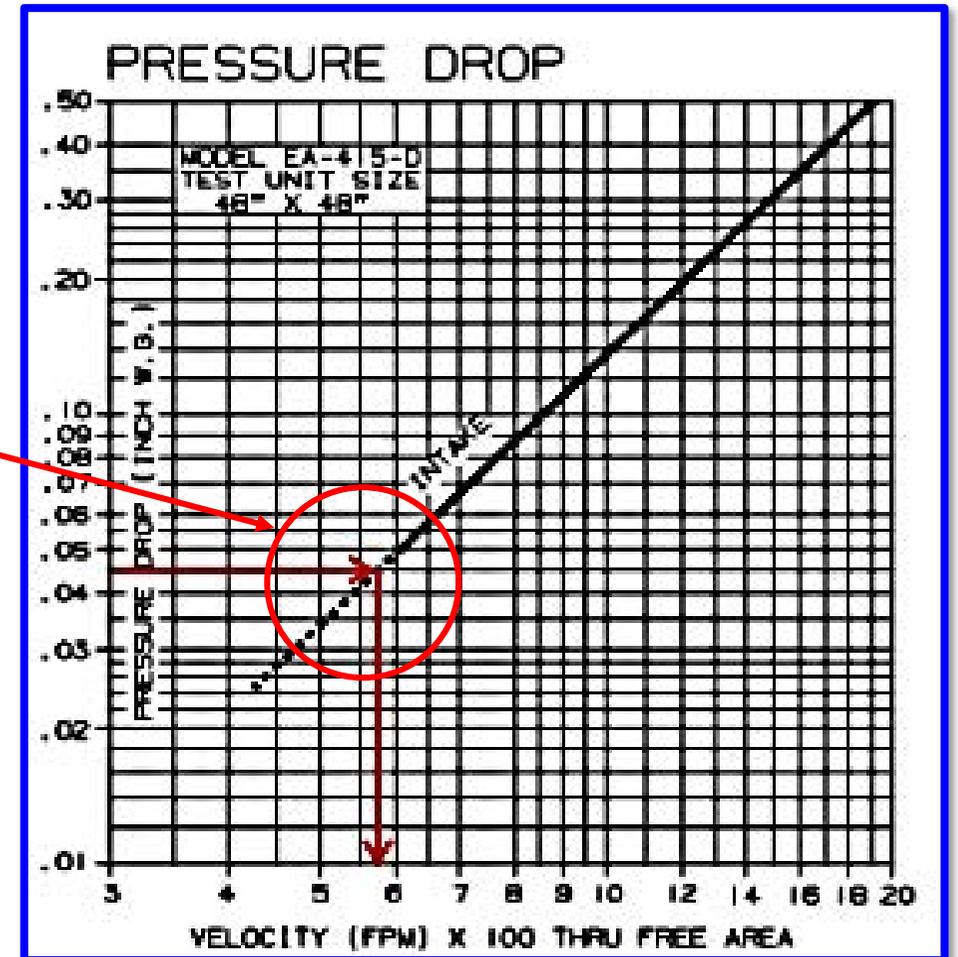
- N.B. For intake louvers: keep working air velocity 20%+ under beginning point of water penetration.
- To do this take 868 fpm. \times 0.80 = 694 fpm. intake velocity. If no working face velocity value is specified, 500 fpm. is a conservative and safe value to use with most intake air louver applications.
- For a sample calculation assume a specified 6000 cfm. and divide it by either the calculated intake velocity or 500 fpm. For comparison, do it both ways:
 - 6000 cfm./694 fpm. = 8.65 sq. ft. of free area required
 - 6000 cfm./500 fpm. = 12.0 sq. ft. of free area required
- Then find closest match on Free Area Chart

Note, the more square the louver is the more efficient it will be in regards to air movement.

Louver Sizing

Free area based on CFM and pressure drop in combination

1. Use Pressure Drop Chart and locate .045 on the vertical Y axis of the graph.
2. Draw a horizontal line from .045 to the right to intersect the diagonal pressure drop line labeled INTAKE.
3. From intersection, draw a line down to the intersection of the horizontal X axis line. This is now the new working velocity of 575 fpm.
4. 575 fpm falls between a conservative 500 fpm and the 20% less than beginning point of water penetration value of 694 fpm.



Louver Sizing

Pressure Drop is the measurement of resistance to airflow through the louver. For an intake louver it is measured on the rear face of the louver opposite intake airflow direction.

CFM and Pressure Drop in Combination

Based upon previous cfm based calculations, check the two potential louver sizes with the added pressure drop requirement and with a working face velocity in the louver of 575 fpm.

1. 48 in. wide x 48 in. high louver with 9.07 sq. ft. of free area
 - Check: $6000 \text{ cfm} / 9.07 \text{ sq. ft. free area} = 661.5 \text{ fpm}$.
 - $661.5 \text{ fpm} > 575 \text{ fpm}$. so based upon our new pressure drop criteria the 48 in. wide x 48 in. high louver will not work.
2. 54 in. wide x 60 in. high louver with 12.21 sq. ft. of free area
 - Check: $6000 \text{ cfm} / 12.21 \text{ sq. ft. free area} = 491.4 \text{ fpm}$.
 - $491.4 \text{ fpm} < 575 \text{ fpm}$ so based upon the added pressure drop criteria the 54 in. wide x 60 in. high louver will work; however, the velocity of 83.6 fpm. is lower than desired.

Louver Sizing

Free area based on CFM and pressure drop in combination

Fine tune louver size to better match the required free area. 6000 cfm./575 fpm. = 10.43 sq. ft. of free area required.

Using the rule of thumb that square louvers are more efficient, find a size 48 in. wide & between 48 in. and 60 in. high or 54 in. wide & between 48 in and 60 in high that comes close to the new free area of 10.43 sq. ft.

FREE AREA

		FREE AREA (SQ. FT.)								
		WIDTH								
HEIGHT		12"	18"	24"	30"	36"	42"	48"	54"	60"
		12"	.33	.53	.74	.95	1.16	1.36	1.57	1.77
24"	.80	1.30	1.81	2.31	2.82	3.32	3.82	4.33	4.83	
36"	1.26	2.05	2.84	3.64	4.43	5.23	6.02	6.81	7.61	
48"	1.84	3.00	4.16	5.32	6.48	7.64	8.80	9.97	11.13	
60"	2.25	3.68	5.10	6.52	7.95	9.37	10.79	12.21	13.64	
72"	2.83	4.62	6.41	8.20	9.99	11.78	13.57	15.36	17.15	
84"	3.29	5.37	7.45	9.53	11.61	13.69	15.77	17.85	19.93	
96"	3.82	6.23	8.64	11.05	13.47	15.88	18.29	20.70	23.11	

Louver Sizing

Free area based on CFM and pressure drop in combination

Free Area Interpolation

60" - 48" = 12" this will be the number of graduations we will be working with.

$$\begin{aligned}48" \times 48" &= 9.07 \text{ sq. ft free area} \\48" \times 60" &= 10.79 \text{ sq. ft free area} \\10.79 - 9.07 &= 1.72\end{aligned}$$

$1.72/12 = .1433$ increase in free area per inch of louver height

$$\begin{aligned}10.43 \text{ (required free area)} - 9.07 \text{ (48" x 48" free area)} &= 1.36 \\1.36 / .1433 &= 9.49 \text{ increments}\end{aligned}$$

(to keep from working in fractional inches round increments up to next whole number)

$$10 \times .1433 = 1.433$$

$$\begin{aligned}9.07 + 1.433 &= 10.503 \text{ sq. ft. free area} \\&\text{for a 48" wide x 58" high (48+10)}\end{aligned}$$

Check for Pressure Drop velocity:

$$6000 \text{ CFM } 10.503 \text{ sq. ft. free area} = 571.26 \text{ fpm}$$

$$\begin{aligned}48" \text{ wide x } 58" \text{ high} \\571.26 \text{ fpm (calculated)} < 575 \text{ fpm (required)} \\ \text{PRESSURE DROP VELOCITY O.K.}\end{aligned}$$

Less efficient louver shape, lower louver cost

60" - 48" = 12" this will be the number of graduations we will be working with.

$$\begin{aligned}54" \times 48" &= 9.97 \text{ sq. ft free area} \\54" \times 60" &= 12.21 \text{ sq. ft free area} \\12.21 - 9.97 &= 2.24\end{aligned}$$

$2.24/12 = .1866$ increase in free area per inch of louver height

$$\begin{aligned}10.43 \text{ (required free area)} - 9.97 \text{ (48" x 48" free area)} &= .46 \\ .46 / .1866 &= 2.46 \text{ increments}\end{aligned}$$

(to keep from working in fractional inches round increments up to next whole number)

$$3 \times .1866 = .5598$$

$$\begin{aligned}9.97 + .5598 &= 10.5298 \text{ sq. ft. free area} \\&\text{for a 54" wide x 51" high (48+3)}\end{aligned}$$

Check for Pressure Drop velocity:

$$6000 \text{ CFM } 10.5298 \text{ sq. ft. free area} = 569.811 \text{ fpm}$$

$$\begin{aligned}54" \text{ wide x } 51" \text{ high} \\569.811 \text{ fpm (calculated)} < 575 \text{ fpm (required)} \\ \text{PRESSURE DROP VELOCITY O.K.}\end{aligned}$$

More efficient shape, higher louver cost

OR



Using Wind Driven Rain and Hurricane Louvers

Wind Driven Rain (WDR) Louvers

Protect air intake and exhaust openings from rain infiltration

Tested* and classified by ability to reject simulated rain compared to an open hole the same size as the core opening.

Effectiveness: 1.0 is 100% and 0.8 is 80%.

<u>Class</u>	<u>Effectiveness</u>
• A	99%
• B	98.9% to 95%
• C	94.9% to 80%
• D	Below 80%

**AMCA 550 Test Method for High Velocity Wind Driven Rain Resistant Louvers*



Hurricane Louvers

Hurricane louvers meet standards of WDR louvers plus provide impact resistance to flying debris in high-wind events, like hurricanes and tornados.

AMCA Test Standard 540, “*Test Method for Louvers Impacted by Wind Borne Debris,*” basis of specification for all louvers requiring impact resistance.

Stationary louvers should be approved for High Velocity Hurricane Zone (HVHZ) louvers, in compliance with Miami-Dade County Building Code protocols.



Where AMCA 540 Applies

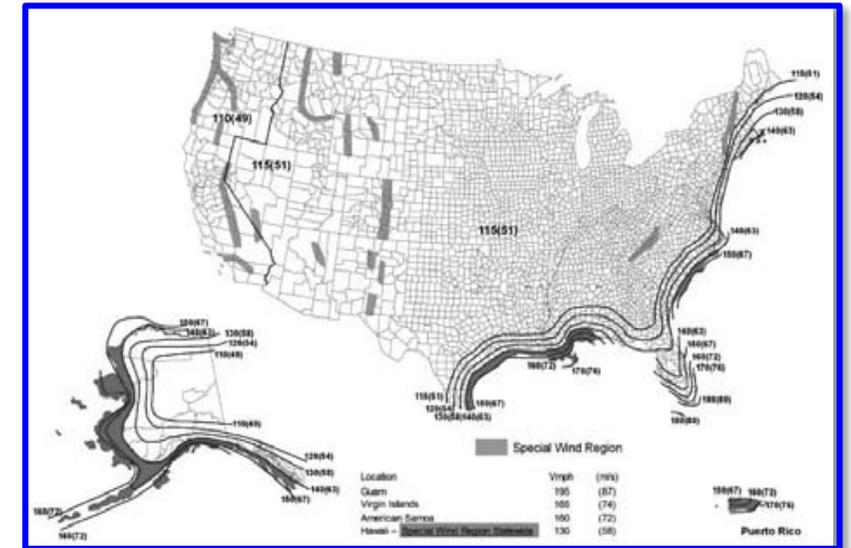
Outside Florida International Building Code (IBC) is used

IBC 2012 Section 1609.1.2.1 states:

“Louvers protecting intake and exhaust ventilation ducts not assumed to be open that are located within 30 feet of grade shall meet requirements of AMCA 540.”

IBC 2012 uses new, higher wind (≥ 140 mph. or 130 mph. 1 mi. from coast) velocity maps.

Louvers supplied in the wind borne debris regions located lower than 30 feet from grade must be impact resistant.



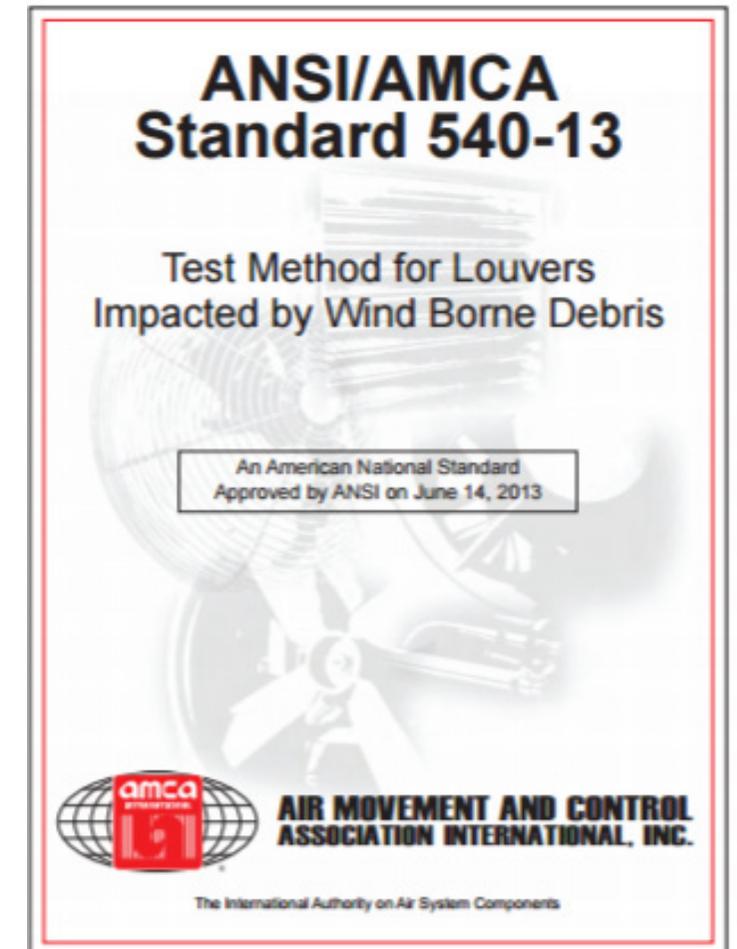
Wind borne debris regions for Category II and Category III non-healthcare buildings.

What AMCA 540 Tests

Establishes uniform methods for laboratory testing of louvers that are impact tested with large missiles.

Tests impact on exterior louvers as required by the IBC and IRC.

For larger louvers, the blades may require additional supports on the rear to meet wind load/impact requirements.



Where AMCA 550 Applies

AMCA 550 establishes water performance

Adopted by the International Mechanical Code and FBC (Florida Mechanical Code) as the performance standard for louvers in hurricane-prone areas.

IBC 2012 and FBC 2010 define the hurricane-prone regions as: “The U.S. Atlantic Ocean and Gulf of Mexico coasts where the basic wind speed for Risk Category II buildings is greater than 115 mph and Hawaii, Puerto Rico, Guam, Virgin Islands and American Samoa”

All of Florida is considered a hurricane zone.

2010 Florida Mechanical Code section 401.5 states: “Louvers that protect air intake openings in structures located in hurricane-prone regions, as defined in the Florida Building Code, Building shall comply with AMCA 550.”

2010 Florida Mechanical Code section 501.2.2 states:
“Louvers that protect exhaust openings in structures located in hurricane-prone regions, as defined in the Florida Building Code, Building, shall comply with AMCA 550.”

What and How AMCA 550 (WDR) Tests

Water is injected into the airstream and driven toward the louver while the intake fan blows air through the louver.

AMCA 550 evaluates louvers for water penetration at wind speeds of 35, 70, 90, and 110 mph.

The rainfall rate used is 8.8 in/hr.

WDR louvers must remove enormous amounts of water from airstream and if a louver with high-water performance is not used, a damper must be located behind the louver and closed during the event.





Summary

Summary

Louvers wide range of functions from decorative to critical protection.

Two primary roles: to facilitate appropriate airflow and to inhibit unwanted penetration.

There are many types of louvers to suit a wide range of contexts.

There are many louver options, components, and accessories that affect performance.

Other louver attributes (free area, pressure drop, water penetration, etc.) affect selection and sizing.

System effects (adjacent walls and overhangs, etc.) also affect louver performance.

Summary

Many weather-based contexts influence the choice and performance of louvers and require specific louver designs.

Building codes describe the minimum performance required but project requirements may demand higher standards.

Manufacturers supply information to assist the designer in assessing components, attributes, regulations, and conditions.

AMCA conducts tests and provides standards and information that verify the performance of various louver types.

The designer must take into consideration all of the above factors and how they may affect one another, and integrate those findings with all available Information.

Thank you for your time



Questions?

This concludes The American Institute of Architects
Continuing Education Systems Course

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