PRODUCT APPLICATION GUIDE

A technical bulletin for engineers, contractors and students in the air movement and control industry.

Louver Fundamentals and Selection Considerations

Louvers have been used in building openings since the Middle Ages to allow airflow into a building, while keeping out the unwanted elements of water, birds, and debris. Today, architects not only use louvers to create exciting and distinct exteriors, but also as the first line of defense to protect HVAC systems and ductwork from water damage. Having a fundamental understanding of performance characteristics early in the selection process will help maximize the benefits of louver form and function. This approach to louver selection ensures maximum HVAC system operation and reduces the need for more costly repairs from damage to air handling equipment.

Understanding the performance characteristics used in louver selection should include two steps. The first is knowledge of the criteria required in the selection process. However, an important second step is gaining an understanding of an organization that sets the performance and certification standards for the industry, and the role it plays in the design process. The Air Movement and Control Association, International, Inc. (AMCA), is a not-for-profit organization consisting of AMCA staff and manufacturer members in the HVAC industry. AMCA provides testing and certifications for products manufactured by the air movement and control industry, so engineering and architectural specifiers and installing contractors have accurate, reliable, and comparable product performance data.

AMCA tests products using specific criteria (industry accepted test procedures) to ensure products meet industry standards for safety and performance in several weather situations. Basic criteria for louver performance used in standards and for the selection process are free area, air volumetric flow rate, air pressure drop, and the beginning point of water penetration. None of these criteria offers enough information for louver selection alone. However, when combined, the results will provide direction for selecting the best louver for the application.

Louvers were a prominent architectural and functional feature since the Middle Ages.

Free Area

The free area of a louver is defined as the total louver face area, minus the airflow restrictions (blades and frame) through which air can freely pass within the openings. Free area is a major determinant of a louver's performance capabilities. The goal is to allow as much air as possible to pass through the louver while keeping out unwanted water, or debris. Too great of a free area and the louver cannot reject water. Too little free area and the louver becomes an unwanted restriction to airflow. Understanding free area and its impact on louver performance allows the specifier to compare and contrast the various louver performance attributes. Free area often is represented in square feet or as a percentage of total louver face area. Published louver free area is calculated using the AMCA standard louver test opening size of 4 ft. x 4 ft.

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Additional free area is easily calculated based on sizes other than the standard 4 ft. x 4 ft. But do not assume that the stated louver free area will remain constant regardless of size for a specific model. Louver free area varies at sizes other than the tested standard of 4 ft. x 4 ft. *(Example 1)*.

Once the free area is known, you can determine a louver's potential air volume at a given velocity, measured in feet per minute (FPM).

Example 1 Free Area Chart - in square feet

Fan area does not increase proportionately with louver face area.

1. **Louver #1**, 24" x 24"
   1.76/4 sq. ft. = 44% free area
2. **Louver #2**, 48" x 48"
   8.32/16 sq. ft. = 52% free area
3. **Louver #3**, 66" x 72"
   17.60/30.25 sq. ft. = 58% free area

Height in Inches	Width in Inches																		
	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
12	0.30	0.50	0.69	0.89	1.08	1.28	1.47	1.62	1.82	2.01	2.21	2.40	2.60	2.79	2.99	3.13	3.32	3.52	3.71
18	0.50	0.83	1.15	1.48	1.80	2.13	2.45	2.70	3.02	[illegible]	3.67	4.00	4.33	4.65	4.98	5.21	5.53	5.86	6.18
24	0.77	1.26	1.76	2.26	2.76	3.25	[illegible]	[illegible]	[illegible]	[illegible]	5.62	6.12	6.61	7.11	7.61	7.96	8.46	8.96	9.45
30	0.98	1.62	[illegible]	2.89	3.52	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7.18	7.82	8.45	9.09	9.72	10.18	10.81	11.45	12.08
36	1.23	2.03	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	9.04	9.84	10.64	11.44	12.23	12.81	13.61	14.41	15.21
42	1.51	2.49	[illegible]	[illegible]	[illegible]	[illegible]	7.38	8.12	9.10	10.08	11.06	12.03	13.01	13.99	14.97	15.67	16.65	17.63	18.60
48	1.70	2.80	[illegible]	[illegible]	[illegible]	[illegible]	8.32	9.16	10.26	11.36	12.47	13.57	14.67	15.78	16.88	17.67	18.77	19.88	20.98
54	1.97	3.25	4.53	5.81	7.09	8.37	[illegible]	10.62	[illegible]	13.18	14.46	15.74	17.02	18.03	19.58	20.49	21.77	23.05	24.33
60	2.17	3.58	4.98	6.39	7.79	[illegible]	[illegible]	[illegible]	[illegible]	14.49	15.89	17.30	18.71	20.11	21.52	22.53	23.93	25.34	26.74
66	2.44	4.02	5.60	7.18	8.76	[illegible]	[illegible]	[illegible]	[illegible]	16.28	17.86	19.45	21.03	22.61	24.19	25.32	26.90	28.48	30.06
72	2.63	4.34	6.05	7.76	9.47	[illegible]	[illegible]	[illegible]	[illegible]	17.60	19.31	21.01	22.72	24.43	26.14	27.36	29.07	30.78	32.49
78	2.90	4.79	6.67	8.55	10.43	12.32	14.20	15.63	17.51	[illegible]	21.27	23.16	25.04	26.92	28.80	30.15	32.03	33.92	35.80
84	3.10	5.12	7.13	9.14	11.15	13.17	15.18	16.70	18.72	20.73	22.74	24.75	26.77	28.78	30.79	32.23	34.25	36.26	38.27
90	3.37	5.55	7.74	9.92	12.11	14.29	16.47	18.13	20.32	22.50	24.68	26.87	29.05	31.24	33.42	34.99	37.17	39.36	41.54
96	3.81	6.28	8.75	11.22	13.69	16.16	18.63	20.50	22.97	25.44	27.91	30.38	32.85	35.32	37.79	39.56	42.03	44.50	46.97
102	3.83	6.32	8.81	11.30	13.78	16.27	18.76	20.64	23.13	25.62	28.10	30.59	33.08	35.56	38.05	39.83	42.32	44.81	47.29
108	4.11	6.78	9.44	12.11	14.77	17.44	20.10	22.13	24.79	27.46	30.12	32.79	35.45	38.12	40.78	42.69	45.36	48.03	50.69
114	4.30	7.09	9.88	12.67	15.46	18.26	21.05	23.16	25.95	28.74	31.53	34.32	37.11	39.90	42.70	44.70	47.49	50.28	53.07
120	4.57	7.54	10.51	13.48	16.44	19.41	22.38	24.63	27.59	30.56	33.53	36.49	39.46	42.43	45.39	47.52	50.49	53.45	56.42

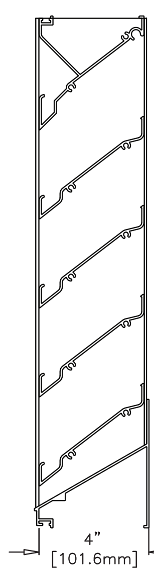
1.76/4 sq. ft. = 44% Free Area

8.32/16 sq. ft. = 52% Free Area

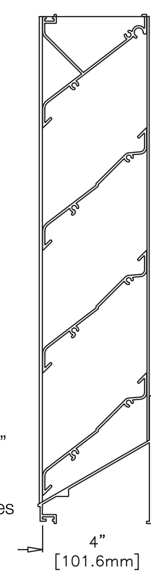
17.60/30.25 sq. ft. = 58% Free Area

Louvers are available in a wide variety of performance types with varying blade profiles, blade angles and blade spacing. The specifier should pay close attention to the product data sheets as even similar models within the same performance category can have noticeably different free areas *(Example 2)*.

Example 2



Louver 1
Size: 48" x 48"
Depth - 4"
Frame Thickness – .081"
Blade Profile - Drainable
Blade Spacing – 4"
Blade Angle - 30 Degrees
Free Area - 53%



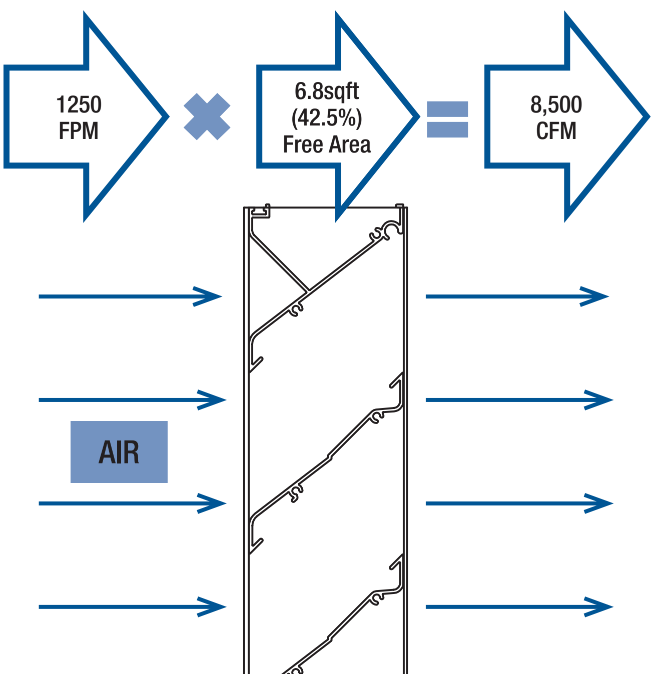
Louver 2
Size: 48" x 48"
Depth - 4"
Frame Thickness – .081"
Blade Profile - Drainable
Blade Spacing - 5"
Blade Angle - 45 Degrees
Free Area - 49%

Air Volume (CFM)

Air volume flow rate is the measurement of air flowing into or out of a space measured in cubic feet per minute (CFM). Louvers allow air to pass through the building envelope and into the HVAC system while keeping water, birds and debris out of the intake airstream. Additionally, louvers must provide the required system CFM per square foot of louver free area to the air handling equipment to ensure operation at peak performance. Louver CFM potential is calculated easily by multiplying the proposed air velocity (FPM) by the free (sq. ft.) of the louver (*Example 3*). Louver selection should not be only based on a maximum CFM required. Rather, the maximum CFM should be compared to the point at which the louver allows measurable water to pass through it along with the intake air. The point at which measurable water passes through a louver is referred to as the beginning point of water penetration. Understanding the relationship of the beginning point of water penetration to a louver's maximum CFM will help decision making on which louver to select, or if additional provisions are necessary to capture any water that may pass.

Example 3 – Air Volumetric Flow Rate

CFM = air velocity (FPM) x Area (sq. ft.) –
1,250 fpm x 6.80 sq. ft. = 8,500 cfm



The Beginning Point of Water Penetration

The ability to prevent water penetration through a louver is an important criterion for louver selection. As previously discussed, louver design allows air into buildings while keeping out unwanted water and debris. Accomplishing this requires careful attention to design. A complex arrangement of specific louver blade profiles, the angles of the blades, blade position, spacing, or a combination of blade position and spacing all contribute to the degree of minimizing water penetration.

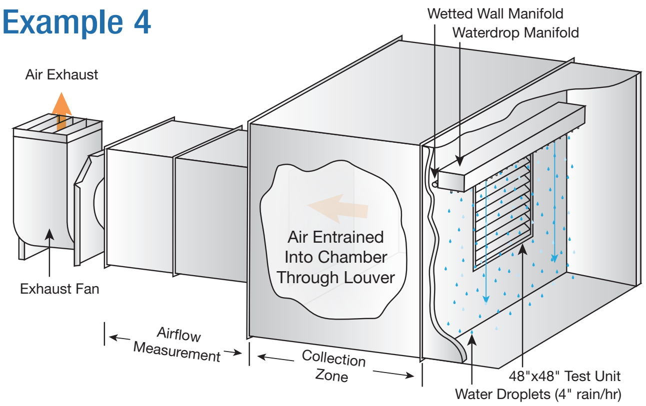
Each louver manufacturer has a different blade configuration approach to water penetration. Most manufacturers submit designs for testing against the AMCA 500-L tests—the industry standard for water penetration (*Example 4*). Per AMCA, "water penetration is the amount of water passing through a louver while air is flowing through it at a specific free area velocity. It is expressed as the weight of water passing through the louver divided by the free area, at a specified free area velocity." Stated more simply, the beginning point of water penetration, is the moment at which .01 oz. of water will pass through a louver at a given intake velocity measured in FPM.

The test is conducted as follows:

- Simulated Wind: None
- Simulated Rain: Free-falling water droplets in front of test louver at a rate of 4 inches per hour
- Wetted-wall: Applies water to the wall face above the louver at a rate of ¼ gallon per hour
- Duration: 15 minutes
- Test louver size: 48" x 48"
- Finish: Natural mill finish only
- Accessories: No bird or insect screen permitted

AMCA 500-L Louver Water Penetration Test

Example 4



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It is important to note that this test only simulates the conditions a louver might encounter during a gentle rain. The test does not subject louvers to wind-driven rain or other severe weather conditions.

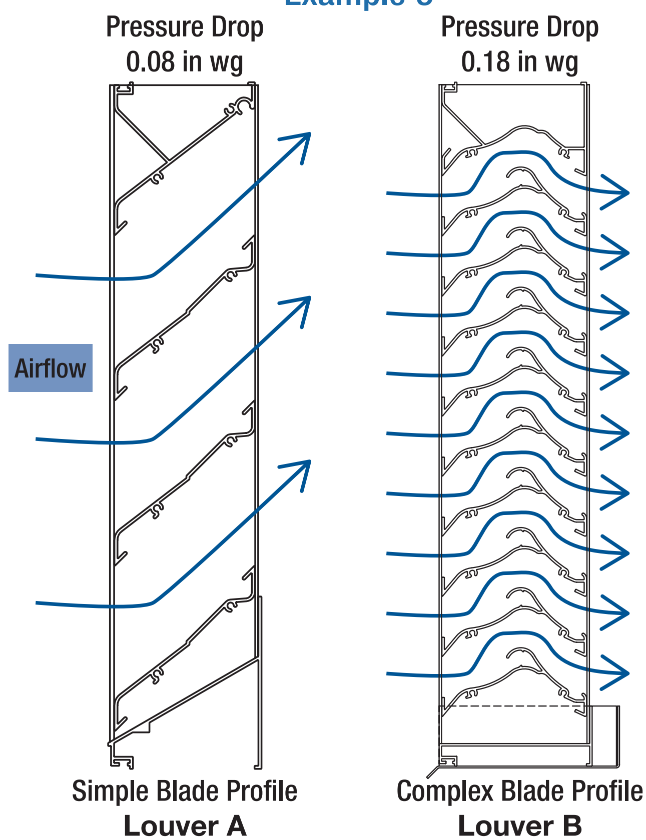
Pressure Drop

Pressure drop is the resistance to airflow across a louver stated in inches of water. The level of airflow resistance is a significant factor in louver selection. Factors affecting pressure drop are the same for the beginning point of water penetration. (*Example: 5*) A negligible pressure drop allows a high degree of airflow but may also allow water and debris through the louver opening. Conversely, a high-pressure drop may not allow an acceptable airflow. The latter may place a strain on air-handling equipment, causing it to work harder, resulting in increased energy cost and greater acoustic noise or the need to invest in more expensive air-handling equipment.

The cost to operate air-handling equipment varies depending on a louver's resistance to airflow (pressure drop). Most louvers have a pressure drop in a range between 0.03 - 0.50 in. wg. Air handling equipment must work to move the air through the system. The ideal pressure drop is one that meets your specifications.

Louver A's simple blade profile does not cause a higher pressure drop when compared to a complex blade profile (Louver B).

Example 5



Conclusion

Louvers are essential components of a building's HVAC system and proper selection and application can be complex. Many variables govern the performance characteristics and potential applications of louvers. This makes selecting the best louver a challenge as manufacturers offer many different louver styles. The best approach to louver selection combines the importance of understanding the value of independent third party certified testing, the applicable test standards, with the basics of free area, pressure drop, air volume, and the beginning point of water penetration. This information helps designers and their clients specify the best aesthetically pleasing louvers that meet the demands of today's high-performance HVAC systems.

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