ENGINEERING REPORT

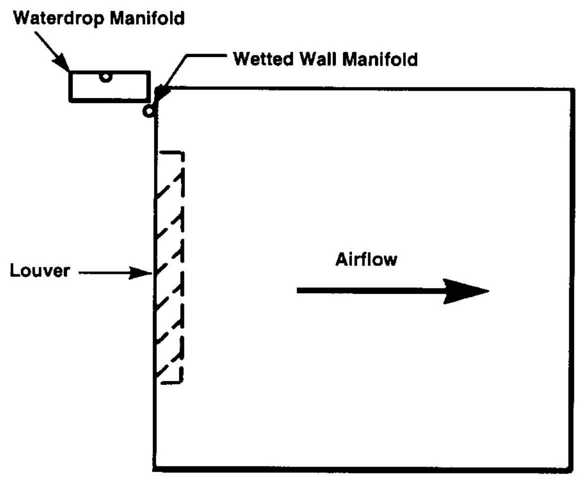
TOPIC: Louver Wind Driven Rain Performance

Report No. 996:1 **SEPTEMBER 1996** **By James Livingston**

The challenge for system designers when sizing louvers is to minimize water penetration. Engineers calculate the required size of louvers based on the amount of air required for the system and the airflow at which the louver begins significant water carry-over. Usually, the engineer specifies louvers that are large enough to handle the required airflow at a free area velocity somewhat less than the maximum recommended by the manufacturer. While the standard test for water penetration for years has been a "still air" procedure with no wind applied to the louver, the importance of wind driven rain testing is becoming more apparent.

Historically, louver water penetration has been measured by the Air Movement and Control Association, Inc. (AMCA), a trade association. In the AMCA water penetration test, the 4' x 4' louver test sample is mounted in a wall of the test chamber. The exterior face of the louver is flush with the face of the chamber wall. A fan installed in the chamber several feet behind the louver pulls air through the sample. Water is introduced to the louver in two ways; by applying water to the wall above the louver that runs down to the test sample and by dropping water in front of the louver from a tray above. The object of the test is to see how much moisture is pulled through the louver at various airflow rates. Airflow is measured in free area velocity in feet per minute through the louver's free area. The water that accumulates in the test chamber behind the sample is collected and measured after the test. The beginning point of water penetration is considered to be the free area velocity at which the louver allows .01 ounces of water per square foot of free area to penetrate during the 15 minute test. This beginning point of water penetration is the benchmark to which all louvers that participate in the AMCA test are compared. Air is pulled through the louver in this test only; no air is blown at the sample to represent wind.

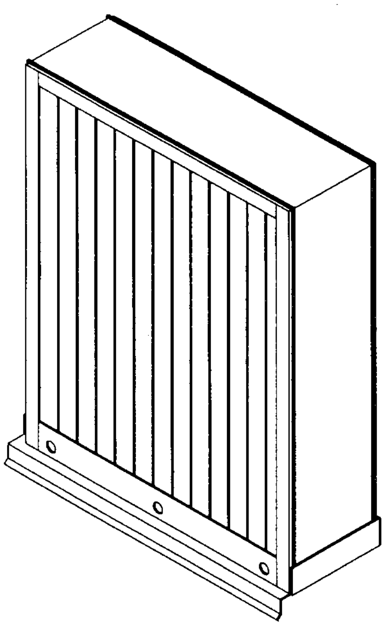
While this test procedure certainly is a good method to compare louvers in a draw-through fan configuration, it does not address a typical storm situation where rain is accompanied by wind. The AMCA procedure tests up to 1,250 feet per minute velocity through the free area. This airflow pulled through a 50% free area louver creates the equivalent of slightly over 7 mph wind velocity at the face of the test sample. Keep in mind that this airflow is being pulled through the sample and really only represents the system airflow, not additional wind applied to the louver face.



AMCA WATER PENETRATION CHAMBER

In Europe, another trade association, the HEVAC Association, has developed a British Standard water penetration test procedure for louvers that subjects the samples to water, system pressure *and* wind. This procedure utilizes a fan installed at the intake of the louver chamber that applies 13 meters per second, or 29.1 mph, wind to the test samples. Rain is simulated in the test via several nozzles that spray water into the airstream in front of the louver. Air is also pulled through the louver simultaneously by a fan mounted behind the louver. The water applied in the test simulates a 75mm per hour, or 3" per hour, rainfall rate. The louvers' performance is indicated in an efficiency rate, which is a comparison of the amount of water that penetrates the louver versus the amount that would penetrate a clear opening of identical size under the same weather conditions.

Louvers that perform well in the HEVAC or similar wind driven rain penetration tests typically are different in design than standard wall louvers. Over the years, the AMCA test has significantly influenced the design of louvers in the U.S. Many louver manufacturers have discovered that by making design changes to the blades and frames, louvers with greater blade spacing and fewer blades can perform comparably in the water penetration test to louvers with more blades at closer spacing. However, louvers with greatly spaced blades usually do not perform as well in wind driven tests as designs utilizing numerous blades. For wind driven rain performance, design features such as drainable blades that are intended to capture and manage water at the front of the louver become less effective. Instead, blade profiles and spacing become the most important factor in a louvers' performance. Since water is being forced into the louver in these applications, the blades must block moisture internally and prevent it from passing completely through the unit. Increasing louver depth also reduces water penetration in these conditions. While horizontal blade models can be designed to preform well, vertical blade designs typically provide the best performance. Free area and pressure drop, which usually are adversely affected as the number of blades in a louver increases, actually improve when the blade spacing is extremely narrow and the blade profile is properly designed.

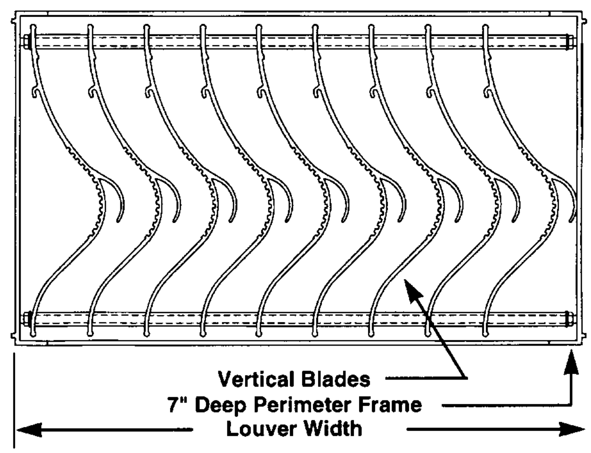


EME6625 LOUVER

Louvers of this design are obviously good choices for applications where wind driven rain penetration is unacceptable. Coastal or other regions that are subject to excessive rain and severe weather will benefit from these products. Another use of these models are in high intake velocity applications that would typically induce excessive water carry over through a standard wall louver.

During the development of the EME6625 louver, Ruskin constructed a wind driven water penetration test chamber in its research and development lab. While modeled after the HEVAC chamber, the following modifications were made to represent more severe weather conditions:

1. Wind was delivered through a 60" diameter duct instead of a 48" duct used in the HEVAC method.
2. Wind velocities applied in the Ruskin test reached as high as 75 mph. HEVAC test utilizes 29.1 mph velocity.
3. Ruskin louver test sample size is 48" x 48" instead of 39 3/8" x 39 3/8" specified in HEVAC test.
4. Water flow rate was as high as 6" per hour in the Ruskin test instead of 3" per hour.
5. Pressure drop and airflow rates were measured in an AMCA 500 test chamber.



EME6625 PLAN SECTION

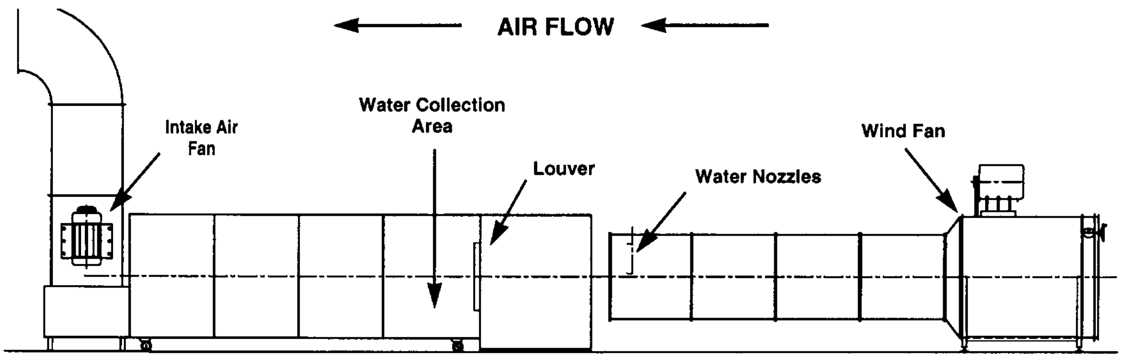
Wind velocities and water flow rates were increased to represent severe storm conditions. The 48" x 48" test sample size was chosen to correspond with other louver test standards.

At 40 mph wind velocity and 3" per hour rain fall rate, the EME6625 proves to be 100% effective at preventing water penetration. With 40 mph wind and 6" per hour rainfall, the EME is 98% effective. When the wind velocity is elevated to 75 mph with 3" per hour rainfall, the EME is again 98% effective. In addition to its excellent water penetration characteristics, the EME offers remarkably low pressure drop. At 1,500 fpm free area intake velocity, the louver creates approximately .15 inches w.g. drop making it one of the best models available for high intake velocity applications. The EME6625 can handle the same amount of air as a standard wall louver that is 30% to 40% larger with similar pressure drop and no measurable water penetration.

Summary:

As designers learn more about louvers capable of withstanding wind driven rain, their interest will result in additional product development. The benefits of these louvers are obvious and their possible applications are numerous. A standard test procedure for wind driven rain will probably be adopted by U.S. louver manufacturers in the near future which should also increase the number of models and information available to designers in the future. Today, the EME6625 is the solution for wind driven rain and/or high intake velocity applications.

RUSKIN WIND DRIVEN RAIN TEST CHAMBER



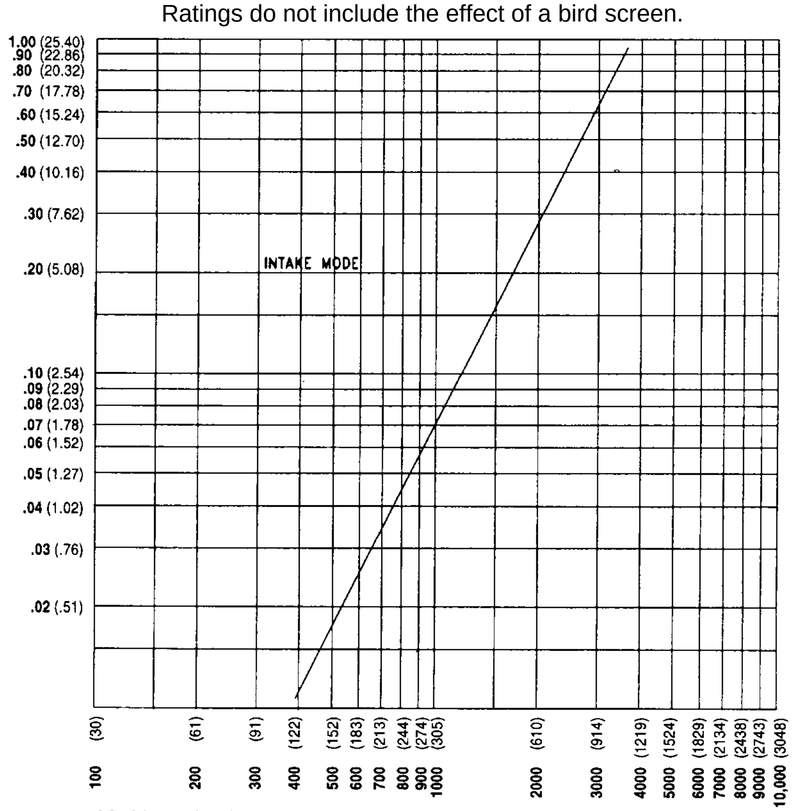
EME6625 LOUVER WIND DRIVEN WATER PENETRATION PERFORMANCE

WIND VELOCITY mph (kph)	RAIN FALL RATE in./hr. (mm/hr.)	AIRFLOW THROUGH FREE AREA fpm (m/min)	PRESSURE DROP inches w.g. (kPa)	EFFECTIVENESS RATIO
40 (64)	3 (76)	2062 (628)	.30 (.07)	100%
50 (80)	6 (152)	2062 (628)	.30 (.07)	98%
75 (121)	3 (76)	1856 (566)	.21 (.05)	98%

Effectiveness ratio is the percentage of water applied to the louver that did not penetrate during the test duration.

EME6625 LOUVER PRESSURE DROP

Ratings do not include the effect of a bird screen.



Air Velocity in feet and (meters) per minute through Free Area

RUSKIN®

3900 Dr. Greaves Rd.
Kansas City, MO 64030
(816) 761-7476
FAX (816) 765-8955