

Certification of Engineered Flood Openings (TB 1 – August 2008)

I do hereby certify that the CRAWLSPACE FEMA FLOOD LOUVER, Patent No. US D583,042, dated December 16, 2008 and owned by Crawl Space Door Systems, Inc. when properly installed and sized in accordance with Federal Emergency Management Agency's National Flood Program regulations (44 CFR 60.3(c)(5)) and National Flood Insurance Program, Technical Bulletin (TB) 1-August 2008 is designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for entry and exit of floodwater during floods up to and including the base (100-year) flood.

I also do hereby certify that I calculated the Non-Engineered, Net-Free Air and Engineered Opening size for each model and size of the Flood Louvers. The results of the calculations are recorded in the table below. The Engineered size opening calculation was performed by using the formula in TB 1 – August 2008, Openings in Foundation Walls for Buildings Located in Special Flood Hazard Areas in accordance with the National Flood Insurance Program and ASCE/SEI 24-05, Flood Resistance Design and Construction. The Net-Free Air opening size for each model was provided by the manufacturer and is included as attachment 1. The formula ($A_o = 0.033 [1/c] R A_e$) from ASCE 24 was used to calculate the Engineered opening size for each model, where: A_o = total net area of openings required (in^2); 0.033 = coefficient corresponding to a factor of safety of 5.0 ($\text{in}^2 \cdot \text{hr}/\text{ft}^3$); $c = 0.40$ opening shape coefficient (ASCE 24 Table 2-2 "rectangular, long axis horizontal, short axis vertical unobstructed during design flood", $c = 0.35$ opening coefficient square; there is an unobstructed rectangular shape between the louvers); $R = 5 \text{ ft/hr}$ worst case rate of rise and fall; and A_e = total enclosed area the opening can control.

$$A_e = A_o / 0.033 [1/c] R = 0.033 [1/0.40] 5 = 0.4125 \text{ in}^2 \text{ per ft}^2 \text{ enclosed area}$$

Example: FV816: = 95 in^2 / 0.4125 in^2 per ft^2 = 230 ft^2

Model #	Size (HxW)	Non-Engineered (Sq. Inches)	c Factor	Net-Free Air (Sq. Inches)	Engineered Enclosed Area (Sq. ft)
FV816	8" x 16"	128	0.40	95	230
FV1220	12" x 20"	240	0.40	175	424
FV1232	12" x 32"	380	0.40	290	703
FV1616	16" x 16"	255	0.35	200	424
FV1624	16" x 24"	380	0.40	285	691
FV1632	16" x 32"	510	0.40	385	933
FV2032	20" x 32"	640	0.40	505	1,224
FV2424	24" x 24"	575	0.35	435	923
FV2436	24" x 36"	860	0.40	665	1,612

Installation Limitations and Instructions

Each individual opening, and any louvers, screens, or other covers, shall be designed to allow automatic entry and exit of floodwaters during design flood or lesser flood conditions; there shall be a minimum of two openings on different sides of each enclosed area; if a structure has more than one enclosed area below the BFE, each area shall have openings; openings shall not be less than 3 inches in any direction in the plane of the wall; the bottom of each required opening shall be no more than 1 ft above the adjacent ground level; the difference between the exterior and interior floodwater levels shall not exceed 1 ft during base flood conditions; in the absence of reliable data on the rates of rise and fall, assume a minimum rate of rise and fall of 5 ft/hr; where data or analysis indicates more rapid rates of rise and fall, the total net area of the required opening shall be increased to account for the higher rates of rise and fall.

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