PRODUCT APPROVAL SUPPORTING CALCULATIONS

Series/Model Contours Steel Edge ISW/OSW Opaque Steel Frame Door

REPORT NO.: 27206.09-107-16-R1

RENDERED TO: Jeld-Wen Windows & Doors
3737 Lakeport Blvd
Klamath Falls, Oregon

PREPARED BY: Michael D. Stremmel, P.E.

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REVISION 2 DATE: 12/1/2023

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This item has been digitally signed and sealed by Michael D. Stremmel, PE on the date adjacent to the seal.

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SCOPE:
Molimo, LLC was contracted by Jeld-Wen Windows & Doors to evaluate alternate installation methods for their Contours Steel Edge ISW/OSW Opaque Steel Frame Door. The evaluation is based on physical testing and product certifications.

Reference standards utilized in this project include:

Florida Building Code. International Code Council.

ANSI/AWC *National Design Specification (NDS) for Wood Construction*. American Wood Council.

AISI S100 *North American Specification for the Design of Cold-Formed Steel Structural Members*. American Iron and Steel Institute.

ICC-ES Report ESR-1976 ITW Buildex TEKS Self-Drilling Fasteners. ICC Evaluation Service.

NOA 21-0201.06 *Tapcon Concrete and Masonry Anchors with Advanced Threadform Technology*. Miami-Dade County Product Control Section.

The anchorage analysis presented herein does not address the water resistance, water penetration, or air infiltration performance of the installation method or the installed product. In addition, the analyses rely on the assumption that the building substrate is capable of withstanding the incurred loads.

Certification of Independence

In accordance with Rule 61G20-3 Florida Administrative Code, Molimo, LLC hereby certifies the following:

- Molimo, LLC does not have, nor does it intend to acquire or will it acquire, a financial interest in any company manufacturing or distributing products tested or labeled by the agency.
- Molimo LLC s is not owned, operated or controlled by any company manufacturing or distributing products it tests or labels.
- Michael D. Stremmel, P.E. does not have nor will acquire, a financial interest in any company manufacturing or distributing products for which the reports are being issued.
- Michael D. Stremmel, P.E does not have, nor will acquire, a financial interest in any other entity involved in the approval process of the product.

ANALYSES:

Summary of Test Results

Table 1 summarizes the various Contours Steel Edge ISW/OSW Opaque Steel Frame Door products and their corresponding performance levels which have been established by testing or product certification.

Table 1: Summary of Test Results

Series/Model	Test Report Number	Size (W x H)	Performance
Opaque Steel Edge Door (Inswing)	National Certified Testing Laboratories No. NCTL-210-3879-1A (Rev. 1, 4/24/14)	38-15/16" x 85-1/8"	+70 / -70 psf (Wind Zone 4)
Opaque Steel Edge Door (Outswing)	National Certified Testing Laboratories No. NCTL-210-3879-1A (Rev. 1, 4/24/14)	38-15/16" x 84"	+70 / -70 psf (Wind Zone 4)

Testing documented in Table 1 was conducted by National Certified Testing Laboratories of Orlando, Florida (Florida Department of Business & Professional Regulation Test Lab No. TST1589 – laboratory was approved at the time of testing). The testing documented above is certified by NAMI under certification numbers NI011573.04 (Expires 4/30/2026) and NI011573.05 (Expires 4/30/2026).

As-Tested Installation Analysis

For air/water/structural testing, the test specimen was secured to a SPF wood test buck with #8 wood screws (1-1/2" min. embedment) at the sill and jambs. The as tested installation method is evaluated on Pages 5 and 6. These capacities will be used to prove acceptable anchors and substrates for the product.

Alternate Anchorages

Calculations on Pages 7 through 9 determine the design capacity of alternate installation anchorages for the product.

Anchorages Requirements

As-tested spacing must be maintained. It must be determined that the anchorages are not overloaded for the approved product size and design pressures. Calculations presented on Page 14 show the alternate anchorages are acceptable for the established product performance.

Anchorage requirements established by this report are accurately presented in Drawing D1000346.

As-Tested Installation – Through Frame to Wood

Anchor: #8 Wood Screw (1-1/2" Min Embedment)

Details: 16 ga (0.060") thick steel door frame
No shim space was utilized

Substrate: SPF wood test buck (G = 0.42)

Wood Screw Capacity (Shear)

Z' = 127 lb (See Following Page)

Design Capacity of the Connection = 127 lb

Lateral Design Strength of Wood Connections

Data

Project: Contours Steel Edge ISW/OSW Opaque Steel Frame Door
Comments: 1-1/2" min embedment

Fastener

Fastener	=	#8 Wood Screw	
Shank Dia	=	0.164	in.
Root Dia.	=	0.131	in.
F_{yb}	=	90,000	psi
Fastener length	=	1.500	in.

Main Member

Material	=	SPF	
G	=	0.42	
θ	=	90	
F_e	=	3,350	psi
Thickness	=	1.500	in.

Side Member

Material	=	ASTM A 653, Grade 33 Steel	
G	=	N/A	
θ	=	90	
F_{es}	=	61,850	psi
Thickness	=	0.060	in.

Calculations

Lateral Bearing Factors

D	=	0.131	in.	k_1	=	0.4742	
ℓ_m	=	1.276	in.	k_2	=	0.5224	
K_θ	=	1.25		k_3	=	13.64	
K_D	=	2.20		R_d	=	2.20	(Mode I_m, I_s)
R_e	=	0.054		R_d	=	2.20	(Mode II)
R_t	=	21.27		R_d	=	2.20	(Mode III_m, III_s, IV)

Lateral Design Values, Z

Mode I_m	=	255	lbf	
Mode I_s	=	221	lbf	
Mode II	=	105	lbf	
Mode III_m	=	120	lbf	
Mode III_s	=	79	lbf	<== Minimum Value
Mode IV	=	108	lbf	

Adjustment Factors

C_D	=	1.6	C_Δ	=	1.0
Wet Service Factor			Is fastener installed in end grain?		No
Fabrication/In-Service		Dry/Dry	C_{eg}	=	1.00
C_M	=	1.0	Is fastener part of a diaphragm?		No
In service temperature		T≤100°F	C_{di}	=	1.0
C_t	=	1.0	Is fastener toe-nailed?		No
C_g	=	1.0	C_{tn}	=	1.00

Adjusted Design Value, Z

Z' = 127 lbf

Alternate Installation – Through-Frame to Concrete

Anchor: 1/4" Tapcon Anchor
- 1-1/4" min embedment
- 2-1/2" min edge distance
- 3" min anchor spacing
- 1/4" max shim space

Details: 16 ga (0.060") thick steel door frame

Substrate: 3,000 psi Concrete

Anchor Capacity (Shear of 1/4" Tapcon)

$P_{ss} / \Omega =$ 223 lb (NOA-No. 21-0201.06)

Bearing Capacity (of Steel frame)

$P_b = 0.85\ F_e\ D\ t\ /K_D = 0.85\ (45{,}000\ psi)(0.250")(0.060")/(3.0) =$ 191 lb

Bending Capacity (of 1/4" Tapcon)

L = 1/4" (maximum shim space)

$S = \pi\ d^3 / 32 = \pi\ (0.190")^3 / 32 = 0.000673\ in^3$

$F_b = (1.3)(0.6\ F_y) = (1.3)(0.6)(137{,}000\ psi) = 106{,}860\ psi$ (1.3 for weak axis bending)

$F_b = M / S = (V)\ (L/2) / S$ (L/2 for guided bending)

$V = 2\ S\ F_b / L = (2)(0.000673\ in3)(106{,}860\ psi) / 1/4"$

V = 575 lb

Design Capacity of the Connection = 191 lb

Alternate Installation – Through-Frame to CMU Block

Anchor: 3/16" Tapcon Anchor
- 1-1/4" min embedment
- 2-1/2" min edge distance
- 3" min anchor spacing
- 1/4" max shim space

Details: 16 ga (0.060") thick steel door frame

Substrate: CMU Block

Anchor Capacity (Shear of 1/4" Tapcon)

$P_{ss} / \Omega =$ 161 lb (NOA-No. 21-0201.06)

Bearing Capacity (of Steel frame)

$P_b = 0.85\ F_e\ D\ t\ /K_D = 0.85\ (45{,}000\ psi)(0.250")(0.060")/(3.0) =$ 191 lb

Bending Capacity (of 1/4" Tapcon)

L = 1/4" (maximum shim space)

$S = \pi\ d^3 / 32 = \pi\ (0.190")^3 / 32 = 0.000673\ in^3$

$F_b = (1.3)(0.6\ F_y) = (1.3)(0.6)(137{,}000\ psi) = 106{,}860\ psi$ (1.3 for weak axis bending)

$F_b = M / S = (V)\ (L/2) / S$ (L/2 for guided bending)

$V = 2\ S\ F_b / L = (2)(0.000673\ in3)(106{,}860\ psi) / 1/4"$

V = 575 lb

Design Capacity of the Connection = 161 lb

Anchorage Requirements

Series/Model: Opaque Steel Edge Door (In-Swing & Out-Swing)

Test Unit Size: 38 15/16” x 84 3/8”

Design Pressure: +70.0 / -70.0 psf

Through-Frame Installation Method

Through frame installation method is validated by the test

Through Frame Anchor Capacity = 127 lb / anchor

Alternate Installation Methods

Through-Frame to Concrete = 191 lb / anchor

Through-Frame to CMU Block = 161 lb / anchor

Minimum Alternate Installation Capacity = 161 lb / anchor

127 lb < 161 lb

Alternate Anchorages OK at tested spacing

Revision Log

Rev. #	Date	Page(s)	Revision(s)
0	9/28/2023	All	Original Report Issue
1	11/14/2023	4	Updated Certification Numbers
2	12/1/2023	4	Updated Table 1 with sizes for inswing and outswing units