



**Project No.:** 27561.02-107-16  
**Project Name:** Gladiator Steel OSW Glazed  
Wood Edge OXXO  
**Revision 1 Date:** 11/17/2023  
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## PRODUCT APPROVAL SUPPORTING CALCULATIONS

**Series/Model: Gladiator Steel OSW Glazed Wood Edge OXXO**

**REPORT NO.:** 27561.02-107-16

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

**PREPARED BY:** Michael D. Stremmel, P.E.  
Molimo, LLC  
1410 Eden Road  
York, Pennsylvania 17402

**DATE:** 11/17/2023

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

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Michael D. Stremmel, P.E.  
Senior Project Engineer  
FL PE 65868  
FL REG 37122

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**SCOPE:**

Molimo, LLC was contracted by Jeld-Wen Windows & Doors to evaluate alternate installation methods for their Gladiator Steel OSW Glazed Wood Edge OXXO. 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.



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### 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 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.



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**ANALYSES:**

**Summary of Test Results**

Table 1 summarizes the various Gladiator Steel OSW Glazed Wood Edge OXXO 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
Jeld-Wen Gladiator/Finishield Glazed Wood-Edge Steel Double Doors with Glazed Fixed Side Lites	National Certified Testing Laboratories Report No. NCTL-210-3558-1 (10/07/2008)	148-1/2" x 80-7/8"	+45 / -45 psf (Wind Zone 4) w/o shoot bolts
Jeld-Wen Gladiator/Finishield Glazed Wood-Edge Steel Double Doors with Glazed Fixed Side Lites	National Certified Testing Laboratories Report No. NCTL-210-3558-1 (10/07/2008)	148-1/2" x 80-7/8"	+55 / -55 psf (Wind Zone 4) w/ shoot bolts

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 number NI009861-R6 (Expires 10/31/2028).



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**ANALYSES:** (Continued)

**Summary of Test Results** (Continued)

**Table 2:** Plastics Checklist of Test Results

Product	Test Report Number	Test Standard	Test Results
Dylite Expandable Polystyrene	Intertek Report No. 3113726SAT-001 Rev. 1 (3/13/2009)	ASTM E84	Flame Spread: 35 Smoke Developed: 450
White PVC 1476 5110	Intertek Report No. P6504.01-106-18-R0 (8/23/2023)	ASTM D638 (before and after G155)	+9.5%
		ASTM D1929	824°F (440°C)
		ASTM D2843	71.8
		ASTM D635	Class CC1
White PVC 1476 5290	Intertek Report No. P6504.01-106-18-R0 (8/23/2023)	ASTM D638 (before and after G155)	+9.5%
		ASTM D1929	806°F (430°C)
		ASTM D2843	72.6
		ASTM D635	Class CC1

Testing documented in Table 2 was conducted by Intertek of York, Pennsylvania (Florida Department of Business & Professional Regulation Test Lab No. TST1558) and Intertek of Elmhendorf, Texas (Florida Department of Business & Professional Regulation Test Lab No. TST1585).

The test results listed in Table 2 meet the requirements listed in Miami-Dade County Checklist #0445, *For the Approval of: Plastic and Foam Plastic.*



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**ANALYSES:** (Continued)

**As-Tested Installation Analysis**

For air/water/structural testing, the test specimen was secured to a Douglas-Fir wood test buck with #8 wood screws (1-1/2" min. embedment) at the head, sill, and jambs. The as tested installation method is evaluated on Pages 7 and 8. These capacities will be used to prove acceptable anchors and substrates for the product.

**Alternate Anchorages**

Calculations on Pages 9 through 15 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 16 show the alternate anchorages are acceptable for the established product performance.

Anchorage requirements established by this report are accurately presented in Drawing D1000355.



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**As-Tested Installation – Through Frame to Wood**

Anchor: #8 x 2-1/2" Wood Screw  
(1-1/2" min embedment)}

Details: 0.719" thick wood frame (G = 0.42)  
No shim space was utilized

Substrate: Douglas-Fir wood test buck (G = 0.46)

**Wood Screw Capacity (Shear)**

Z' = 111 lb

(See Following Page)

**Design Capacity of the Connection = 111 lb**

## Lateral Design Strength of Wood Connections

### Data

<b>Fastener</b>	=	#8 Wood Screw
Shank Dia	=	0.164 in.
Root Dia.	=	0.131 in.
$F_{yb}$	=	90,000 psi
Fastener length	=	2.500 in.

<b>Project:</b>	Gladiator Steel OSW Glazed Wood Edge OXXO
<b>Comments:</b>	As-tested Installation 1-1/2" min embedment

<b>Main Member</b>	=	Douglas Fir (South)
Material	=	Douglas Fir (South)
G	=	0.46
$\theta$	=	90
$F_e$	=	4,000 psi
Thickness	=	1.500 in.

<b>Side Member</b>	=	SPF
Material	=	SPF
G	=	0.42
$\theta$	=	90
$F_{es}$	=	3,350 psi
Thickness	=	0.719 in.

### Calculations

#### Lateral Bearing Factors

D	=	0.131 in.
$\ell_m$	=	1.477 in.
$K_\theta$	=	1.25
$K_D$	=	2.20
$R_e$	=	1.194
$R_t$	=	2.05

$k_1$	=	0.7971
$k_2$	=	1.1882
$k_3$	=	1.29
$R_d$	=	2.20 (Mode I <sub>m</sub> , I <sub>s</sub> )
$R_d$	=	2.20 (Mode II)
$R_d$	=	2.20 (Mode III <sub>m</sub> , III <sub>s</sub> , IV)

#### Lateral Design Values, Z

Mode I <sub>m</sub>	=	352 lbf
Mode I <sub>s</sub>	=	143 lbf
Mode II	=	114 lbf
Mode III <sub>m</sub>	=	123 lbf
Mode III <sub>s</sub>	=	69 lbf
Mode IV	=	82 lbf

<== Minimum Value

#### Adjustment Factors

$C_D$	=	1.6
Wet Service Factor		
Fabrication/In-Service		Dry/Dry
$C_M$	=	1.0
In service temperature		T ≤ 100°F
$C_t$	=	1.0
$C_g$	=	1.0

$C_\Delta$	=	1.0
Is fastener installed in end grain?		No
$C_{eg}$	=	1.00
Is fastener part of a diaphragm?		No
$C_{di}$	=	1.0
Is fastener toe-nailed?		No
$C_{tn}$	=	1.00

#### Adjusted Design Value, Z

$Z'$	=	<b>111</b> lbf
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**Alternate Installation – Strap Anchor to Wood**

Anchor: #8 x 1-1/2" Flat head screw securing the strap to the substrate  
 1/4" max shim space

Details: 20 gauge (0.033" thick) 33 KSI steel strap anchor w/ two #8 screws securing the  
 strap to the frame  
 1-1/2" thick wood frame

Substrate: Spruce-Pine-Fir 2x Wood Substrate (G = 0.42 min.)

**Wood Screw Capacity (Shear)**

$$Z' = \underline{122 \text{ lb}}$$

(See Following Page)

**Bending of #8 x 1-1/2" flat head screw**

$$L = 1/4" \text{ (maximum shim space)}$$

$$S = \pi d^3 / 32 = \pi (0.131")^3 / 32 = 0.000221 \text{ in}^3$$

$$F_b = (1.3)(0.6 F_y) = (1.3)(0.6)(90,000 \text{ psi}) = 70,200 \text{ psi} \quad (1.3 \text{ for weak axis bending})$$

$$F_b = M / S = (V) (L/2) / S \quad (L/2 \text{ for guided bending})$$

$$V = 2 S F_b / L = (2)(0.000221 \text{ in}^3)(70,200 \text{ psi}) / 1/4"$$

$$V = \underline{124 \text{ lb}}$$

**Bearing Capacity (of #8 screw on frame)**

$$P_b = F_e D t / K_D = (3,350 \text{ psi})(0.164")(0.719") / (10(0.164) + 0.5) = \underline{184 \text{ lb}}$$

**Bearing Capacity (of strap anchor)**

$$P_b = 2.7 D t F_{tu} = 2.7(0.164")(0.033")(45,000 \text{ psi}) = 657 \text{ lb}$$

$$P_{\text{allow}} = 657 \text{ lb} / 3.0 = \underline{219 \text{ lb}}$$

**Design Capacity of the Connection = 122 lb**

## Lateral Design Strength of Wood Connections

### Data

#### 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.

<b>Project:</b>	Gladiator Steel OSW Glazed Wood Edge OXXO
<b>Comments:</b>	Steel Strap Installation 1-1/2" min embedment

#### Main Member

Material	=	SPF
G	=	0.42
$\theta$	=	90
$F_e$	=	3,350 psi
Thickness	=	1.500 in.

#### Side Member

Material	=	ASTM A 653, Grade 33 Steel
G	=	N/A
$\theta$	=	90
$F_{es}$	=	61,850 psi
Thickness	=	0.033 in.

### Calculations

#### Lateral Bearing Factors

D	=	0.131 in.
$\ell_m$	=	1.303 in.
$K_\theta$	=	1.25
$K_D$	=	2.20
$R_e$	=	0.054
$R_t$	=	39.48

$k_1$	=	0.8723
$k_2$	=	0.5195
$k_3$	=	23.87
$R_d$	=	2.20 (Mode I <sub>m</sub> , I <sub>s</sub> )
$R_d$	=	2.20 (Mode II)
$R_d$	=	2.20 (Mode III <sub>m</sub> , III <sub>s</sub> , IV)

#### Lateral Design Values, Z

Mode I <sub>m</sub>	=	260 lbf
Mode I <sub>s</sub>	=	122 lbf
Mode II	=	106 lbf
Mode III <sub>m</sub>	=	122 lbf
Mode III <sub>s</sub>	=	77 lbf
Mode IV	=	108 lbf

<== Minimum Value

#### Adjustment Factors

$C_D$	=	1.6
Wet Service Factor		
Fabrication/In-Service Dry/Dry		
$C_M$	=	1.0
In service temperature $T \leq 100^\circ\text{F}$		
$C_t$	=	1.0
$C_g$	=	1.0

$C_\Delta$	=	1.0
Is fastener installed in end grain?		
$C_{eg}$	=	1.00
Is fastener part of a diaphragm?		
$C_{di}$	=	1.0
Is fastener toe-nailed?		
$C_{tn}$	=	1.00

#### Adjusted Design Value, Z

$Z'$	=	122 lbf
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**Alternate Installation – Through-Frame to Concrete**

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

Details: Through the Wood Frame  
- 1" thick

Substrate: 3,000 psi Concrete

Anchor Capacity (Shear of 3/16" Tapcon)

$$P_{ss} / \Omega = \underline{181 \text{ lb}} \quad (\text{NOA-No. 16-1222.06})$$

Bearing Capacity (of Wood frame)

$$P_b = F_e D t / K_D = (3,350 \text{ psi})(0.170")(1.00") / (10(0.170) + 0.5) = \underline{259 \text{ lb}}$$

Bending Capacity (of 3/16" Tapcon)

$$L = 1/4" \text{ (maximum shim space)}$$

$$S = \pi d^3 / 32 = \pi (0.170")^3 / 32 = 0.000482 \text{ in}^3$$

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

$$F_b = M / S = (V) (L/2) / S \quad (L/2 \text{ for guided bending})$$

$$V = 2 S F_b / L = (2)(0.000482 \text{ in}^3)(106,860 \text{ psi}) / 1/4"$$

$$V = \underline{412 \text{ lb}}$$

**Design Capacity of the Connection = 181 lb**

**Qualifies 1/4" Tapcon if longer length anchor is required to achieve minimum embedment**

**Alternate Installation – Through-Frame to CMU Block**

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

Details: Through the Wood Frame  
- 1" thick

Substrate: CMU Block

Anchor Capacity (Shear of 3/16" Tapcon)

$$P_{ss} / \Omega = \underline{135 \text{ lb}} \quad (\text{NOA-No. 16-1222.06})$$

Bearing Capacity (of Wood frame)

$$P_b = F_e D t / K_D = (3,350 \text{ psi})(0.170")(1.00") / (10(0.170) + 0.5) = \underline{259 \text{ lb}}$$

Bending Capacity (of 3/16" Tapcon)

$$L = 1/4" \text{ (maximum shim space)}$$

$$S = \pi d^3 / 32 = \pi (0.170")^3 / 32 = 0.000482 \text{ in}^3$$

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

$$F_b = M / S = (V) (L/2) / S \quad (L/2 \text{ for guided bending})$$

$$V = 2 S F_b / L = (2)(0.000482 \text{ in}^3)(106,860 \text{ psi}) / 1/4"$$

$$V = \underline{412 \text{ lb}}$$

**Design Capacity of the Connection = 135 lb**

**Qualifies 1/4" Tapcon if longer length anchor is required to achieve minimum embedment**

### Alternate Installation – Strap Anchor to Concrete

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

Details: 20 gauge (0.033" thick) 33 KSI steel strap anchor w/ two #8 screws securing the strap to the frame  
1.00" thick wood frame

Substrate: 3,000 psi Concrete

#### Anchor Capacity (Shear of 3/16" Tapcon)

$$P_{ss} / \Omega = \underline{181 \text{ lb}} \quad (\text{NOA-No. 16-1222.06})$$

#### Bearing Capacity (of 3/16" Tapcon on strap anchor)

$$P_b = 2.7 D t F_{tu} = 2.7(0.170")(0.033")(45,000 \text{ psi}) = 681 \text{ lb}$$

$$P_{\text{allow}} = 681 \text{ lb} / 3.0 = \underline{227 \text{ lb}}$$

#### Bearing Capacity (of #8 screw on frame)

$$P_b = F_e D t / K_D = (3,350 \text{ psi})(0.164")(1.00") / (10(0.164) + 0.5) = \underline{257 \text{ lb}}$$

#### Bearing Capacity (of #8 screw on strap anchor)

$$P_b = 2.7 D t F_{tu} = 2.7(0.164")(0.033")(45,000 \text{ psi}) = 657 \text{ lb}$$

$$P_{\text{allow}} = 657 \text{ lb} / 3.0 = \underline{219 \text{ lb}}$$

#### Bending Capacity (of 3/16" Tapcon)

$$L = 1/4" \text{ (maximum shim space)}$$

$$S = \pi d^3 / 32 = \pi (0.170")^3 / 32 = 0.000482 \text{ in}^3$$

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

$$F_b = M / S = (V) (L/2) / S \quad (L/2 \text{ for guided bending})$$

$$V = 2 S F_b / L = (2)(0.000482 \text{ in}^3)(106,860 \text{ psi}) / 1/4"$$

$$V = \underline{412 \text{ lb}}$$

**Design Capacity of the Connection = 181 lb (one concrete anchor per strap)**

**Qualifies 1/4" Tapcon if longer length anchor is required to achieve minimum embedment**

**Alternate Installation – Strap Anchor to CMU Block**

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

Details: 20 gauge (0.033" thick) 33 KSI steel strap anchor w/ two #8 screws securing the strap to the frame  
 1.00" thick wood frame

Substrate: CMU Block

Anchor Capacity (Shear of 3/16" Tapcon)

$$P_{ss} / \Omega = \underline{135 \text{ lb}} \quad (\text{NOA-No. 16-1222.06})$$

Bearing Capacity (of 3/16" Tapcon on strap anchor)

$$P_b = 2.7 D t F_{tu} = 2.7(0.170")(0.033")(45,000 \text{ psi}) = 681 \text{ lb}$$

$$P_{\text{allow}} = 681 \text{ lb} / 3.0 = \underline{227 \text{ lb}}$$

Bearing Capacity (of #8 screw on frame)

$$P_b = F_e D t / K_D = (3,350 \text{ psi})(0.164")(1.00") / (10(0.164) + 0.5) = \underline{257 \text{ lb}}$$

Bearing Capacity (of #8 screw on strap anchor)

$$P_b = 2.7 D t F_{tu} = 2.7(0.164")(0.033")(45,000 \text{ psi}) = 657 \text{ lb}$$

$$P_{\text{allow}} = 657 \text{ lb} / 3.0 = \underline{219 \text{ lb}}$$

Bending Capacity (of 3/16" Tapcon)

$$L = 1/4" \text{ (maximum shim space)}$$

$$S = \pi d^3 / 32 = \pi (0.170")^3 / 32 = 0.000482 \text{ in}^3$$

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

$$F_b = M / S = (V) (L/2) / S \quad (L/2 \text{ for guided bending})$$

$$V = 2 S F_b / L = (2)(0.000482 \text{ in}^3)(106,860 \text{ psi}) / 1/4"$$

$$V = \underline{412 \text{ lb}}$$

**Design Capacity of the Connection = 135 lb (one concrete anchor per strap)**

**Qualifies 1/4" Tapcon if longer length anchor is required to achieve minimum embedment**

**Alternate Installation – Strap Anchor to Wood (Cap Installation)**

Anchor: Two #8 x 1-1/2" Flat head screw securing the strap to the substrate

Details: 20 gauge (0.033" thick) 33 KSI steel strap anchor w/ two #8 screws securing the strap to the frame  
1.00" thick wood frame  
1/4" max shim space

Substrate: Spruce-Pine-Fir 2x Wood Substrate (G = 0.42 min.)

**Wood Screw Capacity (Withdrawal)**

$$W' = 1.6(82 \text{ lb/in})(1.5 \text{ in}) = \underline{197 \text{ lb}}$$

**Pull-over Capacity (of #8 screw on strap)**

$$P_{\text{nov}} = 1.5 t d F_{\text{tu}} = 1.5 (0.033")(0.332")(45,000 \text{ psi}) = 739 \text{ lb}$$

$$P_{\text{allow}} = 739 \text{ lb} / 3.0 = \underline{246 \text{ lb}}$$

**Bearing Capacity (of #8 screw on frame)**

$$P_b = F_e D t / K_D = (3,350 \text{ psi})(0.164")(1.00") / (10(0.164) + 0.5) = \underline{257 \text{ lb}}$$

**Bearing Capacity (of #8 screw on strap anchor)**

$$P_b = 2.7 D t F_{\text{tu}} = 2.7(0.164")(0.033")(45,000 \text{ psi}) = 657 \text{ lb}$$

$$P_{\text{allow}} = 657 \text{ lb} / 3.0 = \underline{219 \text{ lb}}$$

**Design Capacity of the Connection = 197 lb (one screw)**

**Design Capacity of the Connection = 394 lb (two screws)**

### Anchorage Requirements

Series/Model: Gladiator Steel OSW Glazed Wood Edge OXXO  
Test Unit Size: 148-1/2" x 80-7/8"  
Design Pressure: +45.0 / -45.0 psf (w/o shoot bolts)  
Design Pressure: +45.0 / -45.0 psf (w/ shoot bolts)

### Through-Frame Installation Method

Through frame installation method is validated by the test

Through Frame Anchor Capacity = 111 lb / anchor

### Alternate Installation Methods

Strap Anchor to Wood = 122 lb / anchor

Through-Frame to Concrete = 181 lb / anchor

Through-Frame to CMU Block = 135 lb / anchor

Strap Anchor to Concrete = 181 lb / anchor

Strap Anchor to CMU Block = 135 lb / anchor

Strap Anchor to Wood (Cap Installation) = 197 lb / anchor

Minimum Alternate Installation Capacity = 122 lb / anchor

122 lb > 111 lb

**Alternate Anchorages OK at tested spacing**





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### Revision Log

<b>Rev. #</b>	<b>Date</b>	<b>Page(s)</b>	<b>Revision(s)</b>
0	11/17/2023	All	Original Report Issue
1	2/23/2024	All	Added Table 2 for the Plastic Checklist test results