

Micah Swartz, P.E.	Project Number:	MS24-09006
	Project Name:	1240 Envision
	Date:	10/9/2024

**Product Approval Supporting Calculations
Alternative Anchorage Analysis & Design**

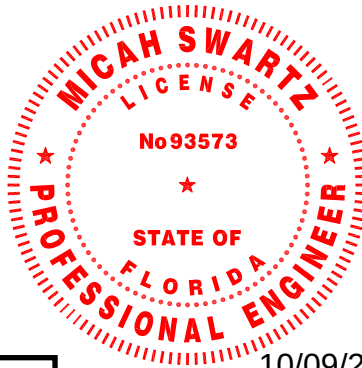
Project Number: MS24-09006

Drawing Number: HLOS-U

Reference Test Report: 29074.01-201-12

Product Name: 1240 Envision - 42"x120"

Prepared for:
VPI Quality Windows
3420 E. Ferry Avenue
Spokane, WA 99202



Prepared by:
Micah Swartz, P.E.

Micah Swartz

10/09/24 Micah Swartz, PE
Florida License No. PE 93573

This item has been digitally signed and sealed by Micah Swartz, P.E. on the date adjacent to the seal.

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Scope:

Micah Swartz, P.E. is contracted by Jeld-Wen Windows & Doors to evaluate alternative anchorage for the product: 1240 Envision - 42"x120". This evaluation is based on testing performed by Molimo, LLC in York, PA, test report no.: 29074.01-201-12 and dated 7/31/24.

This evaluation does not include the air infiltration, water resistance or water penetration of the installation method or the installed product. In addition, the design of the building substrate to resist the superimposed loads is by others.

Reference Standards:

Florida Building Code, Building, 2023 Edition

ANSI/AWC NDS 2018 - National Design Specification (NDS) for Wood Construction

ANSI S100-16 (2020) North American Specification for the Design of Cold-Formed Steel Structural Members

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

NOA 24-0102.06 Tapcon Concrete and Masonry Anchors with Advanced Threadform Technology

Certification of Independence:

In accordance with Rule 61G20-3 Florida Administrative Code, Micah Swartz, P.E. hereby certifies the following:

- (1) Micah Swartz, P.E. 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.
- (2) Micah Swartz, P.E. is not owned, operated or controlled by any company manufacturing or distributing products it tests or labels.
- (3) Micah Swartz, 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.
- (4) Micah Swartz, 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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Design Summary:

The table below summarizes the product: 1240 Envision - 42"x120" and their corresponding performance levels as established by testing.

Table 1: Summary of Test Results

Series/Model	Test Report Number	Size (W x H)	Performance
1240 Envision - 42"x120"	29074.01-201-12 (7/31/24)	42" x 120"	+50 psf / -55 psf

As Tested Design:

Screw Information:

Screw Size: 8 Screw Embed: 1 in Edge Distance: 3/4 in (minimum)

Wood Screw Withdrawal: 131 lbs

Wood Screw Lateral: 106 lbs

Alternative Fasteners:

Screw Information:

Screw Size: 8 Screw Embed: 1 in Edge Distance: 3/4 in (minimum)

Wood Screw Withdrawal: 131 lbs

Wood Screw Lateral: 106 lbs

TEK Screw Information:

Screw Size: 10-16

TEK Withdrawal: 145 lbs

TEK Lateral: 147 lbs

Tapcon Information:

Tapcon Size: 3/16 Embedment: 1-1/4 in (minimum) Edge Distance: 2-1/2 in (minimum)

Tapcon Lateral (Concrete): 155 lbs

Tapcon Lateral (CMU): 135 lbs

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Subject:	As Tested - Wood Screw Withdrawal	Input:	
		Calculation:	

Screw Information:	
Screw Size:	8
Screw Embed:	1 in
Root Diameter:	0.131 in
Main Member Type:	S-P-F
G:	0.42
F _{em} :	3,350 psi

$W' = W * C_D * C_M^2 * C_t$ – As per table 11.3.1 NDS 2018

C _D :	1.6	Load Duration Factor - Table 2.3.2 (NDS 2018)
C _M :	1.0	Wet Service Factor - Table 11.3.3 (NDS 2018)
C _t :	1.0	Temperature Factor - Table 11.3.4 (NDS 2018)

W:	82	lbs/in - Table 12.2B (NDS 2018)
W:	82	lbs

W':	131	lbs
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Subject: As Tested - Wood Screw Lateral Design - Single Shear

Input:
 Calculation:

Screw Information:

Screw Size: 8
 Screw Embed: 1 in

Root Diameter: 0.131 in

Main Member Type: S-P-F G: 0.42

F_{em}: 3,350 psi thickness (t_m): 1.5 in

Side Member Type: Alum G: N/A

F_{es}: 21,000 psi thickness (t_s): 0.125 in

Lateral Design Factors - Table 12.3.1A (NDS 2018)

D:	0.131	in	Diameter
F _{yb} :	100	ksi	Dowel Bending Yield Strength
F _{em} :	3,350	psi	Main Member dowel bearing strength
F _{es} :	21,000	psi	Side Member dowel bearing strength
l _m :	1	in	Main Member dowel bearing length
l _s :	0.125	in	Side Member dowel bearing length
R _d :	2.2		Reduction term - Table 12.3.1B (NDS 2018)
R _e :	0.1595		= F _{em} /F _{es}
R _t :	8.0		= l _m /l _s
k ₁ :	0.515		See Table
k ₂ :	0.664		See Table

Reference Lateral Design Values - Table 12.3.1A (NDS 2018)

Z_{I_m}: 199 lbs

$Z_{Im} = \frac{D l_m F_{em}}{R_d} \text{ (EQ 12.3 - 1)}$

Z_{II}: 81 lbs

$Z_{II} = \frac{k_1 D l_s F_{es}}{R_d} \text{ (EQ 12.3 - 3)}$

Z_{III_m}: 100 lbs

$Z_{III_m} = \frac{k_2 D l_m F_{em}}{(1 + 2R_e) R_d} \text{ (EQ 12.3 - 4)}$

Z_{IV}: 108 lbs

$Z_{IV} = \frac{D^2}{R_d} \sqrt{\frac{2 F_{em} F_{yb}}{3(1 + R_e)}} \text{ (EQ 12.3 - 6)}$

Z_{MIN}: 81 lbs

Note: Side member is part of the Jeld-Wen assembly and verified during testing. Modes Z_{Is} and Z_{IIIs} are not applicable to the calculation.

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Subject: As Tested - Wood Screw Lateral Design - Single Shear Cont.

Adjusted Lateral Design Values

$$Z' = Z * C_D * C_M * C_t * C_g * C_{\Delta} - \text{As per table 11.3.1 NDS 2018}$$

C _D :	1.6	Load Duration Factor - Table 2.3.2 (NDS 2018)
C _M :	1.0	Wet Service Factor - Table 11.3.3 (NDS 2018)
C _t :	1.0	Temperature Factor - Table 11.3.4 (NDS 2018)
C _g :	1.0	Group Action Factor - Section 11.3.6 (NDS 2018)
C _Δ :	1.0	Geometry Factor - Section 12.5.1.1 (NDS 2018)

$$Z': \boxed{129} \text{ lbs}$$

Fastener Bending Across Shim Space

Ω:	1.67	
L:	0.25	in Maximum Shim Gap
D:	0.131	in Diameter
F _{yb} :	100	ksi Dowel Bending Yield Strength

$$\frac{F_{yb}}{\Omega} = \frac{M}{S} = \frac{16ZL}{\pi D^3} \Leftrightarrow Z = \frac{F_{yb} \pi D^3}{16 \Omega L} \quad \text{Where } M = \frac{ZL}{2} \text{ (Guided Bending)}$$

$$Z_n/\Omega: \boxed{106} \text{ lbs}$$

Bearing on Masonry Strap

Ω:	3.00	
F _u :	33	ksi Tensile Strength of strap
t:	20	GA
t:	0.036	in thickness of strap
D:	0.131	in

$$\frac{P_{nv}}{\Omega} = 2.7 * t * D * F_u - (EQ.J4.3.1 - 4, AISI S100)$$

$$P_{nv}/\Omega: \boxed{140} \text{ lbs}$$

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Subject:	Wood Screw Withdrawal	Input:	
		Calculation:	

Screw Information:	
Screw Size:	8
Screw Embed:	1 in
Root Diameter:	0.131 in
Main Member Type:	S-P-F
G:	0.42
F _{em} :	3,350 psi

$W' = W * C_D * C_M^2 * C_t$ – As per table 11.3.1 NDS 2018

C _D :	1.6	Load Duration Factor - Table 2.3.2 (NDS 2018)
C _M :	1.0	Wet Service Factor - Table 11.3.3 (NDS 2018)
C _t :	1.0	Temperature Factor - Table 11.3.4 (NDS 2018)

W:	82	lbs/in - Table 12.2B (NDS 2018)
W:	82	lbs

W':	131	lbs
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Subject: Wood Screw Lateral Design - Single Shear

Input:

Calculation:

Screw Information:

Screw Size: Root Diameter: in

Screw Embed: in

Main Member Type: G: F_{em}: psi thickness (t_m): in

Side Member Type: G: F_{es}: psi thickness (t_s): in

Lateral Design Factors - Table 12.3.1A (NDS 2018)

D:	0.131 in	Diameter
F _{yb} :	100 ksi	Dowel Bending Yield Strength
F _{em} :	3,350 psi	Main Member dowel bearing strength
F _{es} :	21,000 psi	Side Member dowel bearing strength
l _m :	1 in	Main Member dowel bearing length
l _s :	0.125 in	Side Member dowel bearing length
R _d :	2.2	Reduction term - Table 12.3.1B (NDS 2018)
R _e :	0.1595	= F _{em} /F _{es}
R _t :	8.0	= l _m /l _s
k ₁ :	0.515	See Table
k ₂ :	0.664	See Table

Reference Lateral Design Values - Table 12.3.1A (NDS 2018)

Z_I: lbs $Z_{Im} = \frac{Dl_m F_{em}}{R_d}$ (EQ 12.3 – 1)

Z_{II}: lbs $Z_{II} = \frac{k_1 D l_s F_{es}}{R_d}$ (EQ 12.3 – 3)

Z_{III}: lbs $Z_{III_m} = \frac{k_2 D l_m F_{em}}{(1 + 2R_e) R_d}$ (EQ 12.3 – 4)

Z_{IV}: lbs $Z_{IV} = \frac{D^2}{R_d} \sqrt{\frac{2F_{em} F_{yb}}{3(1 + R_e)}}$ (EQ 12.3 – 6)

Z_{MIN}: lbs

Note: Side member is part of the Jeld-Wen assembly and verified during testing. Modes Z_{Is} and Z_{IIIs} are not applicable to the calculation.

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Subject:

Wood Screw Lateral Design - Single Shear Cont.

Adjusted Lateral Design Values

$Z' = Z * C_D * C_M * C_t * C_g * C_{\Delta}$
– As per table 11.3.1 NDS 2018

C _D :	1.6	Load Duration Factor - Table 2.3.2 (NDS 2018)
C _M :	1.0	Wet Service Factor - Table 11.3.3 (NDS 2018)
C _t :	1.0	Temperature Factor - Table 11.3.4 (NDS 2018)
C _g :	1.0	Group Action Factor - Section 11.3.6 (NDS 2018)
C _Δ :	1.0	Geometry Factor - Section 12.5.1.1 (NDS 2018)

Z':

129

 lbs

Fastener Bending Across Shim Space

Ω:	1.67	
L:	0.25	in Maximum Shim Gap
D:	0.131	in Diameter
F _{yb} :	100	ksi Dowel Bending Yield Strength

$$\frac{F_{yb}}{\Omega} = \frac{M}{S} = \frac{16ZL}{\pi D^3} \Leftrightarrow Z = \frac{F_{yb}\pi D^3}{16\Omega L}$$
Where $M = \frac{ZL}{2}$ (Guided Bending)

Z_n/Ω:

106

 lbs

Bearing on Masonry Strap

Ω:	3.00	
F _u :	33	ksi Tensile Strength of strap
t:	20	GA
t:	0.036	in thickness of strap
D:	0.131	in

$$\frac{P_{nv}}{\Omega} = 2.7 * t * D * F_u \text{ -- (EQ.J4.3.1 -- 4, AISI S100)}$$

P_{nv}/Ω:

140

 lbs

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Subject: TEK Withdrawal

Input:
Calculation:

Tensile Strength of Fastener - ESR 1976

Screw Size:

P_{nv}/Ω : lbs See ESR-1976

Tensile Pullout - ESR 1976

Screw Size:

F_u : ksi Tensile Strength of material NOT in contact with screw head

t: GA

t: in Thickness of material NOT in contact with screw head

P_{nv}/Ω : lbs See ESR-1976

Tensile Pullover

Note: The tensile pullover analysis checks the material IN contact with the screw head. This material is part of the Jeld-Wen assembly and has been verified by testing. Below is a check to ensure the head size of the TEK screw is equal to or larger than the head of the tested fastener, ensuring compliance.

Tested Fastener Head Size:

Screw Size: Tested fastener is a

Head Size: in

TEK Screw Head Size:

Screw Size:

Head Size: in

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Subject:	TEK Lateral Design	Input:	
		Calculation:	

Shear Strength of Fastener - ESR 1976

Screw Size: 10-16

P_{nv}/Ω : 573 lbs See ESR-1976

Bearing Strength of Material NOT in Contact with Screw Head - AISI S100

Screw Size:	10-16	Ω :	3.00
D:	0.138 in	Root Diameter of TEK Screw	
F_u :	45 ksi	Tensile Strength of material NOT in contact with screw head	
t:	18 GA		
t:	0.0478 in	Thickness of material NOT in contact with screw head	

$$\frac{P_{nv1}}{\Omega} = 2.7 * t * D * F_u - (EQ.J4.3.1 - 3, AISI S100)$$

$$\frac{P_{nv2}}{\Omega} = 4.2\sqrt{t^3 * D} * F_u - (EQ.J4.3.1 - 1, AISI S100)$$

P_{nv1}/Ω : 267 lbs

P_{nv2}/Ω : 245 lbs

P_{nv}/Ω : 245 lbs $\frac{P_{nv}}{\Omega} = \text{smallest of } \frac{P_{nv1}}{\Omega} \text{ and } \frac{P_{nv2}}{\Omega}$

Bearing Strength of Material IN in Contact with Screw Head

Note: Material IN contact with the screw head is part of the Jeld-Wen assembly and has been verified by testing.

Fastener Bending Across Shim Space

L:	0.25 in	Maximum Shim Gap	Ω :	3.00
D:	0.138 in	Root Diameter of TEK Screw		
F_{yb} :	100 ksi	Yield Strength of TEK Screw		

$$\frac{F_{yb}}{\Omega} = \frac{M}{S} = \frac{16P_nL}{\pi D^3} \Leftrightarrow P_n = \frac{F_{yb}\pi D^3}{16\Omega L}$$

Where $M = \frac{P_nL}{2}$ (Guided Bending)

P_n/Ω : 206 lbs

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Bearing Strength of Masonry Straps - AISI S100

Screw Size:	10-16	TEK Screw	Ω:	3.00
D:	0.138	in	Root Diameter of TEK Screw	
F _u :	33	ksi	Tensile Strength of Masonry Strap	
t:	20	GA		
t:	0.0359	in	Thickness of Masonry Strap	

$$\frac{P_{nv}}{\Omega} = 2.7 * t * D * F_u - (EQ.J4.3.1 - 3, AISI S100)$$

P_{nv}/Ω: 147 lbs

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Subject: Tapcon Lateral Design

Input:

Calculation:

Tapcon Size:

Size:

D: in Nominal Diameter

D_{sh}: in Shank Diameter

Fastener Shear Capacity - 3,000 psi Concrete

P_{nv}/Ω: lbs See Table 1B of NOA 24-0102.06

Fastener Shear Capacity - Medium-Weight CMU

P_{nv}/Ω: lbs See Table 3 of NOA 24-0102.06

Note:

- Critical anchor spacing is 16D
- Minimum Anchor Embedment is 1-1/4"
- Minimum Edge Distance is 2-1/4"

Fastener Bending Across Shim Space

L: in Maximum Shim Gap

D_{sh}: in Shank Diameter of Tapcon

F_{yb}: ksi Yield Strength of Tapcon

Ω:

$$\frac{F_{yb}}{\Omega} = \frac{M}{S} = \frac{16P_n L}{\pi D^3} \Leftrightarrow P_n = \frac{F_{yb} \pi D^3}{16 \Omega L}$$

Where $M = \frac{P_n L}{2}$ (Guided Bending)

P_n/Ω: lbs

Bearing Strength of Masonry Straps - AISI S100

Size: Tapcon Size

D_{sh}: in Shank Diameter of Tapcon Screw

F_u: ksi Tensile Strength of Masonry Strap

t: GA

t: in Thickness of Masonry Strap

Ω:

$$\frac{P_{nv}}{\Omega} = 2.7 * t * D * F_u - (EQ. J4.3.1 - 3, AISI S100)$$

P_{nv}/Ω: lbs