# Product Approval Supporting Calculations
# Alternative Anchorage Analysis & Design

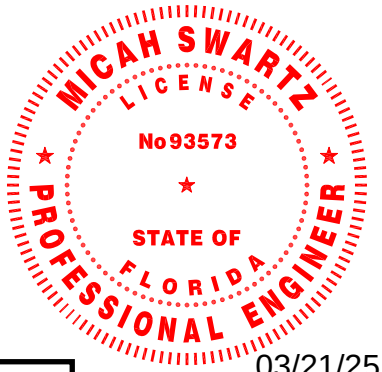
**Project Number:** SCE 25-03012

**Drawing Number:** D009452

**Reference Test Report:** NCTL 210-3902-1

**Product Name:** Premium Atlantic Vinyl 36" X 72"

**Prepared for:**
Jeld-Wen Windows & Doors
3737 Lakeport Blvd.
Klamath Falls, OR




03/21/25

Prepared by:
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**Scope:**

Swartz Consulting Engineers LLC is contracted by Jeld-Wen Windows & Doors to evaluate alternative anchorage for the product: Premium Atlantic Vinyl 36" X 72". This evaluation is based on testing performed by National Certified Testing Laboratories in Orlando, FL, test report no.: NCTL 210-3902-1 and dated 7/29/13.

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*

*AISI 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*

*ICC-ES Report ESR-2196 Hilti Self Drilling Screws to connect cold-formed steel*

*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, Swartz Consulting Engineers LLC hereby certifies the following:

(1) Swartz Consulting Engineers 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

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(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.

**Design Summary:**

The table below summarizes the product: Premium Atlantic Vinyl 36" X 72" 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 |
|---|---|---|---|
| Premium Atlantic Vinyl 36" X 72" | NCTL 210-3902-1 (7/29/13) | 36" X 72" | +55 psf / -60 psf |

***As Tested Design:***

Applied Load (psf): -60 psf Width: 36 in Height: 72 in Window Area: 18.0 $ft^2$

Total Load: -1080 lbs Number of Fasteners: 16 ft Load Per Fastener (Nailfin): -68 lbs
Load Per Fastener (Thru Frame): -68 lbs

**Screw Information:**

Screw Size: 10 Screw Embed: 1.5 in Edge Distance: 3/4 in (minimum)

Wood Screw Withdrawal: 228 lbs Unity: 0.30
Wood Screw Lateral: 149 lbs Unity: 0.45

***Alternative Fasteners:***

**Screw Information:**

Screw Size: 10 Screw Embed: 1.5 in Edge Distance: 3/4 in (minimum)

Wood Screw Withdrawal: 228 lbs Unity: 0.30
Wood Screw Lateral: 149 lbs Unity: 0.45

**Nail Information:**

Nail Size: 6d Nail Type: Box Edge Distance: 3/4 in (minimum)

Total Load: -1080 lbs Number of Nails: 24 Load Per Fastener (Nailfin): -45 lbs

Nail Withdrawal: 47 lbs Unity: 0.96
Nail Lateral: 76 lbs Unity: 0.59

**Design Summary Continued:**

**TEK Screw Information:**

Screw Size: 10-16

| | | | | |
|---|---|---|---|---|
| TEK Withdrawal: | 145 | lbs | Unity: | 0.47 |
| TEK Lateral: | 147 | lbs | Unity: | 0.46 |

**Tapcon Information:**

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

| | | | | |
|---|---|---|---|---|
| Tapcon Lateral (Concrete): | 155 | lbs | Unity: | 0.44 |
| Tapcon Lateral (CMU): | 135 | lbs | Unity: | 0.50 |

**Summary of Test Results - Plastics Checklist**

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

| Product | Test Report Number | Test Standard | Performance |
|---|---|---|---|
| White PVC 1476 5110 | P6504.04-106-18 R0 | ASTM D638 (before and after G155) | +9.5% |
| | | ASTM D1929 | 824 °F (440 °C) |
| | | ASTM D2843 | 71.8 |
| | | ASTM D635 | Classification CC1 |
| | | ASTM 256 | -3.3% |
| White PVC 1476 5290 | P6504.04-106-18 R0 | ASTM D638 (before and after G155) | +9.5% |
| | | ASTM D1929 | 806 °F (430 °C) |
| | | ASTM D2843 | 72.6 |
| | | ASTM D635 | Classification CC1 |
| | | ASTM 256 | -35.5% |

The testing summarized in the table above was conducted by Intertek in York, PA dated 08/23/23 and meets the requirements listed in Miami-Dade County Checklist #0445, For the approval of: Plastic and Foam Plastic.

The Saflex FlySafe 3D interlayer meets the requirements listed in Miami-Dade County Checklist #0445, For the approval of: Plastic and Foam Plastic as shown by NOA 23-0713.19

**Subject:** As Tested - Wood Screw Withdrawal

Input:
Calculation:

**Screw Information:**

Screw Size: 10 Root Diameter: 0.152 in
Screw Embed: 1.5 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: 95 lbs/in - Table 12.2B (NDS 2018)
W: 143 lbs

W': 228 lbs

**Subject:** As Tested - Wood Screw Lateral Design - Single Shear

Input:
Calculation:

**Screw Information:**

Screw Size: 10 Root Diameter: 0.152 in
Screw Embed: 1.5 in

Main Member Type: S-P-F G: 0.42 $F_{em}$: 3,350 psi thickness ($t_m$): 1.5 in

Side Member Type: S-P-F G: 0.42 $F_{es}$: 3,350 psi thickness ($t_s$): 1.25 in

**Lateral Design Factors - Table 12.3.1A (NDS 2018)**

| | | | |
|---|---|---|---|
| D: | 0.152 | in | Diameter |
| $F_{yb}$: | 90 | ksi | Dowel Bending Yield Strength |
| $F_{em}$: | 3,350 | psi | Main Member dowel bearing strength |
| $F_{es}$: | 3,350 | psi | Side Member dowel bearing strength |
| $l_m$: | 1.5 | in | Main Member dowel bearing length |
| $l_s$: | 1.25 | in | Side Member dowel bearing length |
| $R_d$: | 2.2 | | Reduction term - Table 12.3.1B (NDS 2018) |
| $R_e$: | 1 | | $= F_{em}/F_{es}$ |
| $R_t$: | 1.2 | | $= l_m/l_s$ |
| $k_1$: | 0.459 | | See Table |
| $k_2$: | 1.133 | | See Table |

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

$Z_{Im}$: 347 lbs $Z_{I_m} = \frac{Dl_m F_{em}}{R_d}$ (EQ 12.3 − 1)

$Z_{II}$: 133 lbs $Z_{II} = \frac{k_1 D l_s F_{es}}{R_d}$ (EQ 12.3 − 3)

$Z_{IIIm}$: 131 lbs $Z_{III_m} = \frac{k_2 D l_m F_{em}}{(1+2R_e)R_d}$ (EQ 12.3 − 4)

$Z_{IV}$: 105 lbs $Z_{IV} = \frac{D^2}{R_d}\sqrt{\frac{2F_{em}F_{yb}}{3(1+R_e)}}$ (EQ 12.3 − 6)

$Z_{MIN}$: 105 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.

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

**Adjusted Lateral Design Values**

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

| | | |
|---|---|---|
| $C_D$: | 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) |
| $C_\Delta$: | 1.0 | Geometry Factor - Section 12.5.1.1 (NDS 2018) |

$Z'$: **168** lbs

**Fastener Bending Across Shim Space**

| | | | |
|---|---|---|---|
| Ω: | 1.67 | | |
| L: | 0.25 | in | Maximum Shim Gap |
| D: | **0.152** | in | Diameter |
| $F_{yb}$: | **90** | ksi | Dowel Bending Yield Strength |

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

$Z_n/\Omega$: **149** 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: | **0.152** | in | |

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

$P_{nv}/\Omega$: **162** lbs

**Subject:** Nail Withdrawal

Input:
Calculation:

**Nail Information:**

Nail Size: 6d
Nail Type: Box
Nail Length: 2 in
Nail Diameter: 0.099 in
Nail Embedment: 1.88 in

Main Member Type: S-P-F G: 0.42 $F_{em}$: 3,350 psi thickness ($t_m$): 1.5 in

Side Member Type: PVC G: N/A $F_{es}$: 13,750 psi thickness ($t_s$): 0.125 in

$$W' = W * C_D * {C_M}^2 * C_t \ - As\ per\ table\ 11.3.1\ NDS\ 2018$$

$C_D$: 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: 16 lbs/in $W = 1380G^{5/2}D \ - Carbon\ Steel\ Nails\ (EQ.12.2-3, NDS\ 2018)$
W: 29 lbs

W': 47 lbs

**Subject:** Nail Lateral Design - Single Shear

Input:
Calculation:

**Nail Information:**

Nail Size: 6d | Nail Length: 2 in
Nail Type: Box | Nail Diameter: 0.099 in | Nail Embedment: 1.63 in

Main Member Type: S-P-F | G: 0.42 | $F_{em}$: 3,350 psi | thickness ($t_m$): 1.5 in

Side Member Type: PVC | G: N/A | $F_{es}$: 13,750 psi | thickness ($t_s$): 0.125 in

**Lateral Design Factors - Table 12.3.1A (NDS 2018)**

| | | | |
|---|---|---|---|
| D: | 0.099 | in | Diameter |
| $F_{yb}$: | 100 | ksi | Dowel Bending Yield Strength |
| $F_{em}$: | 3,350 | psi | Main Member dowel bearing strength |
| $F_{es}$: | 13,750 | psi | Side Member dowel bearing strength |
| $l_m$: | 1.625 | 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) |
| $R_e$: | 0.2436 | | $= F_{em}/F_{es}$ |
| $R_t$: | 13.0 | | $= l_m/l_s$ |
| $k_1$: | 1.230 | | See Table |
| $k_2$: | 0.612 | | See Table |

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

$Z_{Im}$: 245 lbs $\quad Z_{I_m} = \frac{D l_m F_{em}}{R_d}$ (EQ 12.3 − 1)

$Z_{II}$: 95 lbs $\quad Z_{II} = \frac{k_1 D l_s F_{es}}{R_d}$ $(EQ\ 12.3 - 3)$

$Z_{IIIm}$: 101 lbs $\quad Z_{III_m} = \frac{k_2 D l_m F_{em}}{(1 + 2R_e) R_d}$ (EQ 12.3 − 4)

$Z_{IV}$: 60 lbs $\quad Z_{IV} = \frac{D^2}{R_d}\sqrt{\frac{2F_{em}F_{yb}}{3(1+R_e)}}$ $(EQ\ 12.3 - 6)$

$Z_{MIN}$: 60 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.

**Subject:** Nail 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) |
| $C_\Delta$: | 1.0 | Geometry Factor - Section 12.5.1.1 (NDS 2018) |

$Z'$: **96** lbs

**Fastener Bending Across Shim Space**

| | | | |
|---|---|---|---|
| Ω: | 1.67 | | |
| L: | 0.25 | in | Maximum Shim Gap |
| D: | **0.099** | in | Diameter |
| $F_{yb}$: | **100** | ksi | Dowel Bending Yield Strength |

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

$Z_n/\Omega$: **76** 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: | **0.099** | in | |

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

$P_{nv}/\Omega$: **106** lbs

Subject: TEK Withdrawal

Input:
Calculation:

**Shear Strength of Fastener - ESR 1976**

Screw Size: **10-16**

$P_{nv}/\Omega$: **885** lbs See ESR 2196

**Tensile Pullout - ESR 1976**

Screw Size: **10-16**

$F_u$: 45 ksi Tensile Strength of material NOT in contact with screw head

t: 16 GA

t: **0.0598** in Thickness of material NOT in contact with screw head

$P_{nv}/\Omega$: **145** lbs See ESR 2196

**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: 8 Tested fastener is a

Head Size: **0.312** in

*TEK Screw Head Size:*

Screw Size: **10-16**

Head Size: **0.365** in

Subject: TEK Lateral Design

Input:
Calculation:

**Shear Strength of Fastener - ESR 1976**

Screw Size: **10-16**

$P_{nv}/\Omega$: **573** lbs See ESR 2196

**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 |

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

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

$P_{nv1}/\Omega$: **267** lbs
$P_{nv2}/\Omega$: **245** lbs

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

**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 | |

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

$P_n/\Omega$: **206** lbs

**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 | |

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

$P_{nv}/\Omega$: 147 lbs

Subject: Tapcon Lateral Design

Input:
Calculation:

**Tapcon Size:**

| | | | |
|---|---|---|---|
| Size: | 3/16 | | |
| D: | 0.1875 | in | Nominal Diameter |
| $D_{sh}$: | 0.145 | in | Shank Diameter |

**Fastener Shear Capacity - 3,000 psi Concrete**

$P_{nv}/\Omega$: 181 lbs See Table 1B of NOA 24-0102.06

**Fastener Shear Capacity - Medium-Weight CMU**

$P_{nv}/\Omega$: 135 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: | 0.25 | in | Maximum Shim Gap | Ω: 3.00 |
| $D_{sh}$: | 0.145 | in | Shank Diameter of Tapcon | |
| $F_{yb}$: | 100 | ksi | Yield Strength of Tapcon | |

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

$P_n/\Omega$: 239 lbs

**Bearing Strength of Masonry Straps - AISI S100**

| | | | | |
|---|---|---|---|---|
| Size: | 3/16 | | Tapcon Size | Ω: 3.00 |
| $D_{sh}$: | 0.145 | in | Shank Diameter of Tapcon Screw | |
| $F_u$: | 33 | ksi | Tensile Strength of Masonry Strap | |
| t: | 20 | GA | | |
| t: | 0.0359 | in | Thickness of Masonry Strap | |

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

$P_{nv}/\Omega$: 155 lbs