

PRODUCT APPROVAL SUPPORTING CALCULATIONS

Series/Model 1630 Horizontal Sliding Window

REPORT NO.: 27489.03-107-16

RENDERED TO: MI Windows and Doors
702 West Market Street
Gratz, Pennsylvania 17030

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

REPORT DATE: 12/11/2023

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

Printed copies of this document are not
considered signed and sealed and the signature
must be verified on any electronic copies.



2023.12.11 06:41:51 -05'00'

A handwritten signature in black ink, appearing to read "Michael D. Stremmel".

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

It is a violation to alter this document in any way unless acting under the direction of a licensed professional engineer.

SCOPE:

Molimo, LLC was contracted by MI Windows and Doors to evaluate alternate installation methods for their 1630 Horizontal Sliding Window window. The evaluation is based on physical testing and product certifications.

Reference standards utilized in this project include:

Florida Building Code, Building, 8th Edition (2023). International Code Council, 2023.

ANSI/AWCNDS-2018 National Design Specification (NDS) for Wood Construction. American Wood Council, 2018.

AISI S100-16 North American Specification for the Design of Cold-Formed Steel Structural Members, 2016. American Iron and Steel Institute, 2016.

ICC-ES Report ESR-1976 ITW Buildex TEKS Self-Drilling Fasteners. ICC Evaluation Service. 07/2016.

The anchorage analysis presented herein do 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 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 1630 Horizontal Sliding Window products and their corresponding performance levels which have been established by testing of product certification.

The products considered in this report satisfy the requirements of the *Florida Building Code* for the overall sizes and design pressures of the following product certifications and their installation methods presented in this report.

Table 1: Summary of Product Certifications and Limitations of Use

Series/Model	Test Report Number	Product Certification	Size (W x H)	Performance
1630 (XOX)	27142.03-106-12 (Rev. 0, 11/16/2023)	CPD 21465	110" x 63"	±50 psf Wind Zone 3

Testing documented in Table 1 was conducted by Molimo, LLC of York, Pennsylvania (Florida Department of Business & Professional Regulation Test Lab No. TST11282, IAS Certificate of Accreditation TL-678).

ANALYSES: (Continued)

As-Tested Installation Analysis

For air/water/structural testing, the test specimen was secured to a pine wood test buck with #8 x 1-1/2" screws at the jambs. A structural test specimen with #8 x 1-5/8" screws through the integral PVC nail fin was also tested. The as tested installation methods are evaluated on Pages 8 through 10 and the established design capacities are summarized in Table 2.

Table 2: As-tested Anchorage Design Capacities

Test Specimen Installation Method	Connection Details	Capacity
1630 Horizontal Sliding Window (XOX) Mounting Fin Install	<u>Head, Sill, and Jambs</u> #8 x 1-5/8" wood screws Located within 4" from each corner and spaced a maximum of 12" on center	85.9 lb
	<u>Head and Sill at each meeting stile</u> 0.048" thick steel installation clip, secured to the frame with #10 x 1/2" pan head screws and to the wood buck #8 x 1-1/4" pan head screws.	322 lb

The capacities presented in Table 2 will be used to prove acceptable alternate anchors and substrates for the windows.

ANALYSES: (Continued)

Alternate Anchorages

Calculations on Pages 11 and 12 determine the design capacity of alternate mounting fin installation anchorages for the window. The alternate anchorage capacities are summarized in Table 3.

Table 3: Alternate Anchorage Capacities for Mounting Fin Installations

Substrate	Anchor	Capacity	Comments
18 Ga. Steel Stud	#10-16 TEKS Screw	104 lb	1. 33 KSI yield strength stud 2. Full penetration +3 threads 3. Limited by pullout capacity
Frame Clip	Steel frame clip with two #10 SMS to the window and two #10-16 TEKS screw to the substrate	380 lb	1. 33 KSI yield strength stud 2. Full penetration +3 threads 3. Limited by pullout capacity

ANALYSES: (Continued)**Anchorage Requirements**

It must be determined the anchorages are not overloaded for the approved window size and design pressures. Calculations presented on Page 13 shows the following:

1. Mounting Fin Installation Method: The as-tested spacing is adequate for the minimum anchor capacity reported in this report when the windows are subjected to the maximum design pressures of the products at their approved maximum sizes.

Based on the calculations, Table 5 shows the maximum anchor spacing for each installation method. The anchor spacings shown in the following table apply to all substrates and anchor types.

Table 5: Anchorage Spacing Requirements

Installation Method	Maximum Anchor Spacing
Mounting Fin	4" from each corner, and spaced a maximum of 12" on center, through the mounting fin into the building substrate
Frame Clip	Head and sill, one at each end of all interlocks

As-Tested Installation – Nail Fin to Wood

Anchor: #8 x 1-5/8" Wood Screw

Details: Through the PVC Nail Fin

Substrate: SPF wood test buck (G = 0.42 min.)

Wood Screw Capacity (Tension)

$W = 1.6(1.50" - 0.062")(82 \text{ lb/in})$ (NDS, Table 12.2B)

$W = \underline{\underline{189 \text{ lb}}}$

Pull-over of Wood Screw

Pull-over of the wood screw is validated by the test

As-tested spacing: 12" on center

As-tested Anchor head size: 0.330"

Anchor Placement: 4" from corner; 12" on center

Anchor Quantities:

Jambs:	5
Head:	9
Sill:	9
Total:	28

Load to Anchors: $(110")(63")(50 \text{ psf} / 144) = 2,406 \text{ lb}$

Individual Anchor Load: $(2,406 \text{ lb}) / (28 \text{ anchors}) = 85.9 \text{ lb} (< \text{withdrawal capacity})$

Design Capacity of the Connection = 85.9 lb

As-Tested Installation – Frame Clip to Wood Substrate

Anchor: 0.063" thick steel frame clip (HD000063)
- Two #10 x 1/2" Screw to the PVC frame
- Two #8 x 1-1/4" wood screw to the wood substrate

Details: Through the PVC Frame
- Two 0.050" thick frames at anchor location

Substrate: SYP wood test buck (G = 0.55 min.)

Clip to Frame Connection

Bearing Capacity (of PVC frame)

$$P_b = D \ t \ F_{tu} = (0.190")(0.100")(10,000 \text{ psi})$$

$$P_b = \underline{190 \text{ lb}}$$

Bearing Capacity (of #10 SMS on frame clip)

$$P_b = 2.7 \ D \ t \ F_{tu} = 2.7(0.190")(0.063")(45,000 \text{ psi}) = 1,454 \text{ lb}$$

$$P_{\text{allow}} = 1,454 \text{ lb} / 3.0 = \underline{484 \text{ lb}}$$

Clip to Substrate Connection

Wood Screw Capacity (Shear)

$$Z' = \underline{161 \text{ lb}}$$

(Reference the following page)

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

$$P_b = 2.7 \ D \ t \ F_{tu} = 2.7(0.164")(0.063")(45,000 \text{ psi}) = 1,255 \text{ lb}$$

$$P_{\text{allow}} = 1,255 \text{ lb} / 3.0 = \underline{418 \text{ lb}}$$

Design Capacity of the Connection = 161 lb x 2 = 322 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	=	1.250 in.

Project: 1630 HS (XOX)
Comments: As-Tested (Frame Clip)
 1-1/4" min embedment

Main Member

Material	=	SYP
G	=	0.55
θ	=	90
F_e	=	5,550 psi
Thickness	=	1.500 in.

Side Member

Material	=	ASTM A 36 Steel
G	=	N/A
θ	=	90
F_{es}	=	87,000 psi
Thickness	=	0.048 in.

Calculations

Lateral Bearing Factors

D	=	0.131 in.
ℓ_m	=	1.038 in.
K_θ	=	1.25
K_D	=	2.20
R_e	=	0.064
R_t	=	21.63

k_1	=	0.5641
k_2	=	0.5237
k_3	=	13.13
R_d	=	2.20 (Mode I _m , I _s)
R_d	=	2.20 (Mode II)
R_d	=	2.20 (Mode III _m , III _s , IV)

Lateral Design Values, Z

Mode I _m	=	343 lbf
Mode I _s	=	249 lbf
Mode II	=	140 lbf
Mode III _m	=	159 lbf
Mode III _s	=	101 lbf
Mode IV	=	138 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_Δ	=	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'	=	161 lbf
------	---	----------------

Alternate Installation – Nail Fin to Steel Stud

Anchor: #10-16 TEKS Screw

Details: Through the PVC Nail Fin

Substrate: 18 ga steel stud (33 ksi, 0.043" thick)

Wood Screw Capacity (Tension)

$$P_{ss} / \Omega = \underline{885 \text{ lb}} \quad (\text{ESR-1976})$$

Pull-over of #10-16 TEKS Screw

$$\text{Anchor head size} = 0.365" > 0.330" \quad (\text{maintain as tested spacing})$$

Pull-out of #10-16 TEKS Screw

$$P_{\text{not}} = 0.85 t_c d F_{tu} = 0.85(0.043")(0.190")(45,000 \text{ psi}) = 312 \text{ lb}$$

$$P_{\text{allow}} = 312 \text{ lb} / 3.0 = \underline{104 \text{ lb}}$$

Design Capacity of the Connection = 104 lb

Alternate Installation – Frame Clip to Steel Stud Substrate

Anchor: 0.063" thick steel frame clip (HD000063)
or 0.075" thick aluminum frame clip (M-2336)
- Two #10 x 1/2" Screw to the PVC frame
- Two #10-16 TEKS Screw to the steel stud substrate

Details: Through the PVC Frame
- Two 0.050" thick frames at anchor location

Substrate: 18 ga steel stud (33 ksi, 0.043" thick)

Clip to Frame Connection

Bearing Capacity (of PVC frame)

$$P_b = D t F_{tu} = (0.190")(0.100")(10,000 \text{ psi}) = \underline{190 \text{ lb}}$$

Bearing Capacity (of #10 SMS on frame clip)

$$P_b = 2.7 D t F_{tu} / 3.0 = 2.7(0.190")(0.063")(45,000 \text{ psi}) / 3.0 = \underline{484 \text{ lb}}$$

Clip to Substrate Connection

Anchor Capacity (Shear of #10-16 TEKS)

$$P_{ss} / \Omega = \underline{573 \text{ lb}} \quad (\text{ESR-1976})$$

Bearing Capacity (of #10-16 TEKS on HD000063 frame clip)

$$P_b = 2.7 D t F_{tu} / 3.0 = 2.7(0.190")(0.063")(45,000 \text{ psi}) / 3.0 = \underline{484 \text{ lb}}$$

Bearing Capacity (of #10-16 TEKS on M-2336 frame clip)

$$P_b = 2 D t F_{tu} / 3.0 = 2(0.190")(0.075")(22,000 \text{ psi}) / 3.0 = \underline{209 \text{ lb}}$$

Bearing/Tilting Capacity (of #10-16 TEKS on steel stud)

$$P_b = 2.7 D t F_{tu} = 2.7(0.190")(0.048")(45,000 \text{ psi}) = 1,108 \text{ lb}$$

$$P_b = 4.2 (D t^3)^{1/2} F_{tu} = 2.7 \{ (0.190")(0.048")^3 \}^{1/2} (45,000 \text{ psi}) = 866 \text{ lb}$$

$$P_{\text{allow}} = 866 \text{ lb} / 3.0 = \underline{289 \text{ lb}}$$

Design Capacity of the Connection = 190 lb x 2 = 380 lb

Alternate Requirements

Series/Model: 1630 HS (XOX)
Test Unit Size: 110" x 63"
Design Pressure: ± 50 psf

Mounting Fin Installation Method

Anchor Placement: 4" from corners and 12" on center
Anchor Quantities: Head / Sill = 9 per
Jambs = 5 per
Total = 28

Load to the Anchors = $(110")(63")(50 \text{ psf} / 144) = 2,406 \text{ lb}$

Individual Anchor Load = $2,406 \text{ lb} / 28 \text{ anchors} = 85.9 \text{ lb}$

Least Anchor Capacity = 104 lb (Steel Stud) > 85.9 lb

Tested Anchor Spacing Governs

Frame Clip Installation Method (HD000063 Steel Clip or M-2336 Aluminum Clip)

Interlock Load at Head/Sill

Interlock Load Area: $[(110"/3)(63") - (110"/3)(110"/3) / 2] / 144 = 11.37 \text{ ft}^2$

Anchor Quantity: $n = 1$ per end

Total Interlock Load = $(11.37 \text{ ft}^2)(50 \text{ psf}) / 2 = 568.5 \text{ lb}$

Individual Anchor Clip Load = $568.5 \text{ lb} / 2 = 284.3 \text{ lb}$

Least frame clip Capacity = 322 lb (Wood) > 284.3 lb

Tested Anchor Spacing Governs (one per interlock end)

Revision Log

Rev. #	Date	Page(s)	Revision(s)
0	12/8/2023	All	Original Report Issue