

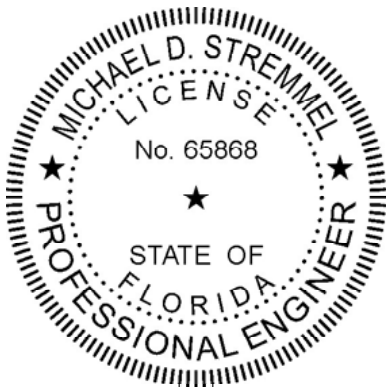
PRODUCT APPROVAL SUPPORTING CALCULATIONS

1618 Sliding Glass Door - XXX (Impact)

REPORT TO:

**MI WINDOWS AND DOORS, LLC
702 WEST MARKET ST
GRATZ, PENNSYLVANIA 17030**

REPORT NUMBER: 27488.12-107-16-R0
REPORT DATE: 12/12/23



2023.12.12 08:28:51 -05'00'

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

Michael D. Stremmel, PE
FL PE 65868
FL REG 37122

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.

Scope

Molimo, LLC was contracted by MI Windows and Doors, LLC to evaluate alternate installation methods for their Series 1618 Sliding Glass Doors – XXX (Impact). The evaluation is based on physical testing and product certifications.

The products considered in this report satisfy the requirements of the *Florida Building Code, Building 8th Edition (2023)* for the overall sizes and design pressures of the following product certifications and the installation methods presented in this report.

Series/Model	Product Certification	Overall Size (W x H)	Performance
1618 SGD – Impact (XXX)	CPD 20482	144" x 96"	Missile D Wind Zone 3 +50/-50 psf
	CPD 20503	144" x 96"	+50/-50 psf 7.50 psf Water Test

Reference standards utilized in this project include:

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

ANSI/AWC NDS-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. 01/2023.

NOA 21-0201.06 *Tapcon Concrete and Masonry Anchors with Advanced Threadform Technology*. Miami-Dade County Product Control Section. 02/06/2021.

AAMA TIR A9-14 *Design Guide for Metal Cladding Fasteners*. American Architectural Manufacturers Association, 2014.

The anchorage analyses 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 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

The following table summarizes the various 1618 Sliding Glass 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	Product Certification	Size (W x H)	Performance
1618 SGD – Impact (XXX)	11714.01-106-11 (Revision -, 12/01/22)	CPD 20481	144" x 96"	Missile D Wind Zone 3 +50/-50 psf
	11714.02-106-11 (Revision -, 12/01/22)	CPD 20503	144" x 96"	+50/-50 psf 7.50 psf Water TEst

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).

As-Tested Installation Analysis

For air/water/structural testing, the test specimens were secured to a pine buck as summarized in Table 2. The as-tested installation methods are evaluated on page 6 to page 9 and the established design capacities are presented in Table 2.

Table 2 As-tested Anchorage Design Capacities

Test	Connection	Capacity
1618 SGD (XXX) Air/Water/Structural Tests Missile Impact Tests	<u>Sill</u> Strap anchor secured to frame with one (1) #8 x 5/8" screws and secured to the pine buck with one (1) #8 x 1-1/2" screw. Placed approximately 12" on center.	156 lb
	<u>Jambs</u> #10 x 2" screw placed 12" on center <u>Head</u> #10 x 3" screw pairs placed 12" on center	156 lb (per screw)

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

Alternate Anchorages

Calculations on page 10 through page 11 determine the design capacity of alternate strap anchor installation anchorages for the door. The alternate anchorage capacities are summarized in Table 3.

Table 3 Alternate Anchorage Capacities for Strap Anchor Installation

Substrate	Anchor	Capacity	Comments
18 Gauge Steel Stud	#10-16 TEKS Screw	155 lb	1. 33 KSI yield strength stud. 2. Full penetration +3 threads. 3. Limited by bending capacity.
Concrete	3/16" Tapcon	164 lb	1. Minimum $f'_c = 3,000$ psi. 2. 1-1/2" Minimum Embedment. 3. 2" Min. Edge Distance. 4. Limited by shear capacity. 5. Maximum 1x buck strip.
CMU	1/4" Tapcon	161 lb	1. Minimum ASTM C90 CMU. 2. 1-1/2" Minimum Embedment. 3. 2" Min. Edge Distance. 4. Limited by shear capacity. 5. Maximum 1x buck strip.

Note: 18 gauge steel strap anchor (part 9859).

Calculations on page 12 through page 15 determine the design capacity of alternate through-frame installation anchorages for the door. The alternate anchorage capacities are summarized in Table 4.

Table 4 Alternate Anchorage Capacities for Through-Frame Installation

Substrate	Anchor	Capacity	Comments
18 Gauge Steel Stud	#10-16 TEKS Screw	155 lb	1. 33 KSI yield strength stud. 2. Full penetration +3 threads. 3. Limited by bending capacity.
Concrete	3/16" Tapcon	186 lb	1. Minimum $f'_c = 3,000$ psi. 2. 1-1/2" Minimum Embedment. 3. 2" Min. Edge Distance. 4. Limited by shear capacity. 5. Maximum 1x buck strip.
CMU	1/4" Tapcon	161 lb	1. Minimum ASTM C90 CMU. 2. 1-1/2" Minimum Embedment. 3. 2" Min. Edge Distance. 4. Limited by shear capacity. 5. Maximum 1x buck strip.

Note: Maximum available length of 3/16" Tapcon anchor is 3-1/4". Use 1/4" x 4" Tapcon anchors for through-frame installations with 1x buck strip.

Anchorage Requirements

Because all alternate strap anchor anchorages and alternate through-frame anchorages evaluated by this report have equal or higher design capacities than the tested anchorages, the alternate strap anchorages and alternate-through frame anchorages proposed by this report may be used for the doors at the as-tested spacing.

Attachments

Appendix A – Revision Log (1 page)

As-Tested Installation – Strap Anchor to Wood

#10 x 1-1/2" Wood Screw securing strap anchor to wood

(1) #8 x 5/8" screws securing strap to PVC frame.

18 gauge (0.043" thick) steel strap anchor ($F_y = 33,000$ psi, $F_u = 45,000$ psi)

1/4" Maximum Shim Space

Spruce-Pine-Fir Wood Substrate Minimum ($G=0.42$)

Allowable Shear of #10 x 1-1/2" Wood Screw

$Z' = 156$ lb (Limited by Mode III_s, See Following 2 Pages)

Allowable Shear of #8 Grade 2 Screw

$V_a = 177$ lb per screw (AAMA TIR A9-14)

Bearing of #8 Screw on Strap Anchor

$V_a = 2.7DtF_{tu}/\Omega$
 $V_a = 2.7(0.164")(0.043")(45,000 \text{ psi})/3.0$
 $V_a = 286$ lb per screw

Bearing of #8 Screw on PVC Frame

$V_a = DtF_p = (0.164")(0.100")(10,000 \text{ psi}) = 164$ lb per screw

Bending of #10 x 1-1/2" Wood Screw

$L = 1/4"$ (maximum shim space)
 $S = \pi d^3/32 = \pi(0.152)^3/32 = 0.000345 \text{ in}^3$
 $F_b = (1.3)(0.6F_y) = (1.3)(0.6)(80,000 \text{ psi}) = 62,400 \text{ psi}$ (1.3 for weak axis bending)
 $F_b = M/S = (VL/2)/S$ ($L/2$ for guided bending)
 $V = 2SF_b/L = (2)(0.000345 \text{ in}^3)(62,400 \text{ psi})/0.25" = 172 \text{ lb}$.

Capacity of Connection is 156 lb

As-Tested Installation – Strap Anchor to Wood (Continued)

Lateral Design Strength of Wood Connections

Data

Fastener			
Fastener	=	#10 Wood Screw	
Shank Dia	=	0.190	in.
Root Dia.	=	0.152	in.
F_{yb}	=	80,000	psi
Fastener length	=	1.500	in.
Main Member			
Material	=	SPF	
G	=	0.42	
θ	=	90	$\leq$ (Angle of load to grain $0^\circ \leq \theta \leq 90^\circ$)
F_e	=	3,350	psi
Thickness	=	1.500	in.
Side Member			
Material	=	ASTM A 653, Grade 33 Steel	
G	=	N/A	
θ	=	90	$\leq$ (Angle of load to grain $0^\circ \leq \theta \leq 90^\circ$)
F_{es}	=	61,850	psi
Thickness	=	0.043	in.

Calculations

Lateral Bearing Factors

D	=	0.152	in.
ℓ_m	=	1.077	in.
K_θ	=	1.25	
K_D	=	2.20	
R_e	=	0.054	
R_t	=	25.05	
k_1	=	0.5560	
k_2	=	0.5684	
k_3	=	20.16	

As-Tested Installation – Strap Anchor to Wood (Continued)

Yield Mode	R _d
I _m , I _s	2.20
II	2.20
III _m , III _s , IV	2.20

Lateral Design Values, Z

Mode I _m	=	249	lbf
Mode I _s	=	184	lbf
Mode II	=	102	lbf
Mode III _m	=	128	lbf
Mode III _s	=	98	lbf
Mode IV	=	137	lbf
C _D	=	1.6	

<===== Minimum Value

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 _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
Z'	=	<u>156</u> lbf

As-Tested – Through-Frame to Wood

#10 x 3" Wood Screw through-frame to wood

PVC Frame; 0.100" thickness at fastener location

1/4" Maximum Shim Space

Spruce-Pine-Fir Wood Substrate Minimum (G=0.42)

Allowable Shear of #10 x 3" Wood Screw

$Z' = 156 \text{ lb}$ (See page 8 to page 9)

Bearing of #10 x 3" Wood Screw on Frame

$$V_a = DtF_p$$

$$V_a = (0.190\text{'}) (0.100\text{'}) (10,000 \text{ psi})$$

$$V_a = 190 \text{ lb}$$

Bending of #10 x 3" Wood Screw

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

$$S = \pi d^3/32 = \pi (0.152\text{'})^3/32 = 0.000345 \text{ in}^3$$

$$F_b = (1.3)(0.6F_y) = (1.3)(0.6)(80,000 \text{ psi}) = 62,400 \text{ psi (1.3 for weak axis bending)}$$

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

$$V = 2SF_b/L = (2)(0.000345 \text{ in}^3)(62,400 \text{ psi})/0.25\text{' = 172 lb}$$

Capacity of Connection is 156 lb per screw

Alternate Installation – Strap Anchor to Steel Stud

#10-16 TEKS Screw securing strap anchor to steel stud

18 gauge (0.0428" thick) steel stud ($F_y = 33,000$ psi, $F_u = 45,000$ psi)

18 gauge (0.043" thick) steel strap anchor ($F_y = 33,000$ psi, $F_u = 45,000$ psi)

1/4" Maximum Shim Space

Allowable Shear of #10-16 TEKS Screw

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

Bearing of #10-16 TEKS Screw on Strap Anchor

$$\begin{aligned} V_a &= 2.7DtF_{tu}/\Omega \\ V_a &= 2.7(0.190")(0.043")(45,000 \text{ psi})/3.0 \\ V_a &= 331 \text{ lb.} \end{aligned}$$

Bearing of #10-16 TEKS Screw on Steel Stud

$$\begin{aligned} V_a &= 2.7DtF_{tu}/\Omega \\ V_a &= 2.7(0.190")(0.0428")(45,000 \text{ psi})/3.0 \\ V_a &= 329 \text{ lb.} \end{aligned}$$

Tilting of #10-16 TEKS Screw in Steel Stud

$$\begin{aligned} V_a &= 4.2(t_2^3 D)^{1/2} F_{tu2}/n_s \\ V_a &= 4.2(0.0428''^3 \times 0.190'')^{1/2} (45,000 \text{ psi})/3.0 \\ V_a &= 243 \text{ lb.} \end{aligned}$$

Bending of #10-16 TEKS Screw

$$\begin{aligned} L &= 1/4" \text{ (Maximum Shim Space)} \\ S &= \pi d^3/32 = \pi(0.140)^3/32 = 0.000269 \text{ in}^3 \\ F_b &= (1.3)(0.6F_y) = (1.3)(0.6)(92,000 \text{ psi}) = 71,760 \text{ psi (1.3 for weak axis bending)} \\ F_b &= M/S = (VL/2)/S \text{ (L/2 for guided bending)} \\ V &= 2SF_b/L = (2)(0.000269 \text{ in}^3)(71,760 \text{ psi})/0.25" = 155 \text{ lb.} \end{aligned}$$

Capacity of Connection is 155 lb.

Alternate Installation – Strap Anchor to Concrete

3/16" Tapcon Anchor; 1-1/2" Minimum Embedment; 2" Minimum Edge Distance

PVC Frame, 0.100" thickness at fastener location

Minimum $f'_c = 3,000$ psi Concrete

18 gauge (0.043" thick) steel strap anchor ($F_y = 33,000$ psi, $F_u = 45,000$ psi)

1/4" Maximum Shim Space

Allowable Shear of 3/16" Tapcon Anchor

$$V_a = 186 \text{ lb} \quad (\text{NOA-No. 16-1222.06})$$

Bearing of 3/16" Tapcon Anchor on Strap Anchor

$$\begin{aligned} V_a &= 2.7D_tF_{tu}/\Omega \\ V_a &= 2.7(0.188")(0.043")(45,000 \text{ psi})/3.0 \\ V_a &= 327 \text{ lb.} \end{aligned}$$

Bending of 3/16" Tapcon

$$\begin{aligned} L &= 1/4" \text{ (Maximum Shim Space)} \\ S &= \pi d^3/32 = \pi(0.145")^3/32 = 0.000299 \text{ in}^3 \\ F_b &= (1.3)(0.6F_y) = (1.3)(0.6)(137,000 \text{ psi}) = 106,860 \text{ psi} \text{ (1.3 for weak axis bending)} \\ F_b &= M/S = (VL/2)/S \text{ (L/2 for guided bending)} \\ V &= 2SF_b/L = (2)(0.000299 \text{ in}^3)(106,860 \text{ psi})/0.25" = 256 \text{ lb.} \end{aligned}$$

Capacity of Connection is 186 lb

Limited to 164 lb capacity of one (1) #8 x 5/8" screw securing strap to frame.

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

Alternate Installation – Strap Anchor to CMU

1/4" Tapcon Anchor; 1-1/2" Minimum Embedment, 2" Minimum Edge Distance

PVC Frame, 0.100" thickness at fastener location

Minimum ASTM C90 Concrete Masonry Unit

18 gauge (0.043" thick) steel strap anchor ($F_y = 33,000$ psi, $F_u = 45,000$ psi)

1/4" Maximum Shim Space

Allowable Shear of 1/4" Tapcon Anchor

$$V_a = 161 \text{ lb} \quad (\text{NOA-No. 16-1222.06})$$

Bearing of 1/4" Tapcon Anchor on Strap Anchor

$$\begin{aligned} V_a &= 2.7D_tF_{tu}/\Omega \\ V_a &= 2.7(0.250")(0.043")(45,000 \text{ psi})/3.0 \\ V_a &= 435 \text{ lb.} \end{aligned}$$

Bending of 1/4" Tapcon

$$\begin{aligned} L &= 1/4" \text{ (Maximum Shim Space)} \\ S &= \pi d^3/32 = \pi(0.190")^3/32 = 0.000673 \text{ in}^3 \\ F_b &= (1.3)(0.6F_y) = (1.3)(0.6)(137,000 \text{ psi}) = 106,860 \text{ psi} \text{ (1.3 for weak axis bending)} \\ F_b &= M/S = (VL/2)/S \text{ (L/2 for guided bending)} \\ V &= 2SF_b/L = (2)(0.000673 \text{ in}^3)(106,860 \text{ psi})/0.25" = 575 \text{ lb.} \end{aligned}$$

Capacity of Connection is 161 lb

Alternate Installation – Trough-Frame to Steel Stud

#10-16 TEKS Screw

PVC Frame; 0.100" thickness at fastener location

1/4" Maximum Shim Space

Minimum 18 gauge 33 KSI Steel Stud

Allowable Shear of #10-16 TEKS Screw

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

Bearing of #10-16 TEKS Screw on Frame

$$\begin{aligned} V_a &= DtF_p \\ V_a &= (0.190")(0.100")(10,000 \text{ psi}) \\ V_a &= 190 \text{ lb} \end{aligned}$$

Bearing of #10-16 TEKS Screw on Steel Stud

$$\begin{aligned} V_a &= 2.7DtF_{tu}/\Omega \\ V_a &= 2.7(0.190")(0.0428")(45,000 \text{ psi})/3.0 \\ V_a &= 329 \text{ lb.} \end{aligned}$$

Tilting of #10-16 TEKS Screw in Steel Stud

$$\begin{aligned} V_a &= 4.2(t_2^3 D)^{1/2} F_{tu2}/n_s \\ V_a &= 4.2(0.0428''^3 \times 0.190'')^{1/2} (45,000 \text{ psi})/3.0 \\ V_a &= 243 \text{ lb.} \end{aligned}$$

Bending of #10-16 TEKS Screw

$$\begin{aligned} L &= 1/4" \text{ (Maximum Shim Space)} \\ S &= \pi d^3/32 = \pi(0.140)^3/32 = 0.000269 \text{ in}^3 \\ F_b &= (1.3)(0.6F_y) = (1.3)(0.6)(92,000 \text{ psi}) = 71,760 \text{ psi (1.3 for weak axis bending)} \\ F_b &= M/S = (VL/2)/S \text{ (L/2 for guided bending)} \\ V &= 2SF_b/L = (2)(0.000269 \text{ in}^3)(71,760 \text{ psi})/0.25" = 155 \text{ lb.} \end{aligned}$$

Capacity of Connection is 155 lb.

Alternate Installation – Through-Frame to Concrete

3/16" Tapcon Anchor

1-1/2" Minimum Embedment; 2" Minimum Edge Distance

1/4" Maximum Shim Space

PVC Frame, 0.100" thickness at fastener location

Minimum $f'_c = 3,000$ psi Concrete

Allowable Shear of 3/16" Tapcon Anchor

$$V_a = 186 \text{ lb} \quad (\text{NOA-No. 16-1222.06})$$

Bearing of 3/16" Tapcon Anchor on Frame

$$V_a = DtF_p$$

$$V_a = (0.188")(0.100")(10,000 \text{ psi})$$

$$V_a = 188 \text{ lb}$$

Bending of 3/16" Tapcon

$$L = 1/4" \text{ (Maximum Shim Space)}$$

$$S = \pi d^3/32 = \pi(0.145")^3/32 = 0.000299 \text{ in}^3$$

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

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

$$V = 2SF_b/L = (2)(0.000299 \text{ in}^3)(106,860 \text{ psi})/0.25" = 256 \text{ lb.}$$

Capacity of Connection is 186 lb

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

Alternate Installation – Through-Frame to CMU

1/4" Tapcon Anchor

1-1/2" Minimum Embedment, 2" Minimum Edge Distance

1/4" Maximum Shim Space

PVC Frame, 0.100" thickness at fastener location

Minimum ASTM C90 Concrete Masonry Unit

Allowable Shear of 1/4" Tapcon Anchor

$$V_a = 161 \text{ lb} \quad (\text{NOA-No. 16-1222.06})$$

Bearing of 1/4" Tapcon Anchor on Frame

$$V_a = DtF_p$$

$$V_a = (0.250")(0.100")(10,000 \text{ psi})$$

$$V_a = 250 \text{ lb}$$

Bending of 1/4" Tapcon

$$L = 1/4" \text{ (Maximum Shim Space)}$$

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

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

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

$$V = 2SF_b/L = (2)(0.000673 \text{ in}^3)(106,860 \text{ psi})/0.25" = 575 \text{ lb.}$$

Capacity of Connection is 161 lb

Perimeter Load at Head

Design Pressure: 50 psf
Door Height: 96"
Door Width: 144"

Load Area of Head: 36 ft²
Wind Load to Head: (50 psf)(36 ft²) = 1,800 lb

Perimeter Load at Head: (1,800 lb)/(144") = 12.5 lb/inch

Anchor Load for 12" Spacing: $P = (12")(12.5 \text{ lb/inch}) = 150 \text{ lb.}$

If anchor capacity > 150 lb, it is not necessary to double up anchors at head.

Appendix A

Revision Log

<u>Identification</u>	<u>Date</u>	<u>Page & Revision</u>
Original Issue	12/12/23	Not Applicable