Window Installation Calculations

E500 Horizontal Sliding Window
E700 Horizontal Sliding Window with Louver

Report Q8188.01-122-34

Rendered to:

QUAKER WINDOWS & DOORS
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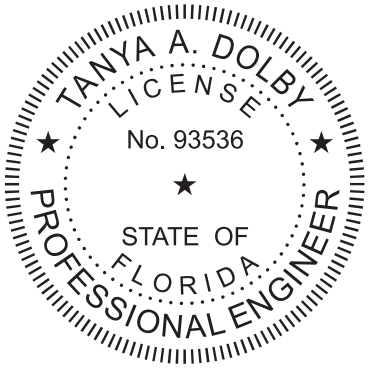

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Scope

Architectural Testing, Inc., an Intertek company, was contracted by Quaker Windows & Doors to evaluate alternate installation methods for their E500 Horizontal Sliding windows and E700 Horizontal Sliding Window with Louver. 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/AWC NDS-2018 National Design Specification (NDS) for Wood Construction with 2018 Supplement. American Wood Council, 2018.

ADM1-2020 Aluminum Design Manual. The Aluminum Association, Inc., 2020.

AISI S100-16(2020) North American Specification for the Design of Cold-Formed Steel Structural Members, 2016 Edition (Reaffirmed 2020). American Iron and Steel Institute, 2020.

ICC-ES Report ESR-1976 ITW Buildex TEKS Self-Drilling Fasteners. ICC Evaluation Service. 01/2023.

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, Architectural Testing, Inc. hereby certifies the following:

- Architectural Testing 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.
- Architectural Testing is not owned, operated or controlled by any company manufacturing or distributing products it tests or labels.
- Tanya Dolby, P.E. and Adam Kunkel do not have nor will acquire, a financial interest in any company manufacturing or distributing products for which the reports are being issued.
- Tanya Dolby, P.E. and Adam Kunkel do 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 E500 Horizontal Sliding Window and E700 Horizontal Sliding Window with Louver 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
E500 Horizontal Sliding Window (OX)	C3383.01-801-47-R1	NI011458-R1	99" x 79"	+/- 50.0 psf
E700 Horizontal Sliding Window (OX) over Louver	D7474.02-201-44-R0	NI012201.01-R1	72" x 89"	+/- 50.0 psf Missile D Wind Zone 4

Test report C3383.01-801-47-R1 was conducted by the Architectural Testing laboratory in Plano, Texas (Florida Department of Business & Professional Regulation Test Lab No. TST1910, IAS Accredited Laboratory TL-331).

Test report D7474.02-201-44-R0 was conducted by the Architectural Testing laboratory in St. Paul, Minnesota (Florida Department of Business & Professional Regulation Test Lab No. TST1795, IAS Accredited Laboratory TL-285).

As-Tested Installation Analysis

For air/water/structural testing, the test specimen was secured to a 2x wood buck with #6 x 2" wood screws through the nail fin, at the spacing noted on page 8. The as-tested installation method is evaluated on page 5 and the established design capacity summarized in Table 2.

Table 2 As-tested Anchorage Design Capacities.

Test	Connection	Capacity
Air/Water/Structural Test	#6 x 2" Wood Screw Through Nail Fin	72 lb

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

Alternate Anchorages

Pages 6 and 7 present the calculation of alternate anchorages for the windows. The alternate anchorage capacities are summarized in Table 3.

Table 3 Alternate Anchorage Capacities for Fin Installation

Substrate	Anchor	Capacity	Comments
Wood SYP 2x	#10 x 2" Wood Screw	104 lb	1. Limited by pull-over capacity. 2. 1-1/2" Minimum penetration. 3. Qualifies installation to wood framing or installation to wood buck.
18 Gauge Steel Stud	#10-16 TEKS Screw	104 lb	1. Limited by pull-over capacity. 2. 33 KSI yield strength stud. 3. Full penetration +3 threads. 4. Pull-over capacity exceeds as-tested pull-over capacity.

The #10 x 2" wood screw and #10-16 TEKS screw has more capacity than the as-tested installation method. Thus, the #10 x 2" wood screw and #10-16 TEKS screw may be used for installation to wood at the as-tested spacing. Calculations presented in page 8 show all evaluated anchors are not overloaded for the approved window size and design pressure.

Thus, #10 x 2" wood screws installed to wood and #10-16 TEKS screws installed to steel stud as specified in Table 3 are approved alternate installations for the subject window with the anchors installed at the as-tested spacing.

As-Tested Nail Fin Installation to Wood

#6 x 2" Pan Head Wood/Deck Screw (Non-Countersunk)
D_{ws} = (0.270” + 0.256”)/2 = 0.263” (Nominal Screw Head Diameter)
D_H = (0.142” + 0.131”)/2 + 0.011” = 0.148” (Section 11.0, AAMA TIR-A9)

1-1/2" Minimum Penetration

1/16" thick 6063-T6 Aluminum Nailing Fin

G = 0.55 Minimum SYP 2x Wood Blocking

¼” maximum shim space

ASD Withdrawal

Withdrawal of #6 Wood Screw

W' = 2,850(G^2)(D)(Cd)(Cm)(Ct)(Ceg)(Ctn)(L)
W' = 2,850 (0.55^2)(0.137'')(1.6)(0.7)(0.7)(1.00)(1.0)(1.50'')
W' = 138 lb

Adjustment Factors

Load Duration Factor - Ten Minutes, Cd = 1.6
Moisture Factor - Fabrication > 19% and In-Service > 19%, Cm = 0.7
Temperature Factor - 100°F < T ≤ 125°F, Ct = 0.7
End Grain Factor - No, Ceg = 1.00
Toe Nail Factor - No, Ctn = 1.0

Pull-Over of #8 PH Wood Screw

$P_{nov} = C_{pov}t_1F_{tu1}(D_{ws}-D_h)/3.0$
P_{nov} = 1.0(0.0625")(30,000 psi)(0.263" – 0.148")/3.0
P_{nov} = 72 lb

Capacity of Connection is 72 lb

Alternate Nail Fin Installation to Wood

#10 Pan Head Wood Screw
D_{ws} = (0.373” + .0357”)/2 = 0.365” (Nominal Screw Head Diameter)
D_H = 0.201” (Nominal Hole Size, AAMA TIR-A9, Table 11.1)
1-1/2" Minimum Penetration

1/16" thick 6063-T6 Aluminum Nailing Fin

G = 0.55 Minimum SYP 2x Wood Blocking

¼” maximum shim space

ASD Withdrawal

Withdrawal of #10 PH Wood Screw

W' = 2,850(G^2)(D)(Cd)(Cm)(Ct)(Ceg)(Ctn)(L)
W' = 2,850 (0.55^2)(0.190'')(1.6)(0.7)(0.7)(1.00)(1.0)(1.50'')
W' = 192 lb

Adjustment Factors

Load Duration Factor - Ten Minutes, Cd = 1.6
Moisture Factor - Fabrication > 19% and In-Service > 19%, Cm = 0.7
Temperature Factor - 100°F < T ≤ 125°F, Ct = 0.7
End Grain Factor - No, Ceg = 1.00
Toe Nail Factor - No, Ctn = 1.0

Pull-Over of #10 PH Wood Screw

$P_{nov} = C_{pov}t_1F_{tu1}(D_{ws}-D_h)/3.0$
P_{nov} = 1.0(0.0625")(30,000 psi)(0.365” – 0.201")/3.0
P_{nov} = 104 lb

Capacity of Connection is 104 lb

Alternate Nail Fin Installation to Steel Stud

#10 HWH TEKS Screw, Nailing Fin to Steel Stud

Full Penetration +3 Threads

1/16" thick 6063-T6 Aluminum Nailing Fin

Minimum 18 Gauge 33 KSI Steel Stud (Qualifies thicker and stronger steel)

¼" maximum shim space

Allowable Tension of #10-16 TEKS Screw

V_a = 885 lb (ESR-1976)

Pull-Over of #10 HWH TEKS Screw in Nail Fin

$P_{nov} = C_{pov}t_1F_{tu1}(D_{ws}-D_h)/3.0$

P_{nov} = 1.0(0.0625")(30,000 psi)(0.365" – 0.201")/3.0

P_{nov} = 104 lb

Pull-Out of #10 HWH TEKS Screw in Steel Stud

$P_{not} = 0.85t_cdF_{u2}/3.0$

P_{not} = 0.85(0.0478")(0.190")(45,000 psi)/3.0

P_{not} = 116 lb

Capacity of Connection is 104 lb

Anchorage Loads

Window Size:	99" wide by 79" tall
Design Pressure:	+/- 50 psf
As-tested Anchor Spacing:	11" on center at jambs 10-1/2" on center at head and sill
Anchors:	8 each jamb; 10 head; 10 sill; 36 total anchors
Maximum Load to Anchor:	(99")(79")(50 psf/144)/(36 anchors) = 75 lb/anchor

Maximum Load to Anchor < Minimum Anchor Capacity; Anchorages OK

Window Size:	72" wide by 89" tall
Design Pressure:	+/- 50 psf
As-tested Anchor Spacing:	14" on center at jambs, head and sill
Anchors:	7 each jamb; 6 head; 6 sill; 26 total anchors
Maximum Load to Anchor:	(72")(89")(50 psf/144)/(26 anchors) = 86 lb/anchor

Maximum Load to Anchor < Minimum Anchor Capacity; Anchorages OK

Analysis 1

Load Resistance Report

December 04, 2023

Details

Selected standard: ASTM E1300 Extended Basic

Glazing Construction (Double Glazed Insulating Unit)

Exterior Lite Properties (3/16 in. Monolithic)

Construction: 3/16 in. (AN)

Airspace Properties

Thickness: 0.625 in.

Interior Lite Properties (3/16 in. Monolithic)

Construction: 3/16 in. (AN)

Load Resistance

Short Duration (3 Sec)

Description	NFL	GTF	LSF	LR
Exterior Lite	36.2 psf	0.900	1/0.500	65.2 psf
Interior Lite	36.2 psf	0.900	1/0.500	65.2 psf

Comparisons

Scenario 1

50.0 psf 3.00 sec <= 65.2 psf	OK
Approximate center of glass deflection	
Exterior Lite	0.58 in.
Interior Lite	0.58 in.

Notes

Load resistance values are computed in accordance with ASTM E1300-16 Section 6.2 and are based on non-factored load values calculated in a manner consistent with those presented in ASTM E1300-16.

Analysis 1

Load Resistance Report

December 04, 2023

Details

Selected standard: ASTM E1300 Extended Basic

Glazing Construction (Double Glazed Insulating Unit)

Exterior Lite Properties (3/16 in. Monolithic)

Construction: 3/16 in. (AN)

Airspace Properties

Thickness: 0.480 in.

Interior Lite Properties (1/4 in. Laminated)

Construction: 1/8 in. (AN) | 0.090 in. (PVB) | 1/8 in. (AN)

Load Resistance

Short Duration (3 Sec)

Description	NFL	GTF	LSF	LR
Exterior Lite	45.3 psf	0.900	1/0.357	114 psf
Interior Lite	53.0 psf	0.900	1/0.643	74.2 psf

Comparisons

Scenario 1

50.0 psf 3.00 sec <= 74.2 psf — OK

Approximate center of glass deflection

- Exterior Lite — 0.28 in.
- Interior Lite — 0.44 in.

Notes

Load resistance values are computed in accordance with ASTM E1300-16 Section 6.2 and are based on non-factored load values calculated in a manner consistent with those presented in ASTM E1300-16.

Revision Log

Rev. #	Date	Page(s)	Revision(s)
0	12/04/23	N/A	Original report issue