Window Installation Analysis

QUAKER WINDOWS & DOORS
M600 Casement Windows

Report Q4430.01-122-34

Rendered to:

Quaker Windows & Doors
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Prepared by:

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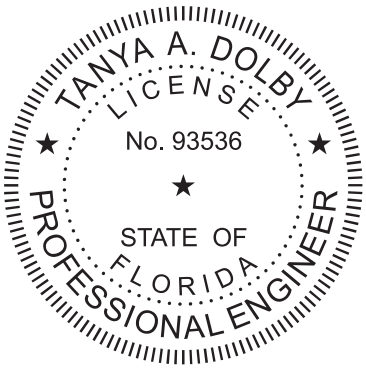

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Scope

Architectural Testing, Inc., an Intertek company, was contracted by Quaker Window & Doors to perform installation analysis for M600 Casement Windows on test report Test Reports G3075.01-801-47-R0, G3081.01-801-47-R1, H0885.01-801-47-R1, and H0898.01-801-47-R0.

The analyses performed satisfy the methods and requirements of the following:

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

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

AAMA TIR-A9-14 *Design Guide for Metal Cladding Fasteners, Includes 2020 Addendum*. American Architectural Manufacturers Association, 2014.

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.

GANA Glazing Manual, 50th Anniversary Edition

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

NOA No. 21-0628.20 Hilti Kwik-Con+ Concrete and Masonry Screw Anchor

The calculations presented herein are for the integrity of the window installations based on wind load only. The weather tightness of the installation is not addressed by this report. The air/water/structural performance of the individual products is not proven by this report.

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 A. Dolby, P.E. and Adam R. Kunkel do not have nor will acquire, a financial interest in any company manufacturing or distributing products for which the reports are being issued.

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Analyses

Summary of Test Results

The following table summarizes the M600 Casement Windows and the corresponding performance level established by testing.

Table 1 Summary of Test Results

Series/Model	Test Report Number	Product Certification	Size (W x H)	Performance
M600 Casement Window	G3075.01-801-47 (Revision 0, 11/21/16)	NI013458-R1	48" x 84"	+/- 70 psf
M600 Twin Casement Window	G3081.01-801-47 (Revision 3, 04/06/18)	NI013458.01-R1	72" x 96"	+/- 70 psf
M600 Casement Window	H0885.01-801-47 (Revision 1, 03/09/18)	NI013806-R1	36" x 72"	+/- 70 psf
M600 Casement Window	H0898.01-801-47 (Revision 0, 05/17/17)	NI013806.01-R1	36" x 96"	+/- 70 psf

Testing documented in Table 1 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).

As-Tested Installation Analysis

The specimen was secured to a 2x Spruce-Pine-Fir wood buck with #6 x 1-5/8" course thread wood/deck screws. The as-tested installation method is evaluated on page 5 and the established design capacity summarized in Table 2. Alternate anchorage is shown in Table 3 and Table 4 with on center spacings in Table 5 and Table 6 on pages 8 and 9.

Table 2 As-Tested Anchorage Design Capacities

Installation	Connection	Capacity	Comments
Nailing Fin to Wood	#6 PH Wood Screw	72 lb	1. Limited by pull-over 2. 1 ½" minimum penetration 3. G = 0.55 Minimum SPF

Anchorage Requirements

#6 x 1-5/8" course thread wood/deck screws actual test anchor capacity based on tested spacing:

Window Mark		Width, w (inch)	Height, h (inch)	w/h	gamma	R (lb/inch)	Anchor Spacing (in)
Design Pressure		70.0 psf					
Anchor Capacity		135.0 lb (#6 PH to Wood)					
G3075.01-801-47	Jamb	48.00	84.00	1.75	0.497	11.61	12
Design Pressure		70.0 psf					
Anchor Capacity		110.0 lb (#6 PH to Wood)					
G3081.01-801-47	Jamb	36.00	96.00	2.67	0.505	8.84	12
Design Pressure		70.0 psf					
Anchor Capacity		110.0 lb (#6 PH to Wood)					
H0885.01-801-47	Jamb	36.00	72.00	2.00	0.503	8.80	12
Design Pressure		70.0 psf					
Anchor Capacity		150.0 lb (#6 PH to Wood)					
H0898.01-801-47	Jamb	36.00	96.00	2.67	0.505	8.84	17

Glazing analysis for tested units are shown on pages 30 to 33. The glass Load Resistance were greater than the tested design pressures.

Calculated alternate anchors on the following pages are shown for 70 psf design pressure, #10, #12, and 3/16" fasteners into wood, metal stud, and concrete substrates.

The alternate anchorage conditions have design capacities which are comparable to or exceeds the least capacity of the as tested anchorage. All anchorage is installed 3" from corners and at the spacing calculated shown on pages 8 and 9 of 41 for 70 psf Design Load. Maximum shim space between the window frame and surrounding substrate is 1/4" for all conditions. Anchors must be fully shimmed and supported.

Note: G3081.01-801-47 Dual Casement anchor spacing is calculated for each individual 36" wide window. The intermediate mullion reactions are transferred to the mid-point of the head and sill. Reference Dual Casement Mullion end reaction notes on pages 8 and 9 and mullion analysis on pages 28 and 29.

Alternate Anchorage Capacities

Table 3 Alternate Anchorage Capacity – Nail Fin

Installation	Connection	Capacity	Comments
Nailing Fin to Wood	#10 PH Wood Screw	114 lb	1. Limited by pull-over 2. 1 ½" minimum penetration 3. G = 0.55 Minimum SYP
Nailing Fin to Wood	#10 Round Washer Head Wood Screw	178 lb	1. Limited by pull-over 2. 1 ½" minimum penetration 3. G = 0.55 Minimum SYP
Nailing Fin to Wood	#12 PH Wood Screw	130 lb	4. Limited by pull-over 5. Full penetration +3 threads 6. G = 0.55 Minimum SYP
Nailing Fin to Steel	#10 HWH TEKS Screw	128 lb	1. Limited by pull-out 2. Full penetration +3 threads 3. Min 18 gauge 33 KSI steel
Nailing Fin to Steel	#12 HWH TEKS Screw	136 lb	1. Limited by pull-over 2. Full penetration +3 threads 3. Min 18 gauge 33 KSI steel
Nailing Fin to Concrete	3/16" Hilti Kwik Con+	123 lb	1. Limited by tension 2. 1" minimum embedment 3. 3,000 psi concrete
Nailing Fin to CMU	3/16" Hilti Kwik Con+	128 lb	1. Limited by tension 2. 1" minimum embedment 3. C90 concrete block

Table 4 Alternate Anchorage Capacity – Strap Anchor

Installation	Connection	Capacity	Comments
Nailing Fin to Wood	#10 PH Wood Screw	154 lb	1. Limited by shear 2. 0.08" thick 6063-T6 Aluminum 3. G = 0.55 Minimum SYP
Nailing Fin to Wood	#10 Round Washer Head Wood Screw	154 lb	1. Limited by shear 2. 0.08" thick 6063-T6 Aluminum 3. G = 0.55 Minimum SYP
Nailing Fin to Wood	#12 PH Wood Screw	193 lb	1. Limited by shear 2. Full penetration +3 threads 3. G = 0.55 Minimum SYP
Nailing Fin to Steel	#10 HWH TEKS Screw	287 lb	1. Limited by tilting 2. Full penetration +3 threads 3. Min 18 gauge 33 KSI steel
Nailing Fin to Steel	#12 HWH TEKS Screw	306 lb	1. Limited by tilting 2. Full penetration +3 threads 3. Min 18 gauge 33 KSI steel
Nailing Fin to Concrete	3/16" Hilti Kwik Con+	215 lb	1. Limited by shear 2. 1” minimum embedment 3. 3,000 psi concrete
Nailing Fin to CMU	3/16" Hilti Kwik Con+	150 lb	1. Limited by shear 2. 1” minimum embedment 3. C90 concrete block

Required Anchor Spacing at 70 psf Design Pressure

Anchorage Requirements

Although the capacities of the alternate anchorages exceed the capacity of the as-tested anchorage, it must be determined the anchorages are not overloaded for the approved window size and design pressures. Calculations presented in page 34 show required spacing for the evaluated anchorage conditions. Results are summarized in the following table.

Table 5 Nail Fin Anchorage Requirements

Substrate	Anchor	Punched 36" x 72" Anchor Spacing	Punched 36" x 96" Anchor Spacing	Punched 48" x 84" Anchor Spacing	Dual 72" x 96" Anchor Spacing
		70 psf	70 psf	70 psf	70 psf
Nailing Fin to Wood	#10-13 PH Wood Screw	13	13	10	13
	#10-13 Round Washer Head Wood Screw	20	20	15	20
	#12-11 PH Wood Screw	15	15	11	15
Nailing Fin to Steel	#10 TEKS Screw	14	14	11	14
	#12 TEKS Screw	15	15	12	15
Nailing Fin to Concrete	3/16" Hilti Kwik Con+	14	14	11	14
Nailing Fin to CMU	3/16" Hilti Kwik Con+	14	14	11	14

If the spacing reported in Table 5 exceeds the as-tested spacing reported in Table 2, the as tested spacing shall govern. Spacing is limited to 12” on center maximum.

Dual Casement Mullion end reaction = 683 lbs

- In addition to the on center spaced anchors, locate a group of four (4) additional anchors at each intermediate mullion location, head and sill. Four (4) total anchors spaced minimum 2” apart. Available capacity in the two adjacent anchors will withstand 114 lb minimum each.

Table 6 Strap Anchorage Requirements

Substrate	Anchor	Punched 36" x 72" Anchor Spacing	Punched 36" x 96" Anchor Spacing	Punched 48" x 84" Anchor Spacing	Dual 72" x 96" Anchor Spacing
		70 psf	70 psf	70 psf	70 psf
Strap Anchor to Wood	#10-13 PH Wood Screw	17	17	13	17
	#10-13 Round Washer Head Wood Screw	17	17	13	17
	#12-11 PH Wood Screw	22	22	17	22
Strap Anchor to Steel	#10 TEKS Screw	32	32	25	32
	#12 TEKS Screw	35	35	26	35
Strap Anchor to Concrete	3/16" Hilti Kwik Con+	24	24	19	24
Strap Anchor to CMU	3/16" Hilti Kwik Con+	17	17	13	17

If the spacing reported in Table 6 exceeds the as-tested spacing reported in Table 2, the as tested spacing shall govern. Spacing is limited to 12” on center maximum.

Dual Casement Mullion end reaction = 683 lbs

- In addition to the on center spaced anchors, locate a group of four (4) additional anchors at each intermediate mullion location, head and sill. Four (4) total anchors spaced minimum 2” apart. Available capacity in the two adjacent anchors will withstand 114 lb minimum each.

Reference Drawings

The reference drawings are the basis of the analysis presented herein and may not reflect the requirements established by this analysis.

- G3075.01-801-47-R0 – M600 Casement Window, 48” x 84”, AW-PG70, 11/21/16
- G3081.01-801-47-R3 - M600 Twin Casement Window, 72” x 96”, AW-PG70, 04/06/18
- H0885.01-801-47-R1 - M600 Casement Window, 36" x 72", AW-PG70, 03/09/18
- H0898.01-801-47 - M600 Casement Window, 36" x 96", AW-PG70, 05/17/17
- M600 Casement O.S. Installation Instructions, 08-15-2023
- M600 Dual Casement O.S. Installation Instructions, 08-15-2023

As-Tested Installation – Nailing Fin to Wood Blocking

#6 x 1-5/8" 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

Calculated Capacity of Connection is 72 lb
Actual Tested Capacity is 110 lb, 135 lb, and 150 lb
Safety Factor = 110/72 = 1.5, 135/72 = 1.875, 150/72 = 2.1
Qualifies 10% Increase to Alternate Anchor Capacity Based on Tested Unit

1 - Alternate Installation – #10 Pan Head Wood Screw, Nail Fin 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

$P_{nov} = C_{pov} t_1 F_{tu1} (D_{ws} - D_h)/3.0$
P_{nov} = 1.0(0.0625'')(30,000 psi)(0.365” – 0.201'')/3.0
P_{nov} = 104 lb

Calculated Capacity of Connection is 104 lb
Capacity of Connection at 10% Over is 114 lb (OK per Tested Capacity)

2 - Alternate Installation – #10 Round Washer Head Wood Screw, Nail Fin to Wood

#10 Round Washer Head Wood Screw
D_{ws} = (0.500” + .472”)/2 = 0.486” (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 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 Round Washer Head Wood Screw

$P_{nov} = C_{pov} t_1 F_{tu1} (D_{ws} - D_h)/3.0$
P_{nov} = 1.0(0.0625")(30,000 psi)(0.486" – 0.201")/3.0
P_{nov} = 178 lb

Calculated Capacity of Connection is 178 lb

3 - Alternate Installation – #12 PH Wood Screw, Nail Fin to Wood

#12 Pan Head Wood Screw

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 #12 PH Wood Screw

$W' = 2{,}850(G^2)(D)(Cd)(Cm)(Ct)(Ceg)(Ctn)(L)$
W' = 2,850 (0.55^2)(0.216'')(1.6)(0.7)(0.7)(1.00)(1.0)(1.50'')
W' = 219 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 #12 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)(0.416" – 0.228")/3.0
P_{nov} = 118 lb

Calculated Capacity of Connection is 118 lb
Capacity of Connection at 10% Over is 130 lb (OK per Tested Capacity)

4 - Alternate Installation – #10 HWH TEKS Screw, Nailing Fin to Steel Stud

#10 HWH TEKS Screw

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

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

$P_{nov} = 1.0(0.0625")(30{,}000\ psi)(0.400" - 0.190")/3.0$

P_{nov} = 131 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

Calculated Capacity of Connection is 116 lb
Capacity of Connection at 10% Over is 128 lb (OK per Tested Capacity)

5 - Alternate Installation – #12 HWH TEKS Screw, Nailing Fin to Steel Stud

#12 HWH TEKS Screw

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 #12 HWH TEKS Screw

V_a = 1184 lb (ESR-1976)

Pull-Over of #12 HWH TEKS Screw in Nail Fin

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

$P_{nov} = 1.0(0.0625")(30{,}000\ psi)(0.415" – 0.216")/3.0$

P_{nov} = 124 lb

Pull-Out of #12 HWH TEKS Screw in Steel Stud

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

$P_{not} = 0.85(0.0478")(0.216")(45{,}000\ psi)/3.0$

P_{not} = 131 lb

Calculated Capacity of Connection is 124 lb
Capacity of Connection at 10% Over is 136 lb (OK per Tested Capacity)

6 - Alternate Installation – Nail Fin to Concrete

3/16" Hilti Kwik-Con+ Anchor
D_{ws} = 0.432" (Nominal Screw Head Diameter) Per Hilti Material Specification
D_H = 0.170" + 0.011" = 0.181" (Shank diameter + clearance)
1-1/2" Minimum Edge Distance, 1" Minimum Embedment, 2" Minimum Spacing

0.062" thick 6063-T6 Aluminum Nailing Fin

Minimum f'_c = 3,000 psi Concrete

Allowable Tension of 3/16" Hilti Kwik-Con+ Anchor
P_{ss}/Ω = 112 lb (NOA-No. 21-0628.20)

Pull-Over of 3/16" Hilti Kwik-Con II+ Anchor
$P_{nov} = C_{pov}t_1F_{tu1}(D_{ws}-D_h)/3.0$
P_{nov} = 1.0(0.062")(30,000 psi)(0.432" - 0.181")/3.0
P_{nov} = 156 lb

Capacity of Connection is 112 lb
Capacity of Connection at 10% Over is 123 lb (OK per Tested Capacity)

7 - Alternate Installation – Nail Fin to CMU

3/16" Hilti Kwik-Con+ Anchor

1-1/2" Minimum Edge Distance, 1" Minimum Embedment, 3" Minimum Spacing

0.062" thick 6063-T6 Aluminum Nailing Fin

Minimum ASTM C90 CMU

Allowable Tension of 3/16" Hilti Kwik-Con+ Anchor
P_{ss}/Ω = 116 lb (NOA-No. 21-0628.20)

Pull-Over of 3/16" Hilti Kwik-Con II+ Anchor
$P_{nov} = C_{pov}t_1F_{tu1}(D_{ws}-D_h)/3.0$
P_{nov} = 1.0(0.062")(30,000 psi)(0.432" - 0.181")/3.0
P_{nov} = 156 lb

Capacity of Connection is 116 lb
Capacity of Connection at 10% Over is 128 lb (OK per Tested Capacity)

8 - Alternate Installation – Strap Anchor to Wood

#10 x 1-1/2" Wood Screw and #10 Round Washer Head Wood Screw

0.08" thick 6063-T6 Aluminum Strap Anchor

1/4" Maximum Shim Space

G = 0.55 Minimum SYP 2x Wood Blocking

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

Z' = 154 lb (Limited by Mode III_s, See Following 2 Pages)

Bearing of #10 x 1-1/2" Wood Screw on Strap Anchor

$V_a = 2DtF_u/n_u$

$V_a = 2(0.190")(0.08")(30{,}000\ psi)/3.0$

$V_a = 304$ lb

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

L = 1/4" (maximum shim space)

$S = \pi d^3/32 = \pi(0.152")^3/32 = 0.000345\ in^3$

$F_b = (1.3)(0.6F_y) = (1.3)(0.6)(90{,}000\ psi) = 70{,}200\ psi$ (1.3 factor for weak axis bending)

$F_b = M/S = (VL/2)/S$ (L/2 for guided bending)

$V = 2SF_b/L = (2)(0.000345\ in^3)(70{,}200\ psi)/0.25" = 194$ lb

Capacity of Connection is 154 lb

Alternate Installation – Strap Anchor to Wood (Continued)

Lateral Design Strength of Wood Connections

ANSI / AWC NDS-2018

Data

Fastener

Fastener	=	#10 Wood Screw	
Shank Dia	=	0.190	in.
Root Dia.	=	0.152	in.
F_{yb}	=	80,000	psi
Fastener length	=	2.000	in.

Main Member

Material	=	SPF		
G	=	0.55		
θ	=	90	<= (Angle of load to grain $0^o \le \theta \le 90^o$)	
F_e	=	3,350	psi	Appendix J
Thickness	=	1.500	in.	

Side Member

Material	=	6063 T6 Aluminum		
G	=	N/A		
θ	=	0	<= (Angle of load to grain $0^o \le \theta \le 90^o$)	
F_{es}	=	37,500	psi	NDS 2018
Thickness	=	0.063	in.	

Calculations

Lateral Bearing Factors

D	=	0.152	in.	
ℓ_m	=	1.500	in.	
K_θ	=	1.25		Table 12.3.1B
K_D	=	2.20		Table 12.3.1B
R_e	=	0.089		Table 12.3.1A
R_t	=	23.81		Table 12.3.1A
k_1	=	0.8593		Table 12.3.1A
k_2	=	0.5399		Table 12.3.1A
k_3	=	13.77		Table 12.3.1A

Yield Mode	R_d	
I_m, I_s	2.20	Table 12.3.1B
II	2.20	Table 12.3.1B
III_m, III_s, IV	2.20	Table 12.3.1B

Alternate Installation – Strap Anchor to Wood (Continued)

Lateral Design Values, Z					
Mode I_m	=	347	lbf		Eq 12.3-1
Mode I_s	=	163	lbf		Eq 12.3-2
Mode II	=	140	lbf		Eq 12.3-3
Mode III_m	=	159	lbf		Eq 12.3-4
Mode III_s	=	96	lbf	<====== Minimum Value	Eq 12.3-5
Mode IV	=	134	lbf		Eq 12.3-6
C_D	=	1.6			11.3.2
Wet Service Factor					
Fabrication/In-Service		Dry/Dry			
C_M	=	1.0			Table 11.3.3
In service temperature		T≤100°F			
C_t	=	1.0			Table 11.3.4
C_g	=	1.0			11.3.6
C_Δ	=	1.0			12.5.1
Is fastener installed in end grain?		No			
C_{eg}	=	1.00			12.5.2
Is fastener part of a diaphragm?		No			
C_{di}	=	1.0			12.5.3
Is fastener toe-nailed?		No			
C_{tn}	=	1.00			12.5.4
Z'	=	**154**	**lbf**		Table 12.3.1

9 - Alternate Installation – #12 PH Wood Screw, Nail Fin to Wood

#12 Pan Head Wood Screw

0.08" thick 6063-T6 Aluminum Strap Anchor

1/4" Maximum Shim Space

G = 0.55 Minimum SYP 2x Wood Blocking

Allowable Shear of #12 PH Wood Screw

Z' = 193 lb (Limited by Mode III_s, See Following 2 Pages)

Bearing of #12 PH Wood Screw on Strap Anchor

$V_a = 2DtF_u/n_u$

$V_a = 2(0.216")(0.08")(30{,}000\ psi)/3.0$

$V_a = 346$ lb

Bending of #12 PH Wood Screw

L = 1/4" (maximum shim space)

$S = \pi d^3/32 = \pi(0.171")^3/32 = 0.0005\ in^3$

$F_b = (1.3)(0.6F_y) = (1.3)(0.6)(90{,}000\ psi) = 70{,}200$ psi (1.3 factor for weak axis bending)

$F_b = M/S = (VL/2)/S$ (L/2 for guided bending)

$V = 2SF_b/L = (2)(0.0005\ in^3)(70{,}200\ psi)/0.25" = 275$ lb

Capacity of Connection is 193 lb

Alternate Installation – Strap Anchor to Wood (Continued)

Lateral Design Strength of Wood Connections

ANSI / AWC NDS-2018

Data

Fastener

Fastener	=	#12 Wood Screw	
Shank Dia	=	0.216	in.
Root Dia.	=	0.171	in.
F_{yb}	=	80,000	psi
Fastener length	=	2.000	in.

Main Member

Material	=	SPF		
G	=	0.55		
θ	=	90	<= (Angle of load to grain $0^o \le \theta \le 90^o$)	
F_e	=	3,350	psi	Appendix J
Thickness	=	1.500	in.	

Side Member

Material	=	6063 T6 Aluminum		
G	=	N/A		
θ	=	0	<= (Angle of load to grain $0^o \le \theta \le 90^o$)	
F_{es}	=	37,500	psi	NDS 2018
Thickness	=	0.063	in.	

Calculations

Lateral Bearing Factors

D	=	0.171	in.	
ℓ_m	=	1.500	in.	
K_θ	=	1.25		Table 12.3.1B
K_D	=	2.21		Table 12.3.1B
R_e	=	0.089		Table 12.3.1A
R_t	=	23.81		Table 12.3.1A
k_1	=	0.8593		Table 12.3.1A
k_2	=	0.5564		Table 12.3.1A
k_3	=	15.41		Table 12.3.1A

Yield Mode	R_d	
I_m, I_s	2.21	Table 12.3.1B
II	2.21	Table 12.3.1B
III_m, III_s, IV	2.21	Table 12.3.1B

Alternate Installation – Strap Anchor to Wood (Continued)

Lateral Design Values, Z					
Mode I_m	=	389	lbf		Eq 12.3-1
Mode I_s	=	183	lbf		Eq 12.3-2
Mode II	=	157	lbf		Eq 12.3-3
Mode III_m	=	184	lbf		Eq 12.3-4
Mode III_s	=	120	lbf	<====== Minimum Value	Eq 12.3-5
Mode IV	=	169	lbf		Eq 12.3-6
C_D	=	1.6			11.3.2
Wet Service Factor					
Fabrication/In-Service		Dry/Dry			
C_M	=	1.0			Table 11.3.3
In service temperature		T≤100°F			
C_t	=	1.0			Table 11.3.4
C_g	=	1.0			11.3.6
C_Δ	=	1.0			12.5.1
Is fastener installed in end grain?		No			
C_{eg}	=	1.00			12.5.2
Is fastener part of a diaphragm?		No			
C_{di}	=	1.0			12.5.3
Is fastener toe-nailed?		No			
C_{tn}	=	1.00			12.5.4
Z'	=	**193**	**lbf**		Table 12.3.1

10 - Alternate Installation – Strap Anchor to Steel Stud

#10-16 TEKS Screw

0.08" thick 6063-T6 Aluminum Strap Anchor

Full Penetration +3 Threads

1/4" Maximum Shim Space

Minimum 18 gauge 33 KSI Steel Stud

Allowable Shear of #10-16 TEKS Screw

P_{ss}/Ω = 573 lb (ESR-1976)

Bearing of #10-16 TEKS Screw on Strap Anchor

$V_a = 2DtF_u/n_u$
$V_a = 2(0.190")(0.08")(30{,}000\ psi)/3.0$
V_a = 304 lb

Bearing of #10-16 TEKS Screw on Steel Stud

$V_a = 2.7DtF_{tu}/3.0$
$V_a = 2.7(0.190")(0.0478")(45{,}000\ psi)/3.0$
V_a = 367 lb

Tilting of #10-16 TEKS Screw in Steel Stud

$V_a = 4.2(t_2^3D)^{1/2}F_{tu2}/n_s$
$V_a = 4.2(0.0478"^3 \times 0.190")^{1/2}(45{,}000\ psi)/3.0$
V_a = 287 lb

Bending of #10-16 TEKS Screw

L = 1/4" (Maximum Shim Space)
$S = \pi d^3/32 = \pi(0.190")^3/32 = 0.0007\ in^3$
$F_b = (1.3)(0.6F_y) = (1.3)(0.6)(92{,}000\ psi) = 71{,}760\ psi$ (1.3 factor for weak axis bending)
$F_b = M/S = (VL/2)/S$ (L/2 for guided bending)
$V = 2SF_b/L = (2)(0.0007\ in^3)(71{,}760\ psi)/0.25" = 386$ lb

Capacity of Connection is 287 lb

11 - Alternate Installation – Strap Anchor to Steel Stud

#12-14 TEKS Screw

0.08" thick 6063-T6 Aluminum Strap Anchor

Full Penetration +3 Threads

1/4" Maximum Shim Space

Minimum 18 gauge 33 KSI Steel Stud

Allowable Shear of #10-16 TEKS Screw

P_{ss}/Ω = 724 lb (ESR-1976)

Bearing of #10-16 TEKS Screw on Strap Anchor

$V_a = 2DtF_u/n_u$
$V_a = 2(0.216")(0.08")(30{,}000\ psi)/3.0$
V_a = 346 lb

Bearing of #10-16 TEKS Screw on Steel Stud

$V_a = 2.7DtF_{tu}/3.0$
$V_a = 2.7(0.216")(0.0478")(45{,}000\ psi)/3.0$
V_a = 356 lb

Tilting of #10-16 TEKS Screw in Steel Stud

$V_a = 4.2(t_2^3D)^{1/2}F_{tu2}/n_s$
$V_a = 4.2(0.0478"^3 \times 0.216")^{1/2}(45{,}000\ psi)/3.0$
V_a = 306 lb

Bending of #10-16 TEKS Screw

L = 1/4" (Maximum Shim Space)
$S = \pi d^3/32 = \pi(0.216")^3/32 = 0.001\ in^3$
$F_b = (1.3)(0.6F_y) = (1.3)(0.6)(92{,}000\ psi) = 71{,}760\ psi$ (1.3 factor for weak axis bending)
$F_b = M/S = (VL/2)/S$ (L/2 for guided bending)
$V = 2SF_b/L = (2)(0.001\ in^3)(71{,}760\ psi)/0.25" = 574$ lb

Capacity of Connection is 306 lb

12 - Alternate Installation – Strap Anchor to Concrete

3/16" Hilti Kwik-Con+ Anchor

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

1/4" Maximum Shim Space

0.08" thick 6063-T6 Aluminum Strap Anchor

Minimum f'_c = 3,000 psi Concrete

Allowable Shear of 3/16" Hilti Kwik-Con+ Anchor

P_{ss}/Ω = 215 lb (NOA-No. 21-0628.20)

Bearing of 3/16" Hilti Kwik-Con+ Anchor on Strap Anchor

$V_a = 2DtF_u/n_u$

$V_a = 2(0.170")(0.08")(30{,}000 \text{ psi})/3.0$

V_a = 272 lb

Bending of 3/16" Hilti Kwik-Con+

L = 1/4" (Maximum Shim Space)

$S = \pi d^3/32 = \pi(0.170")^3/32 = 0.000482 \text{ in}^3$

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

$F_b = M/S = (VL/2)/S$ (L/2 for guided bending)

$V = 2SF_b/L = (2)(0.000482 \text{ in}^3)(106{,}860 \text{ psi})/0.25" = 412$ lb

Capacity of Connection is 215 lb

13 - Alternate Installation – Strap Anchor to CMU

3/16" Hilti Kwik-Con II+ Anchor

1-1/2" Minimum Edge Distance, 1" Minimum Embedment, 3" Minimum Spacing

1/4" Maximum Shim Space

0.08" thick 6063-T6 Aluminum Strap Anchor

Minimum ASTM C90 CMU Block

Allowable Shear of 3/16" Hilti Kwik-Con+ Anchor

P_{ss}/Ω = 150 lb (NOA-No. 21-0628.20)

Bearing of 3/16" Hilti Kwik-Con+ Anchor on Strap Anchor

$V_a = 2DtF_u/n_u$

V_a = 2(0.170")(0.08")(30,000 psi)/3.0

V_a = 272 lb

Bending of 3/16" Hilti Kwik-Con+

L = 1/4" (Maximum Shim Space)

$S = \pi d^3/32 = \pi(0.170")^3/32 = 0.000482\ in^3$

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

$F_b = M/S = (VL/2)/S$ (L/2 for guided bending)

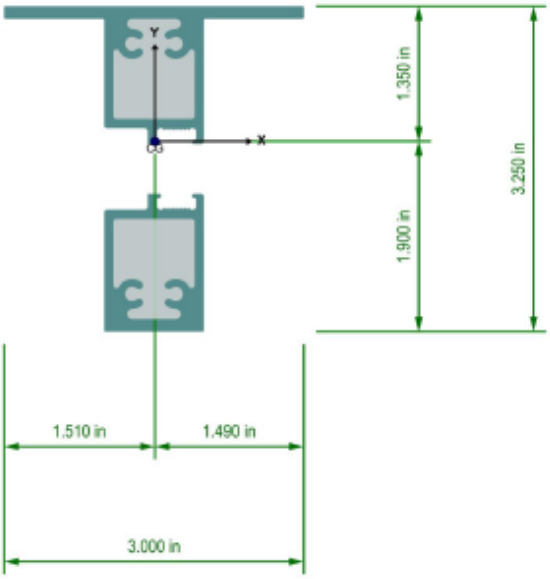
$V = 2SF_b/L = (2)(0.000482\ in^3)(106{,}860\ psi)/0.25" = 412$ lb

Capacity of Connection is 150 lb

Dual Casement Intermediate Mullion Analysis

INTERTEK - ARCHITECTURAL TESTING, INC.
Tanya Dolby

Friday, August 25, 2023 8:01 AM



Geometric Properties

Area	1.418	in^2
Ix	2.060	in^4
Ixy	-0.004	in^4
Iy	0.415	in^4
Sx+	1.527	in^3
Sx-	1.084	in^3
Sy+	0.279	in^3
Sy-	0.275	in^3
Xc	0.000	in
Yc	0.000	in
rx	1.205	in
ry	0.541	in

Overall Properties

Depth	3.250	in
Perimeter	14.389	in
Weight	0.142	lb/in
Width	3.000	in

Quaker

Cbeam R2
Intertek
8/25/2023 16:08 File: Mullion

M600 Casement
By: TAD

Deflection Results

Max. Deflection =	-0.8874"	L/108	(Span 1, @ 48.00")

Stress Results

Span			M(in-lb)	fb-m(ksi)
1	@	48.00" =	19215	17.726

Member Information

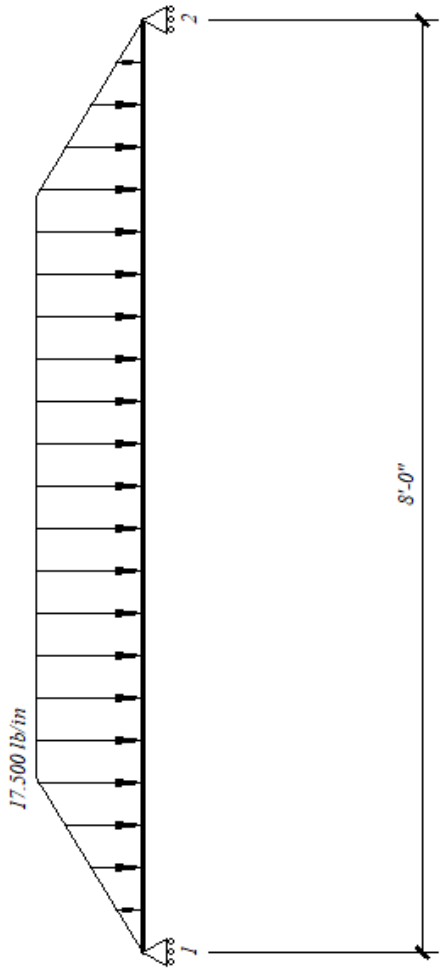
Span	Length(in)	I(in^4)	S(in^3)	E(psi)
1	96.000	2.060	1.084	1.0e+7

Distributed Load Information

Span	W1(#/in)	W2(#/in)	X1(in)	X2(in)
1	0.000	17.500	0.000	18.000
	17.500	17.500	18.000	78.000
	17.500	0.000	78.000	96.000

Support Reactions

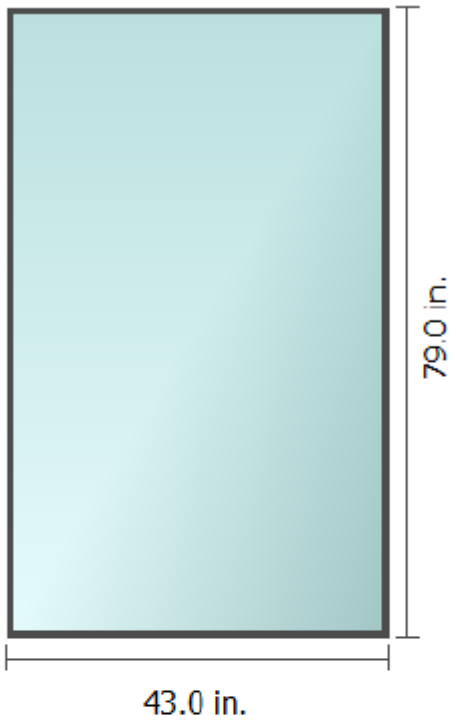
Joint	Pounds
1	683
2	683

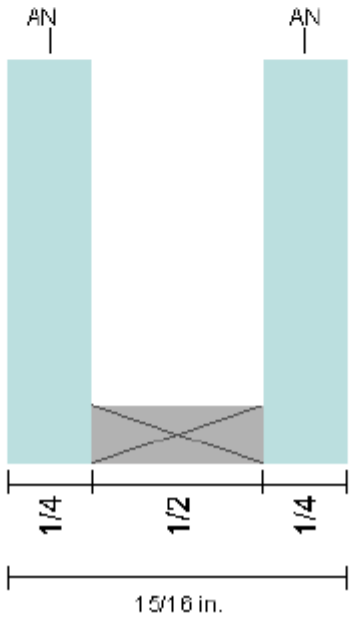


Anchor Reaction = 683 lbs

Glass Analysis

Test Reports G3075.01-801-47-R0, G3081.01-801-47-R1, H0898.01-801-47-R0





Analysis 1

Load Resistance Report

August 25, 2023

Details

Selected standard: ASTM E1300 Extended Basic

Glazing Construction (Double Glazed Insulating Unit)

Exterior Lite Properties (1/4 in. Monolithic)

Construction: 1/4 in. (AN)

Airspace Properties

Thickness: 0.480 in.

Interior Lite Properties (1/4 in. Monolithic)

Construction: 1/4 in. (AN)

Load Resistance

Short Duration (3 Sec)

Description	NFL	GTF	LSF	LR
Exterior Lite	39.0 psf	0.900	1/0.500	70.2 psf
Interior Lite	39.0 psf	0.900	1/0.500	70.2 psf

Comparisons

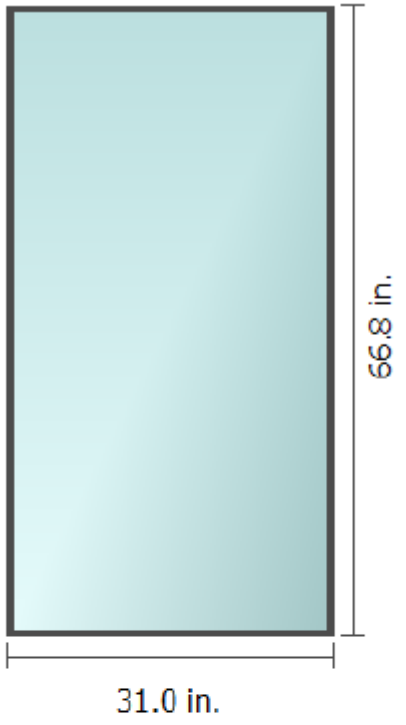
Scenario 1

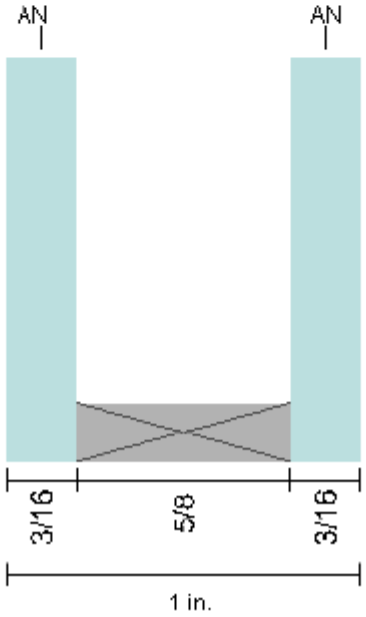
70.0 psf 3.00 sec <= 70.2 psf	OK
Approximate center of glass deflection	
Exterior Lite	0.56 in.
Interior Lite	0.56 in.

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.

Test Report H0885.01-801-47-R1





Analysis 1

Load Resistance Report

August 25, 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: 0.600 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	41.4 psf	0.900	1/0.500	74.6 psf
Interior Lite	41.4 psf	0.900	1/0.500	74.6 psf

Comparisons

Scenario 1

70.0 psf 3.00 sec <= 74.6 psf OK

Approximate center of glass deflection

Exterior Lite 0.37 in.

Interior Lite 0.37 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.

Anchorage Spacing Calculation

Punched Opening Anchor Reactions

Roark's Formulas for Stress & Strain (Sixth Ed.) Table 26-1a

Nail Fin Anchor **Window Design Pressure:** **70.00**

Substrate	Anchor	Anchor Capacity	Width, w (inch)	Height, h (inch)	w/h	gamma	R (lb/in)	Anchor Spacing (in)
Wood	#10 Wood Screw	114 lb	36.00	96.00	2.67	0.51	8.84	13"
			48.00	84.00	1.75	0.50	11.61	10"
	#10 Round Washer Head Wood Screw	178 lb	36.00	96.00	2.67	0.51	8.84	20"
			48.00	84.00	1.75	0.50	11.61	15"
	#12 Wood Screw	130 lb	36.00	96.00	2.67	0.51	8.84	15"
			48.00	84.00	1.75	0.50	11.61	11"
Steel Stud	#10-16 TEKS	128 lb	36.00	96.00	2.67	0.51	8.84	14"
			48.00	84.00	1.75	0.50	11.61	11"
	#12-16 TEKS	136 lb	36.00	96.00	2.67	0.51	8.84	15"
			48.00	84.00	1.75	0.50	11.61	12"
Concrete	3/16" Hilti Kwik Con+	123 lb	36.00	96.00	2.67	0.51	8.84	14"
			48.00	84.00	1.75	0.50	11.61	11"
CMU	3/16" Hilti Kwik Con+	128 lb	36.00	96.00	2.67	0.51	8.84	14"
			48.00	84.00	1.75	0.50	11.61	11"

Strap Anchor **Window Design Pressure:** **70.00**

Substrate	Anchor	Anchor Capacity	Width, w (inch)	Height, h (inch)	w/h	gamma	R (lb/in)	Calculated Anchor Spacing
Wood	#10 Wood Screw	154 lb	36.00	96.00	2.67	0.51	8.84	17"
			48.00	84.00	1.75	0.50	11.61	13"
	#10 Round Washer Head Wood Screw	154 lb	36.00	96.00	2.67	0.51	8.84	17"
			48.00	84.00	1.75	0.50	11.61	13"
	#12 Wood Screw	193 lb	36.00	96.00	2.67	0.51	8.84	22"
			48.00	84.00	1.75	0.50	11.61	17"
Steel Stud	#10-16 TEKS	287 lb	36.00	96.00	2.67	0.51	8.84	32"
			48.00	84.00	1.75	0.50	11.61	25"
	#12-16 TEKS	306 lb	36.00	96.00	2.67	0.51	8.84	35"
			48.00	84.00	1.75	0.50	11.61	26"
Concrete	3/16" Hilti Kwik Con+	215 lb	36.00	96.00	2.67	0.51	8.84	24"
			48.00	84.00	1.75	0.50	11.61	19"
CMU	3/16" Hilti Kwik Con+	150 lb	36.00	96.00	2.67	0.51	8.84	17"
			48.00	84.00	1.75	0.50	11.61	13"

Anchor Spacing is limited to the as tested spacing of 12” maximum on center.

Dual Casement Mullion end reaction = 683 lbs

- In addition to the on center spaced anchors, locate a group of four (4) additional anchors at each intermediate mullion location, head and sill. Four (4) total anchors spaced minimum 2” apart. Available capacity in the two adjacent anchors will withstand 114 lb minimum each.

REFERENCE MATERIAL

#10-16 TEKS Screw References

TABLE 5—FASTENER STRENGTH OF SCREWS[1, 2, 3, 4, 5]

SCREW DESIGNATION	DIAMETER (in.)	ALLOWABLE FASTENER STRENGTH		NOMINAL FASTENER STRENGTH	
		Tensile, P_{ts}/Ω (lbf)	Shear, P_{ss}/Ω (lbf)	Tensile, P_{ts} (lbf)	Shear, P_{ss} (lbf)
10-16	0.190	885	573	2654	1718
12-14	0.216	1184	724	3551	2171
12-24	0.216	1583	885	4750	2654
1/4-14	0.250	1605	990	4816	2970
1/4-28	0.250	1922	1308	5767	3925

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

[1]For tension connections, the least of the allowable pull-out, pullover, and fastener tension strength found in Tables 2, 3, and 5, respectively, must be used for design.
[2]For shear connection, the lower of the allowable shear (bearing) and the allowable fastener shear strength found in Table 4 and 5, respectively, must be used for design.
[3]See Section 4.1 for fastener spacing and end distance requirements.
[4]Nominal strengths are based on laboratory tests
[5]To calculate LRFD values, multiply nominal strength values by the LRFD Φ factor of 0.5.

TABLE 22.11 (Spaced Threads)

6063-T6												
Nominal Thread Diameter & Thread Per Inch	D Nominal Thread Diameter (Inch)	Aluminum Thickness (Inches)										
		0.038	0.060	0.072	0.080	0.094	0.125	0.156	0.188	0.250	0.312	0.375
		Allowable Pullout (Pounds)										
#8-18	0.1640	53	83	100	132	155	235	350	468	669	835	1004
#10-16	0.1900	61	96	116	153	180	239	372	509	775	968	1163
#12-14	0.2160	--	110	132	174	204	271	374	530	833	1100	1322
1/4-14	0.2500	--	127	152	201	236	314	433	614	964	1273	1530
5/16-12	0.3125	--	--	--	--	--	--	--	809	1334	1860	2296
3/8-12	0.3750	--	--	--	--	--	--	--	971	1601	2232	2755

6063-T6		
F_U (Tensile Ultimate Strength)	30000	psi
F_Y (Tensile Yield Strength)	25000	psi

Shading indicates transition region.

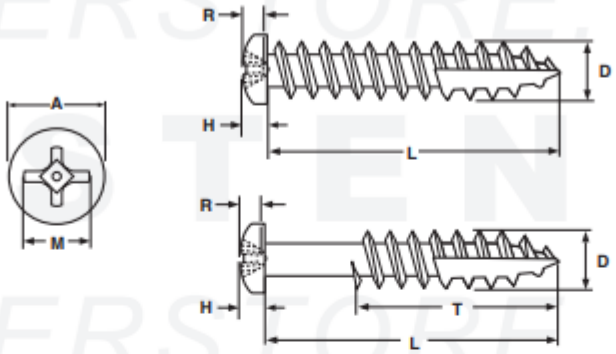
NOTE 32:
1. *Each table lists allowable pull-out (internal threads) values. S_F= 3.0 for D ≤ 0.25"; S_F= 2.5 for D ≥ 0.3125". Fastener allowable strength (basic tension and external threads) needs to be checked separately.*
2. *For pilot hole sizes refer to tables 21.1 to 21.7*
3. *Fastener pullout not shown for aluminum thickness less than approximately 2 threads, unless tested at a lesser thickness.*
4. *Multiple fastener connections and embrittlement need to be checked separately.*

Appendix

WOOD SCREWS

Pan Head w/ Phillips Recess

TYPE-17 DEEP THREAD



PAN PHILLIPS RECESS DEEP THREAD WOOD SCREW WITH TYPE-17 POINT

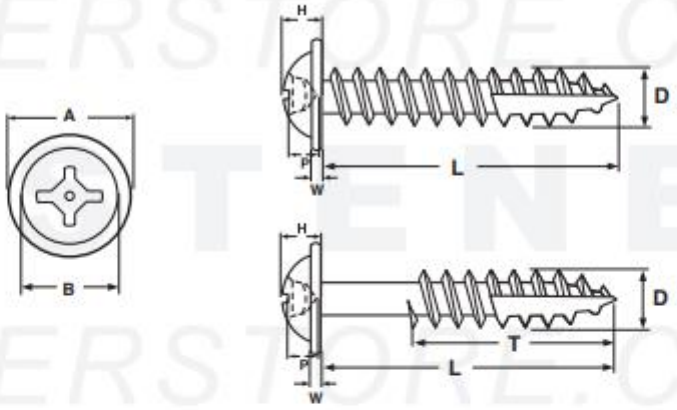
Nominal Diameter & Threads per Inch	A		H		R		M	D		T		Torque Kg/cm (Steel screws)	Recess Size
	Head Diameter		Head Height		Recess Penetration Depth		Recess Diameter	Major Diameter		Threaded Length			
	Max	Min	Max	Min	Max	Min	Ref	Max	Min	L ≤ 1"	L > 1"	Min	
6-13	0.270	0.256	0.097	0.087	0.080	0.055	0.159	0.142	0.131	Full thread	2/3 thread	21	#2
7-12	0.296	0.281	0.106	0.096	0.089	0.064	0.170	0.158	0.147	Full thread	2/3 thread	28	#2
8-11	0.322	0.306	0.115	0.105	0.097	0.071	0.175	0.169	0.159	Full thread	2/3 thread	37	#2
10-9	0.373	0.357	0.133	0.122	0.113	0.089	0.192	0.194	0.185	Full thread	2/3 thread	55	#2
12-8	0.425	0.407	0.151	0.139	0.124	0.098	0.252	0.230	0.213	Full thread	2/3 thread	64	#3

Tolerance on Length	
Up to 5/8"	± 0.03
Over 5/8 to 1.5"	± 0.05
Over 1.5 to 2.75"	± 0.06
Over 2.75"	± 0.09

Description	An externally threaded fastener with a dome-shaped head, cross recess and a single lead thread. The shank has a reduced diameter and a chip cavity cut out where the final several threads end at the tip.	
Applications / Advantages	The deeper thread design offers greater resistance to pull-out forces. Popular in fastening cabinet hardware in locations that do not require the head to countersink. The chip cavity (or auger point) are designed to attach hinges to the edge of hardwood face frames.	Used in environments where corrosion resistance is necessary. The type-17 point enables the screw to more easily penetrate the material into which it's fastened. Can be used in particle board, wood and some plastics.
Material	C1018 - 1022 case-hardened steel	18-8 Stainless Steel
Surface Hardness	Vickers 450 HV minimum	-
Case Depth	0.004" - 0.009"	-
Torque	See values in above table	-
Plating	See Appendix-A for plating information	Stainless deep thread screws are usually supplied without additional finish.

WOOD SCREWS

Round Washer Head w/ Square/Phillips Combo Recess — TYPE-17 DEEP THREAD



ROUND WASHER SQUARE/PHILLIPS RECESS DEEP THREAD WOOD SCREW W/ TYPE-17 POINT

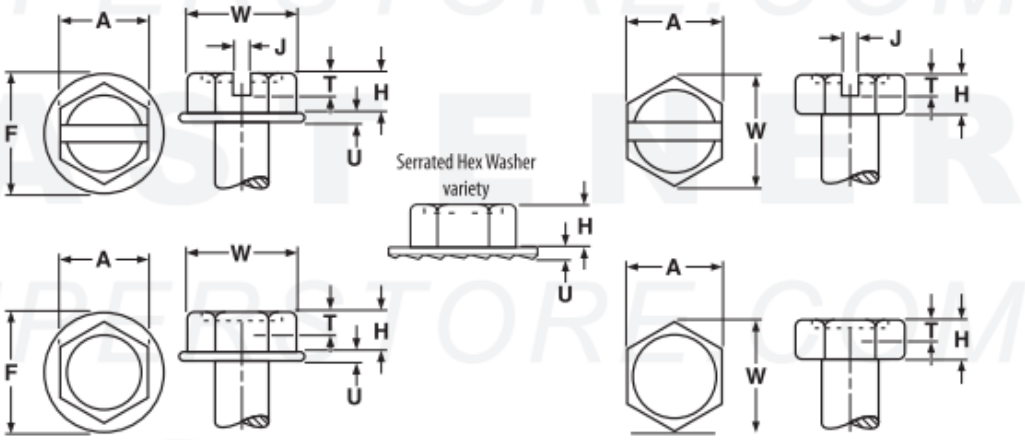
Nominal Diameter	A Washer Diameter		B Head Diameter	H Total Head Height		P Recess Depth		W Washer Thickness		D Major Diameter		T Threaded Length		Recess Size (Square & Phillips)
	Max	Min	Ref	Max	Min	Max	Min	Max	Min	Max	Min	L ≤ 1"	L > 1"	
8	0.376	0.352	0.305	0.120	0.110	0.080	0.065	0.050	0.030	0.174	0.164	Full thread	2/3 thread	#2
10	0.500	0.472	0.300	0.130	0.118	0.073	0.049	0.060	0.040	0.197	0.183	Full thread	2/3 thread	#2

Tolerance on Length	Up to 5/8"	+0 / -0.03
	Over 5/8 to 1.5"	+0 / -0.05
	Over 1.5 to 2.75"	+0 / -0.06
	Over 2.75 to 5"	+0 / -0.09

Description	An externally threaded fastener with a dome-shaped head and an integrally formed washer; a recess that can accomodate either a Phillips or Square screwdriver; and a single lead thread. The shank has a reduced diameter and a chip cavity cut out where the final several threads, ending at the tip.
Applications / Advantages	The deeper thread design offers greater resistance to pull-out forces. The chip cavity (or auger point) enables the fastener to drive—especially in denser woods—without pre-drilling a pilot hole. The head offers a greater bearing surface than a countersunk design. Used to attach surface-mounted door hinges or master lock hasps into dense woods or when attaching two pieces of wood through a pocket hole.
Material	C1022 case-hardened steel
Surface Hardness	Rockwell C 45 minimum
Case Depth	0.004" - 0.009"
Torque	#8 Diameter: 35 kg/cm minimum #10 Diameter: 50 kg/cm minimum
Plating	See Appendix-A for plating information

SELF- TAPPING SCREWS

Hex & Hex Washer Heads — HEAD DIMENSIONS



HEX & HEX WASHER HEADS FOR SELF-TAPPING & SELF-DRILLING SCREWS

ASME B18.6.3—2013*

Nominal Size	A		W	H		F		U		J		T	
	Width Across Flats		Width Across Corners	Height of Head		Diameter of Washer		Thickness of Washer		Width of Slot		Depth of Slot	
	Max	Min	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
4	.188	.181	.202	.060	.049	.243	.225	.019	.011	.039	.031	.036	.025
6	.250	.244	.272	.093	.080	.328	.302	.025	.015	.048	.039	.046	.033
7	.250	.244	.272	.093	.080	.328	.302	.029	.017	.048	.039	.054	.040
8	.250	.244	.272	.110	.096	.348	.322	.031	.019	.054	.045	.066	.052
10	.312	.305	.340	.120	.105	.414	.384	.031	.019	.060	.050	.072	.057
12	.312	.305	.340	.155	.139	.432	.398	.039	.022	.067	.056	.093	.077
14	.375	.367	.409	.190	.172	.520	.480	.050	.030	.075	.064	.101	.083
1/4 (standard)	.375	.367	.409	.190	.172	.520	.480	.050	.030	.075	.064	.101	.083
1/4 (special)	.438	.428	.484	.188	.150	.618	.574	.055	.030	.084	.072	.110	.090
5/16 (special)	.438	.428	.484	.230	.172	.676	.574	.063	.040	.084	.072	.122	.090
5/16 (standard)	.500	.489	.545	.230	.208	.676	.624	.055	.035	.084	.072	.122	.100
3/8	.562	.551	.614	.295	.270	.780	.720	.063	.037	.094	.081	.156	.131
1/2*	.750	.735	.820	.400	.367	1.040	.960	.085	.050	.106	.091	.190	.165

* Slot dimentions for 1/2-inch diameter hex washer head tapping screws are independent of ASME B18.6.3

Tap & Clearance Drill Sizes

Screw Size	Major Diameter	Threads Per Inch	Minor Diameter	Tap Drill				Clearance Drill			
				75% Thread for Aluminum, Brass, & Plastics		50% Thread for Steel, Stainless, & Iron		Close Fit		Free Fit	
				Drill Size	Dec. Eq.	Drill Size	Dec. Eq.	Drill Size	Dec. Eq.	Drill Size	Dec. Eq.
0	.0600	80	.0447	3/64	.0469	55	.0520	52	.0635	50	.0700
1	.0730	64	.0538	53	.0595	1/16	.0625	48	.0760	46	.0810
		72	.0560	53	.0595	52	.0635				
2	.0860	56	.0641	50	.0700	49	.0730	43	.0890	41	.0960
		64	.0668	50	.0700	48	.0760				
3	.0990	48	.0734	47	.0785	44	.0860	37	.1040	35	.1100
		56	.0771	45	.0820	43	.0890				
4	.1120	40	.0813	43	.0890	41	.0960	32	.1160	30	.1285
		48	.0864	42	.0935	40	.0980				
5	.125	40	.0943	38	.1015	7/64	.1094	30	.1285	29	.1360
		44	.0971	37	.1040	35	.1100				
6	.138	32	.0997	36	.1065	32	.1160	27	.1440	25	.1495
		40	.1073	33	.1130	31	.1200				
8	.1640	32	.1257	29	.1360	27	.1440	18	.1695	16	.1770
		36	.1299	29	.1360	26	.1470				
10	.1900	24	.1389	25	.1495	20	.1610	9	.1960	7	.2010
		32	.1517	21	.1590	18	.1695				
12	.2160	24	.1649	16	.1770	12	.1890	2	.2210	1	.2280
		28	.1722	14	.1820	10	.1935				
		32	.1777	13	.1850	9	.1960				
1/4	.2500	20	.1887	7	.2010	7/32	.2188	F	.2570	H	.2660
		28	.2062	3	.2130	1	.2280				
		32	.2117	7/32	.2188	1	.2280				
5/16	.3125	18	.2443	F	.2570	J	.2770	P	.3230	Q	.3320
		24	.2614	I	.2720	9/32	.2812				
		32	.2742	9/32	.2812	L	.2900				
3/8	.3750	16	.2983	5/16	.3125	Q	.3320	W	.3860	X	.3970
		24	.3239	Q	.3320	S	.3480				
		32	.3367	11/32	.3438	T	.3580				
7/16	.4375	14	.3499	U	.3680	25/64	.3906	29/64	.4531	15/32	.4687
		20	.3762	25/64	.3906	13/32	.4062				
		28	.3937	Y	.4040	Z	.4130				
1/2	.5000	13	.4056	27/64	.4219	29/64	.4531	33/64	.5156	17/32	.5312
		20	.4387	29/64	.4531	15/32	.4688				
		28	.4562	15/32	.4688	15/32	.4688				
9/16	.5625	12	.4603	31/64	.4844	33/64	.5156	37/64	.5781	19/32	.5938
		18	.4943	33/64	.5156	17/32	.5312				
		24	.5114	33/64	.5156	17/32	.5312				
5/8	.6250	11	.5135	17/32	.5312	9/16	.5625	41/64	.6406	21/32	.6562
		18	.5568	37/64	.5781	19/32	.5938				
		24	.5739	37/64	.5781	19/32	.5938				
11/16	.6875	24	.6364	41/64	.6406	21/32	.6562	45/64	.7031	23/32	.7188
3/4	.7500	10	.6273	21/32	.6562	11/16	.6875	49/64	.7656	25/32	.7812
		16	.6733	11/16	.6875	45/64	.7031				
		20	.6887	45/64	.7031	23/32	.7188				
13/16	.8125	20	.7512	49/64	.7656	25/32	.7812	53/64	.8281	27/32	.8438
7/8	.8750	9	.7387	49/64	.7656	51/64	.7969	57/64	.8906	29/32	.9062
		14	.7874	13/16	.8125	53/64	.8281				
		20	.8137	53/64	.8281	27/32	.8438				
15/16	.9375	20	.8762	57/64	.8906	29/32	.9062	61/64	.9531	31/32	.9688
1	1.000	8	.8466	7/8	.8750	59/64	.9219	1-1/64	1.0156	1-1/32	1.0313
		12	.8978	15/16	.9375	61/64	.9531				
		20	.9387	61/64	.9531	31/32	.9688				

MATERIAL SPECIFICATIONS

Carbon steel expansion sleeves and spacer sleeves are manufactured from cold rolled steel.
Carbon steel anchors are zinc plated in accordance with ASTM B633, SC 1, Type III.
Stainless steel anchor components are manufactured from AISI Type 304 stainless steel.

MATERIAL SPECIFICATIONS

Carbon Steel with KWIK Cote[1]	• Screws manufactured from 1018 to 1022 cold rolled steel case hardened to HRC 45 minimum • Minimum tensile strength and yield strength for the 1/4-in. is 138 ksi and 137 ksi, respectively • Minimum tensile strength and yield strength for the 3/16-in. is 138 ksi and 137 ksi, respectively
KWIK Cote corrosion resistant coating	• KWIK Cote is a zinc-rich basecoat with an aluminum-rich topcoat.
AISI Type 410 stainless steel1	• Screws manufactured from AISI Type 410 stainless steel. Minimum tensile strength and yield strength for the 1/4-in. is 184ksi and 157 ksi, respectively • Minimum tensile strength and yield strength for the 3/16-in. is 194 ksi and 170 ksi, respectively
Head Styles	• Tapered flat head with #3 Phillips recess for 3/16- and 1/4-in. anchors • Tapered flat head with T-25 TORX recess for 3/16-in. anchor • Tapered flat head with T-27 TORX recess for 1/4-in. anchor • 5/16-in. hex washer with internal T-25 TORX recess for 3/16- and 1/4-in. anchors 
Head diameter	• Maximum 0.507 in. for 3/16- and 1/4-in. tapered Phillips flat head and 1/4-in. tapered T-27 TORX flat head anchors • Maximum 0.385 in. for 3/16-in. tapered T-25 TORX flat head anchor • Maximum 0.432 in. maximum for 3/16- and 1/4-in. T-25 TORX hex washer head anchors
Thread diameter	• Nominal 3/16-in., Major dia. is 0.217 inches, Minor2 is 0.145 inches
Shank diameter	• Nominal 3/16-in. is 0.170 inches • Nominal 1/4-in. is 0.224 inches
Lengths (in.)	• 1-1/4, 1-3/4, 2-1/4, 2-3/4, 3-1/4, 3-3/4, 4 (See ordering information section)
Thread design	• Trilobular, cold formed.
Threads per inch	• Nominal 3/16-in. have 8 tpi. • Nominal 1/4-in. have 8 tpi. • **Inches of thread per fastener** 1.875 inches maximum
Bending capacity	• Ductility at 10° minimum

1 Minimum tensile and yield strength are the average of strength measurement of (30) tested samples. These are not minimum steel properties or minimum manufacturing specifications.
2 Minor diameter is the average measurement taken from (30) samples. This is not a controlled dimension.

Revision Log

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0	08/31/23	N/A	Original report issue