Window Installation Analysis

QUAKER WINDOWS & DOORS
M600 Awning

Report Q6341.01-122-34

Rendered to:

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Scope

Architectural Testing, Inc., an Intertek company, was contracted by Quaker Windows & Doors to evaluate alternate installation methods for their M600 Awning windows. 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 2015 Supplement*. American Wood Council, 2018.

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

AISI S100-16(2020)w/S2-20 *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. 07/2023.

NOA 21-0628.20 *Hilti Kwik-Con+ Concrete and Masonry Screw Anchor.* Miami-Dade County Product Control Section. 08/19/2021.

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.

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- 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.

- Tanya A. Dolby, P.E. and Adam R. 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 M600 Awning Window 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
M600 Awning Window	H0890.01-801-47 (Revision -, 06/06/17)	NI013805-R1	36" x 84"	+/- 70 psf
M600 Awning Window	G3077.01-801-47 (Revision 1, 04/06/18)	NI013438-R2	60" x 36"	+/- 70 psf
M600 Awning Window	G3076.01-801-47 (Revision -, 11/21/16)	NI013438.01-R1	48" x 72"	+/- 70 psf

H0890.01-801-47, G3077.01-801-47, G3076.01-801-47 testing 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

For air/water/structural testing, the test specimen was secured to a 2x Spruce-Pine-Fir wood buck with nailing fins using #6 x 1-5/8" wood screws. The as-tested installation method is evaluated on page 7 and the established design capacities are summarized in Table 2.

Table 2 As-Tested Anchorage Design Capacity

Test	Connection	Capacity
M600 Awning with Window Air/Water/Structural Test	#6 x 1-5/8" Wood Screw Through Nail Fin Placed 2" from each corner and 12" on center	75 lb

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

Alternate Anchorages

Calculations on page 8 through page 14 determine the design capacity of alternate anchorages for the windows. The alternate anchorage capacities are summarized in Table 3 and Table 4.

Table 3 Alternate Anchorage Capacities – Nail Fin

Installation	Connection	Capacity	Comments
Wood	#12 Wood Screw connecting Nailing Fin to Wood Blocking	118 lb	1. Limited by pull-over 2. 1-1/2" min penetration 3. Min Wood blocking, G = 0.55
18 Gauge Steel Stud	#10-16 TEKS Screw connecting Nailing Fin to Light Gauge Steel Framing	116 lb	1. Limited by pull-out 2. Full penetration +3 threads 3. Min 18 gauge 33 KSI steel

Table 4 Alternate Anchorage Capacities - Strap Anchor

Substrate	Anchor	Capacity	Comments
Wood	#12 x 2-1/2" Wood Screw	193 lb	1. Limited by Shear 2. 1-1/4" Minimum Penetration 3. 1/4" Maximum Shim Space 4. Min Wood blocking, G = 0.55
18 Gauge Steel Stud	#12-14 TEKS Screw	306 lb	1. Limited by Tilting 2. Minimum 18 gauge 33 KSI Steel 3. Full penetration +3 threads 4. 1/4" Maximum Shim Space
Concrete	1/4" Hilti Kwik Con II+	379 lb	1. Limited by shear capacity 2. Minimum f'_c = 3,000 psi 3. 1" Minimum Embedment 4. 2-1/2" Min. Edge Distance 5. 1/4" Maximum Shim Space
CMU	1/4" Hilti Kwik Con II+	251 lb	1. Limited by shear capacity 2. Minimum ASTM C90 CMU 3. 1" Minimum Embedment 4. 2-1/2" Min. Edge Distance 5. 1/4" Maximum Shim Space

Anchorage Requirements

The capacities of the alternate anchorages exceed the capacity of the as-tested anchorage. The as tested spacings of 2” from each corner and 12” maximum on center for each anchoring system shall apply to alternate substrates.

Reference Drawings

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

- *M600 Awning Installation Instructions.* Sheets 1 - 6. Quaker Windows and Doors. 09/21/23. (6 pages)

As-Tested Installation – Nailing Fin to Wood Blocking

#6 x 1-5/8" Wood Screw

0.062" thick 6063-T6 Aluminum Nailing Fin

Spruce-Pine-Fir 2x Wood Substrate Minimum (G=0.55)

Allowable Tension of #6 x 1-5/8" Wood Screw

W = 1.6(1.625"-0.062")(69 lb/in) (NDS, Table 11.2B)

W = 173 lb

Pull-Over of #6 x 1-5/8" Wood Screw

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

P_{nov} = 1.0(0.0625")(30,000 psi)(0.270" - 0.1495")/3.0

P_{nov} = 75 lb

Alternate Installation – Nailing Fin to Wood Blocking

#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

Alternate Installation – Nailing Fin to Steel Stud

#10-16 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)

Allowable Tension of #10-16 TEKS Screw

V_a = 885 lb (ESR-1976)

Pull-Over of #10-16 TEKS Screw in Nail Fin

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

$P_{nov} = 1.0(0.0625")(30{,}000\ psi)(0.400" - 0.201")/3.0$

P_{nov} = 124 lb

Pull-Out of #10-16 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 116 lb

Alternate Installation – Strap Anchor to Wood

#12 x 2-1/2" Wood Screw

0.078" thick 6063-T6 Aluminum Strap Anchor

1/4" Maximum Shim Space

Wood Substrate Minimum (G=0.55)

Allowable Shear of #12 x 2-1/2" Wood Screw

Z' = 193 lb (Limited by Mode III, See Following Page)

Bearing of #12 x 2-1/2" Wood Screw on Strap Anchor

$V_a = 2DtF_u/n_u$

$V_a = 2(0.216")(0.078")(30{,}000\ psi)/3.0$

$V_a = 337$ lb

Bending of #12 x 2-1/2" Wood Screw

L = 1/4" (maximum shim space)

$S = \pi d^3/32 = \pi(0.216")^3/32 = 0.001\ in^3$

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

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

$V = 2SF_b/L = (2)(0.001\ in^3)(62{,}400\ psi)/0.25" = 500$ lb

Capacity of Connection is 193 lb

Alternate Installation – Strap Anchor to Wood Blocking (continued)

Lateral Design Strength of Wood Connections

ANSI / AF&PA 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	=	0.42	
θ	=	90	<= (Angle of load to grain)
F_e	=	3,350 psi	(Table 12.3.2)
Thickness	=	1.500 in.	

Side Member

Material	=	6063 T6 Aluminum	
G	=	N/A	
θ	=	0	<= (Angle of load to grain)
F_{es}	=	37,500 psi	
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	=	24.00	(Table 12.3.1A)
k_1	=	0.8662	(Table 12.3.1A)
k_2	=	0.5564	(Table 12.3.1A)
k_3	=	15.53	(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)

Lateral Design Values, Z

Mode I_m	=	389 lbf		(Eq 12.3-1)
Mode I_s	=	181 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	<==== Min Value	(Eq 12.3-5)
Mode IV	=	169 lbf		(Eq 12.3-6)
C_D	=	1.6		(B.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)
Installed in end grain?		No		
C_{eg}	=	1.00		(12.5.2)
Part of a diaphragm?		No		
C_{di}	=	1.0		(12.5.3)
Toe-nailed?		No		
C_{tn}	=	1.00		(12.5.4)
Z'	=	**193 lbf**		(Table 11.3.1)

Alternate Installation – Strap Anchor to Steel Stud

#12-14 TEKS Screw

Full Penetration +3 Threads

0.078" thick 6063-T6 Aluminum Strap Anchor

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

1/4" Maximum Shim Space

Allowable Shear of #12-14 TEKS Screw

V_a = 724 lb (ESR-1976)

Bearing of #12-14 TEKS Screw on Trim Clip

$V_a = 2DtF_u/n_u$

$V_a = 2(0.216")(0.078")(30{,}000\ psi)/3.0$

V_a = 337 lb

Bearing of #12-14 TEKS Screw on Steel Stud

$V_a = 2.7DtF_u/n_u$

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

V_a = 418 lb

Tilting of #12-14 TEKS Screw in Steel

$V_a = 4.2(t_2^3D)^{1/2}F_{tu}/n_s$

$V_a = 4.2(0.0478^3 \times 0.216)^{1/2}(45{,}000\ psi)/3.0$

V_a = 306 lb

Bending of #12-14 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

Alternate Installation – Strap Anchor to Concrete

1/4" Hilti Kwik-Con+ Anchor

1" Minimum Embedment

2-1/2" Minimum Edge Distance

2" Minimum Spacing

0.078" thick 6063-T6 Aluminum Strap Anchor

Minimum f'_c = 3,000 psi Concrete

1/4" Maximum Shim Space

Allowable Shear of 1/4" Hilti Kwik-Con+

P_{ss}/Ω = 379 lb (NOA-No. 21-0628.20)

Bearing of 1/4" Hilti Kwik-Con+ in Strap Anchor

$V_a = 2DtF_u/n_u$

$V_a = 2(0.25")(0.078")(30{,}000\ psi)/3.0$

V_a = 390 lb

Bending of 1/4" Hilti Kwik-Con+

L = 1/4" (Maximum Shim Space)

$S = \pi d^3/32 = \pi(0.224")^3/32 = 0.0011\ in^3$

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

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

$V = 2SF_b/L = (2)(0.0011\ in^3)(106{,}860\ psi)/0.25" = 940$ lb

Capacity of Connection is 379 lb

Alternate Installation – Strap Anchor to CMU

1/4" Hilti Kwik-Con+ Anchor

1" Minimum Embedment

2-1/2" Minimum Edge Distance

3" Minimum Spacing

0.078" thick 6063-T6 Aluminum Strap Anchor

Minimum f'm = 1,500 psi ASTM C90 Concrete Masonry

1/4" Maximum Shim Space

Allowable Shear of 1/4" Hilti Kwik-Con+ Anchor

P_{ss}/Ω = 251 lb (NOA-No. 21-0628.20)

Bearing of 1/4" Hilti Kwik-Con+ in Strap Anchor

$V_a = 2DtF_u/n_u$

$V_a = 2(0.25")(0.078")(30{,}000\ psi)/3.0$

V_a = 390 lb

Bending of 1/4" Hilti Kwik-Con+

L = 1/4" (Maximum Shim Space)

$S = \pi d^3/32 = \pi(0.224")^3/32 = 0.0011\ in^3$

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

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

$V = 2SF_b/L = (2)(0.0011\ in^3)(106{,}860\ psi)/0.25" = 940$ lb

Capacity of Connection is 251 lb

GLASS ANALYSIS

36” x 84” Window

Glazing Information

Supported Edges:	Four sides simply supported
Shape:	Rectangular
Lite Width:	31.0 in.
Lite Height:	78.8 in.
Glazing Angle:	90.0 °

Glazing Construction (Double Glazed Insulating Unit)

Exterior Lite Properties (Monolithic 1/4 in.)

Single Glass Ply Properties

RCSS (Heat Treatment):	0.00 psi (Annealed)
Min Thickness:	0.219 in.
Surface Treatment:	None
Surface Parameters:	7.00 [1.36e-29 in^12/lbf^7] (ASTM)

Airspace Properties

Thickness:	0.480 in.
Sealant Width:	0.236 in.
Elevation:	0.00 ft
Initial Pressure:	14.70 psi
Initial Temperature:	70.0 °F

Interior Lite Properties (Monolithic 1/4 in.)

Single Glass Ply Properties

RCSS (Heat Treatment):	0.00 psi (Annealed)
Min Thickness:	0.219 in.
Surface Treatment:	None
Surface Parameters:	7.00 [1.36e-29 in^12/lbf^7] (ASTM)

Load Combinations

Load Combination 1 - 70.0 psf (3.00 sec)

Description	Load	Duration	Factor	Total
Short Duration	70.0 psf	3.00 sec	1.00	70.0 psf

Scenarios

Scenario 1

Load Combination 1 acting on Exterior Lite	70.0 psf (3.00 sec)
Elevation (Atmospheric Pressure):	0.00 ft (14.6 psi)
Air Space 1 Temperature:	70.0 °F

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	48.3 psf	0.900	1/0.500	87.0 psf
Interior Lite	48.3 psf	0.900	1/0.500	87.0 psf

Comparisons

Scenario 1

70.0 psf 3.00 sec <= 87.0 psf	OK
Approximate center of glass deflection	
Exterior Lite	0.27 in.
Interior Lite	0.27 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.

60” x 36” Window

Glazing Information

Supported Edges:	Four sides simply supported
Shape:	Rectangular
Lite Width:	55.0 in.
Lite Height:	31.0 in.
Glazing Angle:	90.0 °

Glazing Construction (Double Glazed Insulating Unit)

Exterior Lite Properties (Monolithic 1/4 in.)

Single Glass Ply Properties

RCSS (Heat Treatment):	0.00 psi (Annealed)
Min Thickness:	0.219 in.
Surface Treatment:	None
Surface Parameters:	7.00 [1.36e-29 in^12/lbf^7] (ASTM)

Airspace Properties

Thickness:	0.480 in.
Sealant Width:	0.236 in.
Elevation:	0.00 ft
Initial Pressure:	14.70 psi
Initial Temperature:	70.0 °F

Interior Lite Properties (Monolithic 1/4 in.)

Single Glass Ply Properties

RCSS (Heat Treatment):	0.00 psi (Annealed)
Min Thickness:	0.219 in.
Surface Treatment:	None
Surface Parameters:	7.00 [1.36e-29 in^12/lbf^7] (ASTM)

Load Combinations

Load Combination 1 - 70.0 psf (3.00 sec)

Description	Load	Duration	Factor	Total
Short Duration	70.0 psf	3.00 sec	1.00	70.0 psf

Scenarios

Scenario 1

Load Combination 1 acting on Exterior Lite	70.0 psf (3.00 sec)
Elevation (Atmospheric Pressure):	0.00 ft (14.6 psi)
Air Space 1 Temperature:	70.0 °F

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	68.3 psf	0.900	1/0.500	123 psf
Interior Lite	68.3 psf	0.900	1/0.500	123 psf

Comparisons

Scenario 1

70.0 psf 3.00 sec <= 123 psf	OK
Approximate center of glass deflection	
Exterior Lite	0.20 in.
Interior Lite	0.20 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.

48” x 72” Window

Glazing Information

Supported Edges:	Four sides simply supported
Shape:	Rectangular
Lite Width:	43.0 in.
Lite Height:	67.0 in.
Glazing Angle:	90.0 °

Glazing Construction (Double Glazed Insulating Unit)

Exterior Lite Properties (Monolithic 1/4 in.)

Single Glass Ply Properties

RCSS (Heat Treatment):	0.00 psi (Annealed)
Min Thickness:	0.219 in.
Surface Treatment:	None
Surface Parameters:	7.00 [1.36e-29 in^12/lbf^7] (ASTM)

Airspace Properties

Thickness:	0.480 in.
Sealant Width:	0.236 in.
Elevation:	0.00 ft
Initial Pressure:	14.70 psi
Initial Temperature:	70.0 °F

Interior Lite Properties (Monolithic 1/4 in.)

Single Glass Ply Properties

RCSS (Heat Treatment):	0.00 psi (Annealed)
Min Thickness:	0.219 in.
Surface Treatment:	None
Surface Parameters:	7.00 [1.36e-29 in^12/lbf^7] (ASTM)

Load Combinations

Load Combination 1 - 70.0 psf (3.00 sec)

Description	Load	Duration	Factor	Total
Short Duration	70.0 psf	3.00 sec	1.00	70.0 psf

Scenarios

Scenario 1

Load Combination 1 acting on Exterior Lite	70.0 psf (3.00 sec)
Elevation (Atmospheric Pressure):	0.00 ft (14.6 psi)
Air Space 1 Temperature:	70.0 °F

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	47.7 psf	0.900	1/0.500	85.8 psf
Interior Lite	47.7 psf	0.900	1/0.500	85.8 psf

Comparisons

Scenario 1

70.0 psf 3.00 sec <= 85.8 psf	OK
Approximate center of glass deflection	
Exterior Lite	0.47 in.
Interior Lite	0.47 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.

HILTI KWIK-CON +

PRODUCT REVISED
as complying with the Florida Building Code
NOA-No. 21-0628.20
Expiration Date: 12/12/2024
By: Manuel Perez
Miami-Dade Product Control

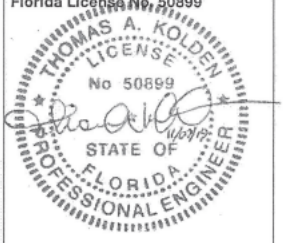
Hilti, Inc.
7250 Dallas Parkway
Plano TX 75024

Hilti Kwik-Con+ Fastening system for concrete and masonry elements
Revision date: October 31, 2019
Drawing: 1327-001
Sheet no. 1 of 1

For office use

PRODUCT APPROVED
as complying with the Florida Building Code
NOA-No. 19-1113.04
Approval Date 12/12/2019
By
Miami-Dade Product Control

Thomas Allan Kolden
Professional Engineer
Florida License No. 50899



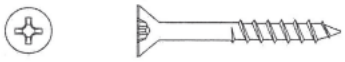
DESCRIPTION

Carbon steel screw anchors have a minimum yield strength of 120 ksi and a minimum tensile strength of 150 ksi. The screw anchors have a zinc coating with a minimum thickness of 8 µm and are coated with an organic coating to resist corrosion. Three-sixteenths and 1/4-in. carbon steel screw anchors are available in 1-1/4, 1-3/4, 2-1/4, 2-3/4, 3-1/4 3-3/4 and 4 inch lengths.

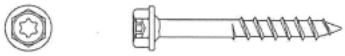
DESIGN LOADS:

Carbon steel screws					
Anchor size	Embedment depth	Concrete 300 psi		C90 Concrete block	
		Tension	Shear	Tension	Shear
3/16"	1"	112	215	116	150
3/16"	1-3/4"	217	215	-	-
1/4"	1"	198	379	122	251
1/4"	1-3/4"	393	379	-	-

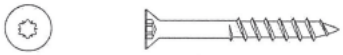
Kwik-Con+ — Philips flat head



Kwik-Con+ — Torx hex washer head



Kwik-Con+ — Torx flat head



Nominal diameter	Shank diameter (in.)	Thread major (in.)	Diameter root (in.)
3/16"	0.170	0.217	0.145
1/4"	0.224	0.283	0.190

GENERAL NOTES

1. Design loads for concrete are based on ultimate loads divided by 4. Design loads are for light-weight or normal-weight ASTM C90 block and are based on ultimate loads divided by 5.
2. In order to achieve the design load, a minimum edge distance of 1-1/2" for 3/16" ø screw, and 2-1/2" for 1/4" ø screw shall be observed.
3. Minimum spacing of anchor shall be 2" in concrete and 3" in concrete blocks in order to acheive the design loads.
4. Anchor installation shall be made in accordance with Hilti's published installation instructions in the Product Technical Guide.
5. Anchors are restricted from use in cracked concrete as defined in ACI 355.2.

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.

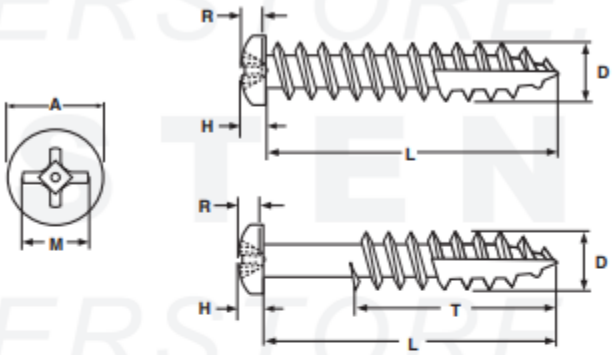
NOTE 32:
1. *Each table lists allowable pull-out (internal threads) values. $S_F = 3.0$ for $D \leq 0.25$"; $S_F = 2.5$ for $D \geq 0.3125$". Fastener allowable strength (basic tension and external threads) needs to be checked separately.*
2. *For pilot hole sizes refer to tables 21.1 to 21.7*
3. *Fastener 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 neccesary. 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.

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				

Revision Log

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