MTC SOLUTIONS

Structural Screw Design Guide

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TABLE OF CONTENTS

Building Forests in Cities

MEC Head Office

Vancouver, BC

MTC Solutions is a specialty supplier of connection solutions for modern mass timber applications in commercial, industrial and residential projects. We are proud to be working with the most innovative partners on cutting-edge projects across North America. Our goal is to see the wood construction industry thrive and help to maintain a low carbon footprint through education, research, and cost-effective approaches.

WE SUPPLY

MTC Solutions stocks more than 450 mass timber connection solutions ready for delivery throughout North America.

WE FUND

We do extensive research with leading North American universities to innovate Mass Timber Connections Solutions, reduce costs and extend the reach of mass timber in the market.

WE GUIDE

We offer free educational sessions on mass timber solutions in forms of webinars, technical learning sessions and event participation throughout North America.

WE EDUCATE

We provide the support needed to design efficient connection solutions. Our North American Support team is available to answer any design questions.

Origine Tower

Quebec City, Quebec

FASTENER LINE

MTC Solutions is the only official North American distributor of SWG ASSY® structural screws. All our fasteners are self-tapping, of the highest quality and engineered to fit the special needs of the North American market.

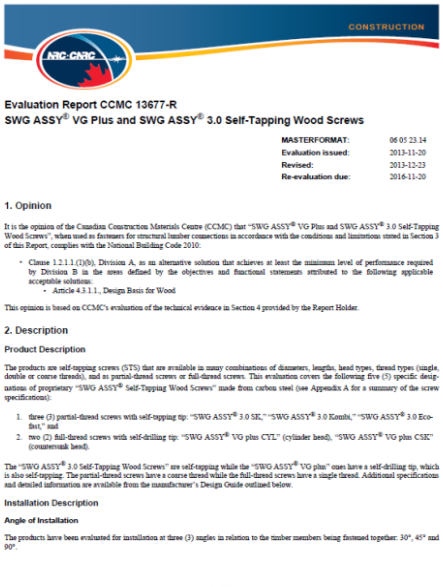
Our fasteners come in a great variety of sizes and shapes. They provide viable timber connection solutions for many structural applications. We are ready to supply what you need for your small and large projects.

We understand that specifying the right structural screw in your connections will significantly contribute to the overall success of a project. Together with leading North American universities, we fund well-researched applications to simplify connections and optimise efficiency.

Code-approved reliability. The ASSY® fasteners are approved by North American bodies and were awarded with ICC-ESR in the US, the Canadian Construction Materials Centre Reports (CCMC) in Canada, and most recently achieved LARR certification in Los Angeles. Our suppliers follow the strictest manufacturing processes and are under observation by North American authorities. With our high-quality product comes a commitment to high-quality service through our team of product consultants and technical support engineers.

CERTIFICATIONS

CCMC 13677-R


CONSTRUCTION

Evaluation Report CCMC 13677-R
SWG ASSY® VG Plus and SWG ASSY® 3.0 Self-Tapping Wood Screws

MASTERFORMAT: 06 05 23.14
Evaluation issued: 2013-11-20
Revised: 2013-12-23
Re-evaluation due: 2016-11-20

1. Opinion

It is the opinion of the Canadian Construction Materials Centre (CCMC) that "SWG ASSY® VG Plus and SWG ASSY® 3.0 Self-Tapping Wood Screws", when used as fasteners for structural lumber connections in accordance with the conditions and limitations stated in Section 3 of this Report, complies with the National Building Code 2010:

- Clause 1.2.1.1.(1)(b), Division A, as an alternative solution that achieves at least the minimum level of performance required by Division B in the areas defined by the objectives and functional statements attributed to the following applicable acceptable solutions:
  - Article 4.3.1.1., Design Basis for Wood

This opinion is based on CCMC's evaluation of the technical evidence in Section 4 provided by the Report Holder.

2. Description

Product Description

The products are self-tapping screws (STS) that are available in many combinations of diameters, lengths, head types, thread types (single, double or coarse threads), and as partial-thread screws or full-thread screws. This evaluation covers the following five (5) specific designations of proprietary "SWG ASSY® Self-Tapping Wood Screws" made from carbon steel (see Appendix A for a summary of the screw specifications):

1. three (3) partial-thread screws with self-tapping tip: "SWG ASSY® 3.0 SK," "SWG ASSY® 3.0 Kombi," "SWG ASSY® 3.0 Eco-fast," and
2. two (2) full-thread screws with self-drilling tip: "SWG ASSY® VG plus CYL" (cylinder head), "SWG ASSY® VG plus CSK" (countersunk head).

The "SWG ASSY® 3.0 Self-Tapping Wood Screws" are self-tapping while the "SWG ASSY® VG plus" ones have a self-drilling tip, which is also self-tapping. The partial-thread screws have a coarse thread while the full-thread screws have a single thread. Additional specifications and detailed information are available from the manufacturer's Design Guide outlined below.

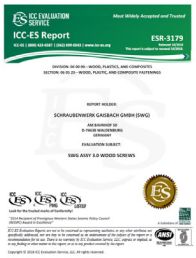
Installation Description

Angle of Installation

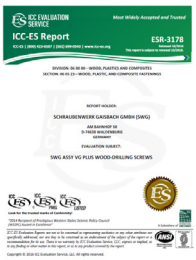
The products have been evaluated for installation at three (3) angles in relation to the timber members being fastened together: 30°, 45° and 90°.

1 of 20

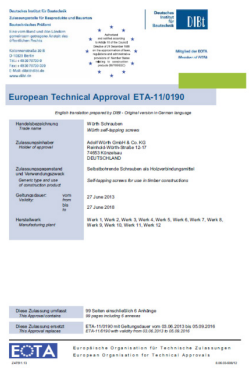
ICC-ESR-3179


ICC EVALUATION SERVICE
Most Widely Accepted and Trusted
ICC-ES Report
ESR-3179
SCHRAUBENWERK GASBACH GMBH (SWG)
SWG ASSY 3.0 WOOD SCREWS

ICC-ESR-3178


ICC EVALUATION SERVICE
Most Widely Accepted and Trusted
ICC-ES Report
ESR-3178
SCHRAUBENWERK GASBACH GMBH (SWG)
SWG ASSY VG PLUS WOOD-DRILLING SCREWS

ETA-11/0190


European Technical Approval ETA-11/0190

LARR-26073


CITY OF LOS ANGELES

LARR-26072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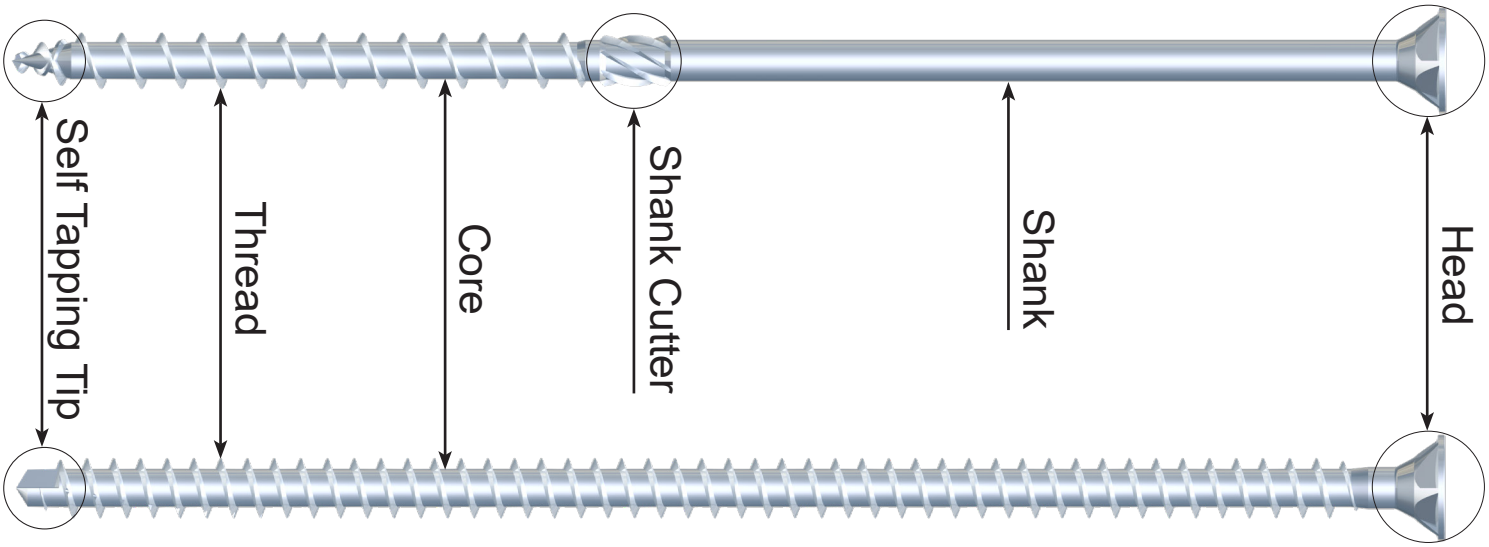
FASTENER TERMINOLOGY

In our fastener product line, there are two main categories: fully threaded and partially threaded screws. Both are engineered to be used in different applications.

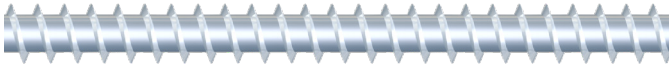


Partially Threaded Screws

Partially threaded screws are designed to pull members tightly together, and are often utilized in situations where head pull-through or lateral loading are critical design considerations. The shank cutter clears a hole slightly larger than the shank, reducing torque during installation and allowing the wood to settle freely as required.

ASSY® carbon steel partially threaded screws are equipped with a 34° counterthread tip, while ASSY A2® stainless steel screws are equipped with a ring thread tip. Both tips ensure a swift and precise bite and reduce splitting forces during installation.

Fully Threaded Screws



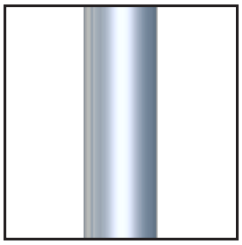
Fully threaded screws are designed to hold wood members firmly in place. Long, fully threaded ASSY® screws are often utilized to take advantage of their high withdrawal capacities through axial loading using installation angles other than 90°. Fully threaded screws are also specially suited for reinforcement applications that utilize the high withdrawal and bearing capacity of the screws along the axial direction.

All ASSY® self tapping fully threaded screws are equipped with a more aggressive drilling point tip to displace wood and reduce torque during installation.

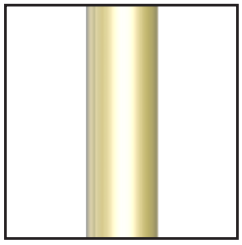
STEEL AND COATING

ASSY® screws are available in two different types of steel: high performance carbon steel (with one of two types of surface coatings) and stainless steel.

Carbon Steel



Zinc and Blue Passivated Surface Coating



Yellow Chromate Surface Coating

Stainless Steel

Carbon steel ASSY® screws with yellow chromate or blue passivated zinc coatings are intended for dry service conditions only, where the moisture content of the wood members does not exceed 19%.

For wet service conditions, select ASSY® screws are available in stainless steel as an alternative to carbon steel. Since stainless steel is a softer metal than carbon steel, ASSY A2® screws exhibit lower fastener strengths compared to regular carbon steel screws, which must be accounted for in design. Pre-drilling may also be a requirement for longer stainless steel screws.

In addition, all ASSY® screws feature a friction-reducing coating to lower torque during installation.

Hardening

ASSY® carbon steel screws are double heat treated to achieve specific mechanical properties. The screws first undergo a case hardening procedure to ensure reliable thread performance. Afterward, the screws are subjected to a tempering and annealing process to improve ductility and toughness. ASSY® screws can bend 45° without fracturing, and feature higher tensile and torsional strength compared to conventional wood fasteners.

ASSY® Fasteners

f_y 1147 MPa [1]

ASSY Bending Yield Strength

[1] for D= 1/2” (12 mm), according to CCMC 13677-R

VS

Lag Screw

f_y 310 MPa

Lag Screw Yield Strength

according to CSA O86

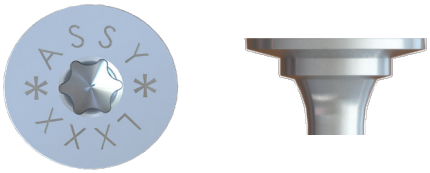
HEAD TYPE

Countersunk Head

The countersunk head is engineered for connections where the screw head is required to be flush with the surface. Optional milling pockets on the underside of the head ensure clean countersinking action.

Washer Head

The washer head screw is engineered to pull connection members tight. The broad washer head supplies maximum pull-through capacity to a connection without using a separate washer.



Flat Washer Head

The flat washer head combines the high pulling power of the washer head with the clean finish of the countersunk head.

Kombi Hex Head

The combination hex head can be driven by proprietary AW® bits or by regular metric hex sockets. The diameter of the tapered shoulder is equal to the thread diameter, making it ideal for tight fitting steel-to-wood connections.

Cylinder Head

The small cylinder head can be driven below the surface of the wood where it remains inconspicuous. Fully threaded cylinder head screws are ideal for reinforcing applications where an unobstructed wood surface is important to the final result.

Reverse Head

The reverse head screw is quite simply the longest fully threaded self-tapping screw in the world. The reverse head is engineered specifically to handle the high torque generated during installation. The reverse head also makes it easier to install screws up to 59” in length while avoiding slippage between the bit driver and the screw.

SELF-TAPPING TIP

All SWG ASSY® screws are equipped with a self-tapping tip, which enables fast and simple installation. The various self-tapping tips are engineered to reduce the splitting force in the wood during installation and reduce drive-in torque. Most importantly, the self-tapping function eliminates the need for pre-drilling with most timber species. This feature is especially advantageous when installing very long screws driven into large wood members.

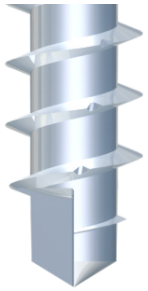
Since pre-drilling can reduce the withdrawal capacity of the screws if the holes are drilled too large, the self-tapping feature also contributes to greater connection consistency and reliability.

Counter Thread Tip

- Fastest wood engagement
- Cuts the wood and reduces the wood splitting tendency
- Reduces torque
- No material removal
- No pre-drilling needed

Ring Thread Tip

- Reduces splitting in applications close to edge
- Reduces blow-out hazards
- No material removal
- No pre-drilling needed



Drilling Tip

- Smallest spacing requirements
- Displaces wood and reduces the wood splitting tendency
- Drills the right diameter for the maximal withdrawal capacity
- No material removal
- No pre-drilling needed

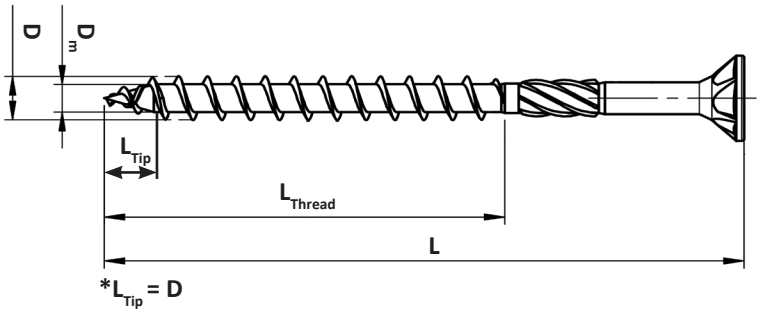
Did you know?

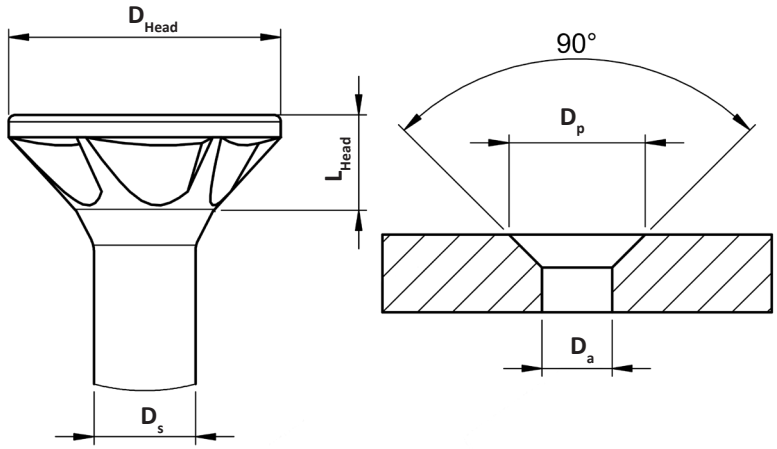
The shank cutter serves an important function on SWG ASSY® partially threaded screws. During installation, the shank cutter clears a hole slightly larger than the shank, reducing torque and allowing the wood to settle freely as required.

ASSY® Ecofast

The ASSY® Ecofast screw is a partially threaded (PT) screw with a countersunk head engineered to offer a flush, clean finish for both wood-to-wood and steel-to-wood connections. Its aggressive thread and self-tapping tip bite into the wood rapidly and assure quick and easy installation. The Ecofast can be used with the 90° cup and 45° wedge washer.

- Countersunk Head
- Counter Thread Tip
- Self-tapping
- Partially Threaded
- Diameters: 1/4”, 5/16”, 3/8”
- Wood/Wood, Wood/Steel
- Code Approved: ICC, CCMC & LARR





Item#	Box size	D	L	L_{Thread}	D_{Head}	D_m	D_s	D_p	D_a	L_{Head}	Bit
#	pieces	in. [mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	
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11060090000	100		3-1/2 [90]	2 [50]							
11060100000	100		4 [100]	2-3/8 [60]							
11060120000	100		4-3/4 [120]	2-3/4 [70]							
11060140000	100		5-1/2 [140]	2-3/4 [70]							
11060160000	100		6-1/4 [160]	2-3/4 [70]							
11060180000	100		7-1/8 [180]	2-3/4 [70]							
11060200000	100		7-7/8 [200]	2-3/4 [70]							
11060220000	100		8-5/8 [220]	2-3/4 [70]							
11060240000	100		9-1/2 [240]	2-3/4 [70]							
11060260000	100		10-1/4 [260]	2-3/4 [70]							
11060280000	100		11 [280]	2-3/4 [70]							
11060300000	100		11-7/8 [300]	2 3/4 [70]							

ASSY® Ecofast

Item#	Box size	D	L		L_{Thread}		D_{Head}	D_m	D_s	D_p	D_a	L_{Head}	Bit
#	pieces	in. [mm]	in.	[mm]	in.	[mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	
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11080100000	75		4	[100]	2-3/8	[60]							
11080120000	75		4-3/4	[120]	3-1/8	[80]							
11080140000	75		5-1/2	[140]	3-1/8	[80]							
11080160000	75		6-1/4	[160]	3-1/8	[80]							
11080180000	75		7-1/8	[180]	3-1/8	[80]							
11080200000	75		7-7/8	[200]	3-1/8	[80]							
11080220000	75		8-5/8	[220]	4	[100]							
11080240000	75		9-1/2	[240]	4	[100]							
11080260000	75		10-1/4	[260]	4	[100]							
11080280000	75		11	[280]	4	[100]							
11080300000	75		11-7/8	[300]	4	[100]							
11080320000	100		12-5/8	[320]	4	[100]							
11080340000	100		13-3/8	[340]	4	[100]							
11080360000	100		14-1/4	[360]	4	[100]							
11080380000	100		15	[380]	4	[100]							
11080400000	100		15-3/4	[400]	4	[100]							

Item#	Box size	D	L		L_{Thread}		D_{Head}	D_m	D_s	D_p	D_a	L_{Head}	Bit
#	pieces	in. [mm]	in.	[mm]	in.	[mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	
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11100200000	50		7-7/8	[200]	4	[100]							
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11100280000	50		11	[280]	4	[100]							
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11100340000	50		13-3/8	[340]	4-3/4	[120]							
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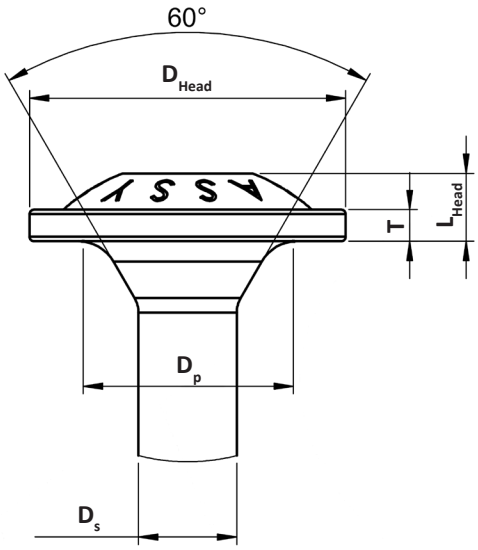
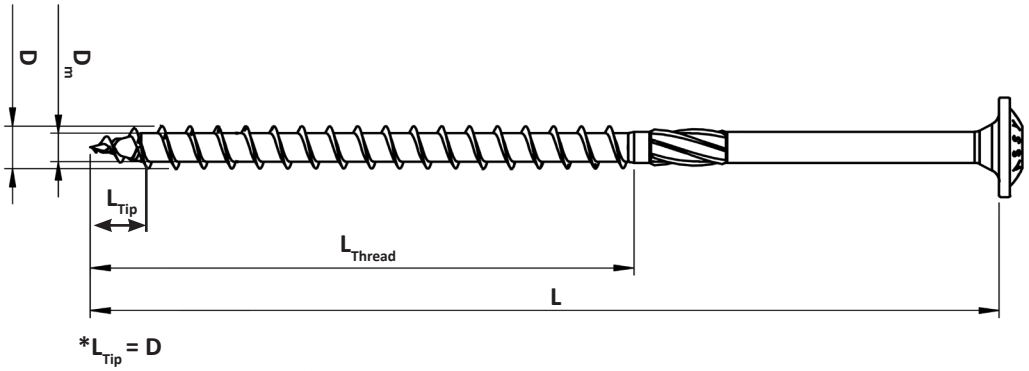
11100380000	50		15	[380]	4-3/4	[120]							
11100400000	50		15-3/4	[400]	4-3/4	[120]							

ASSY® SK

The ASSY® SK with its large washer head offers the highest head pull-through resistance of all ASSY® screws. The SK will pull together and hold your timber work tightly in place, making it the perfect choice for many wood-to-wood assembly applications. The aggressive thread and self-tapping tip make for easy and fast installation in mass timber, heavy timber, or log home construction.

- Largest Washer Head
- Counter Thread Tip
- Self-tapping
- Partially Threaded
- Diameters: 1/4”, 5/16”, 3/8”, 1/2”
- Wood/Wood, Wood/Concrete
- Code Approved: ICC, CCMC & LARR





*L_{Tip} = D

Did you know?

Partially threaded screws are designed to pull timber members tightly together.

ASSY® SK

Item#	Box size	D	L		L_{Thread}		D_{Head}	D_m	D_s	D_p	T	L_{Head}	Bit
#	pieces	in. [mm]	in.	[mm]	in.	[mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	
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12060090000	100		3-1/2	[90]	2	[50]							
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12060120000	100		4-3/4	[120]	2-3/4	[70]							
12060140000	100		5-1/2	[140]	2-3/4	[70]							
12060160000	100		6-1/4	[160]	2-3/4	[70]							
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12060200000	100		7-7/8	[200]	2-3/4	[70]							
12060220000	100		8-5/8	[220]	2-3/4	[70]							
12060240000	100		9-1/2	[240]	2-3/4	[70]							
12060260000	100		10-1/4	[260]	2-3/4	[70]							
12060280000	100		11	[280]	2-3/4	[70]							
12060300000	100		11-7/8	[300]	2-3/4	[70]							

Item#	Box size	D	L		L_{Thread}		D_{Head}	D_m	D_s	D_p	T	L_{Head}	Bit
#	pieces	in. [mm]	in.	[mm]	in.	[mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	
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12080120000	50		4-3/4	[120]	3-1/8	[80]							
12080140000	50		5-1/2	[140]	3-1/8	[80]							
12080160000	50		6-1/4	[160]	3-1/8	[80]							
12080180000	50		7-1/8	[180]	3-1/8	[80]							
12080200000	50		7-7/8	[200]	3-1/8	[80]							
12080220000	50		8-5/8	[220]	4	[100]							
12080240000	50		9-1/2	[240]	4	[100]							
12080260000	50		10-1/4	[260]	4	[100]							
12080280000	50		11	[280]	4	[100]							
12080300000	50		11-7/8	[300]	4	[100]							
12080320000	50		12-5/8	[320]	4	[100]							
12080340000	50		13-3/8	[340]	4	[100]							
12080360000	50		14-1/4	[360]	4	[100]							
12080380000	50		15	[380]	4	[100]							
12080400000	50		15-3/4	[400]	4	[100]							
12080420000	50		16-1/2	[420]	4	[100]							
12080440000	50		17-1/4	[440]	4	[100]							
12080480000	25		19	[480]	4	[100]							
12080520000	25		20-1/2	[520]	4	[100]							

ASSY® SK

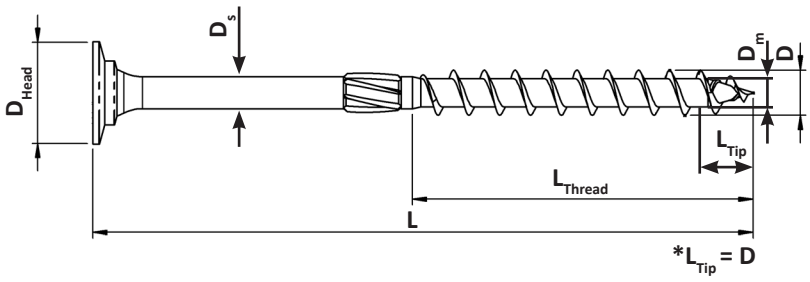
Item#	Box size	D	L		L_{Thread}		D_{Head}	D_m	D_s	D_p	T	L_{Head}	Bit
#	pieces	in. [mm]	in.	[mm]	in.	[mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	
12100100000	50	3/8 [10]	4	[100]	2-3/8	[60]	0.992 [25.2]	0.248 [6.3]	0.283 [7.2]	0.531 [13.5]	0.087 [2.2]	0.181 [4.6]	AW 50
12100120000	50		4-3/4	[120]	3-1/8	[80]							
12100140000	50		5-1/2	[140]	3-1/8	[80]							
12100160000	50		6-1/4	[160]	4	[100]							
12100180000	50		7-1/8	[180]	4	[100]							
12100200000	50		7-7/8	[200]	4	[100]							
12100220000	50		8-5/8	[220]	4	[100]							
12100240000	50		9-1/2	[240]	4	[100]							
12100260000	50		10-1/4	[260]	4	[100]							
12100280000	50		11	[280]	4	[100]							
12100300000	50		11-7/8	[300]	4	[100]							
12100320000	50		12-5/8	[320]	4-3/4	[120]							
12100340000	50		13-3/8	[340]	4-3/4	[120]							
12100360000	50		14-1/4	[360]	4-3/4	[120]							
12100380000	50		15	[380]	4-3/4	[120]							
12100400000	50		15-3/4	[400]	4-3/4	[120]							
12100460000	25		18-1/8	[460]	4-3/4	[120]							

Item#	Box size	D	L		L_{thread}		D_{Head}	D_m	D_s	D_p	T	L_{Head}	Bit
#	pieces	in. [mm]	in.	[mm]	in.	[mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	
12120200000	25	1/2 [12]	7-7/8	[200]	4	[100]	1.157 [29.4]	0.283 [7.2]	0.323 [8.2]	0.552 [14]	0.102 [2.6]	0.196 [5.0]	AW 50
12120220000	25		8-5/8	[220]	4-3/4	[120]							
12120240000	25		9-1/2	[240]	4-3/4	[120]							
12120260000	25		10-1/4	[260]	4-3/4	[120]							
12120280000	25		11	[280]	4-3/4	[120]							
12120300000	25		11-7/8	[300]	4-3/4	[120]							
12120320000	25		12-5/8	[320]	4-3/4	[120]							
12120340000	25		13-3/8	[340]	4-3/4	[120]							
12120360000	25		14-1/4	[360]	4-3/4	[120]							
12120380000	25		15	[380]	5-3/4	[145]							
12120400000	25		15-3/4	[400]	5-3/4	[145]							
12120440000	25		17-1/4	[440]	5-3/4	[145]							
12120480000	25		19	[480]	5-3/4	[145]							
12120520000	25		20-1/2	[520]	5-3/4	[145]							
12121000000	25		39-3/8	[1000]	4-3/4	[120]							

ASSY® F.W.H.

The ASSY® F.W.H. is a two-in-one engineered screw that combines the pulling power of a washer-head screw with the clean finish of a countersunk head screw. The FWH, like the other ASSY® screws, is a structural, self-tapping screw with a counter thread tip for reduced wood splitting and precise setting. This new fastener is only available in 5/16" diameter and offers the high quality and maximum performance expected from an ASSY® screw, at the most competitive price on the market.

- Flat Washer Head
- Counter Thread Tip
- Self-tapping
- Partially Threaded
- Diameters: 5/16"
- Wood/Wood, Wood/Steel
- Code Approved: ETA



Item#	Box size	D	L		L_{Thread}		D_{Head}	D_m	D_s	Bit
#	pieces	in. [mm]	in.	[mm]	in.	[mm]	in. [mm]	in. [mm]	in. [mm]	
10080160000	50	5/16 [8]	6-1/4	[160]	3-1/8	[80]	0.709 [18]	0.209 [5.3]	0.228 [5.8]	AW 40
10080200000	50		7-7/8	[200]	3-1/8	[80]				
10080240000	50		9-1/2	[240]	4	[100]				
10080300000	50		11-7/8	[300]	4	[100]				
10080360000	50		14-1/4	[360]	4	[100]				
10080400000	50		15-3/4	[400]	4	[100]				

Did you know?

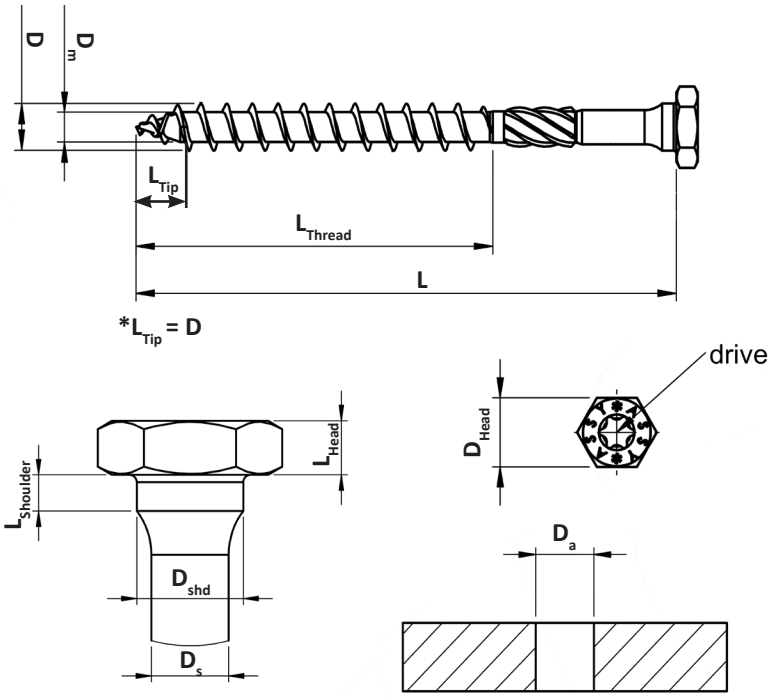
All ASSY® fasteners are self-tapping screws and therefore do not require any pre-drilling to be installed.

A common lag screw, for example, will require up to three pre-drilled holes, each in a different diameter.

ASSY® Kombi

The ASSY® Kombi screw, with its convenient combination hex head, is the multipurpose workhorse among engineered screws, suitable for wood-to-wood and steel-to-wood connections. Kombi screws are also used extensively as anchors in material handling and panel handling systems for CLT, logs, and heavy timber. The combination hex head can be driven by proprietary AW® bits or by regular metric hex sockets, including the magnetic SW® sockets from SWG.

- HEX Head
- Counter Thread Tip
- Self-tapping
- Partially Threaded
- Diameters: 5/16”, 3/8”, 1/2”
- Wood/Wood, Wood/Steel, Material handling systems
- Code Approved: ICC, CCMC & LARR



Item#	Box size	D	L		L_{Thread}		D_{Head}	D_m	D_s	D_a	D_{shd}	L_{Head}	$L_{Shoulder}$	Bit
#	pieces	in. [mm]	in.	[mm]	in.	[mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	
13080060000	75	5/16 [8]	2-3/8	[60]	1 1/2	[40]	0.472 [12]	0.209 [5.3]	0.228 [5.8]	0.354 [9.0]	0.315 [8.0]	0.177 [4.5]	0.110 [2.8]	AW 40 or 1/2” socket
13080080000	75		3-1/8	[80]	2	[50]								
13080100000	75		4	[100]	2-3/8	[60]								
13080120000	75		4-3/4	[120]	3-1/8	[80]								
13080140000	75		5-1/2	[140]	3-1/8	[80]								
13080160000	75		6-1/4	[160]	3-1/8	[80]								
13080180000	75		7-1/8	[180]	3-1/8	[80]								
13080200000	75		7-7/8	[200]	3-1/8	[80]								
13080220000	75		8-5/8	[220]	4	[100]								
13080240000	75		9-1/2	[240]	4	[100]								
13080260000	75		10-1/4	[260]	4	[100]								
13080280000	75		11	[280]	4	[100]								
13080300000	75		11-7/8	[300]	4	[100]								

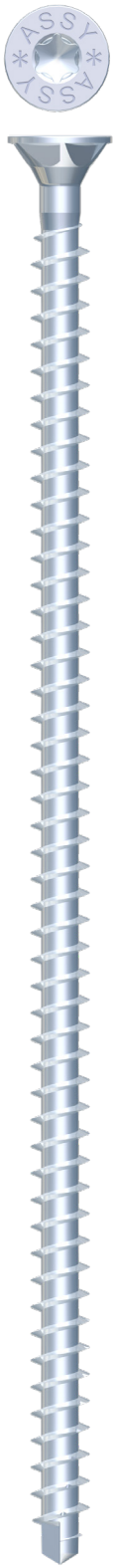
ASSY® Kombi

Item#	Box size	D	L		L_{Thread}		D_{Head}	D_m	D_s	D_a	D_{shd}	L_{Head}	$L_{Shoulder}$	Bit
#	pieces	in. [mm]	in.	[mm]	in.	[mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	
13100060000	50	3/8 [10]	2-3/8	[60]	2	[50]	0.591 [15]	0.248 [6.3]	0.283 [7.2]	0.433 [11]	0.394 [10]	0.196 [5]	0.118 [3]	AW 40 or 19/32" socket
13100080000	50		3-1/8	[80]	2	[50]								
13100100000	50		4	[100]	2-3/8	[60]								
13100120000	50		4-3/4	[120]	3-1/8	[80]								
13100140000	50		5-1/2	[140]	3-1/8	[80]								
13100160000	50		6-1/4	[160]	4	[100]								
13100180000	50		7-1/8	[180]	4	[100]								
13100200000	50		7-7/8	[200]	4	[100]								
13100220000	50		8-5/8	[220]	4	[100]								
13100240000	50		9-1/2	[240]	4	[100]								
13100260000	50		10-1/4	[260]	4	[100]								
13100280000	50		11	[280]	4	[100]								
13100300000	50		11-7/8	[300]	4	[100]								
13100320000	50		12-5/8	[320]	4-3/4	[120]								
13100340000	50		13-3/8	[340]	4-3/4	[120]								
13100360000	50		14-1/4	[360]	4-3/4	[120]								
13100380000	50		15	[380]	4-3/4	[120]								
13100400000	50		15-3/4	[400]	4-3/4	[120]								
13100440000	25		17-1/4	[440]	4-3/4	[120]								
13100480000	25		19	[480]	4-3/4	[120]								

Item#	Box size	D	L		L_{Thread}		D_{Head}	D_m	D_s	D_a	D_{shd}	L_{Head}	$L_{Shoulder}$	Bit
#	pieces	in. [mm]	in.	[mm]	in.	[mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	
13120100000	50	1/2 [12]	4	[100]	2-3/8	[60]	0.669 [17]	0.283 [7.2]	0.323 [8.2]	0.511 [13]	0.472 [12]	0.216 [5.5]	0.126 [3.2]	AW 40 or 11/16" socket
13120120000	50		4-3/4	[120]	3-1/8	[80]								
13120140000	50		5-1/2	[140]	3-1/8	[80]								
13120160000	50		6-1/4 [1]	[160] [1]	5-3/4 [1]	[145] [1]								
13120180000	50		7-1/8	[180]	4	[100]								
13120200000	50		7-7/8	[200]	4	[100]								
13120220000	50		8-5/8	[220]	4-3/4	[120]								
13120240000	50		9-1/2	[240]	4-3/4	[120]								
13120260000	50		10-1/4	[260]	4-3/4	[120]								
13120280000	50		11	[280]	4-3/4	[120]								
13120300000	50		11-7/8	[300]	4-3/4	[120]								
13120320000	50		12-5/8	[320]	4-3/4	[120]								
13120340000	50		13-3/8	[340]	4-3/4	[120]								
13120360000	50		14-1/4	[360]	4-3/4	[120]								
13120380000	50		15	[380]	5-3/4	[145]								
13120400000	25		15-3/4	[400]	5-3/4	[145]								
13120440000	25		17-1/4	[440]	5-3/4	[145]								
13120480000	25		19	[480]	5-3/4	[145]								

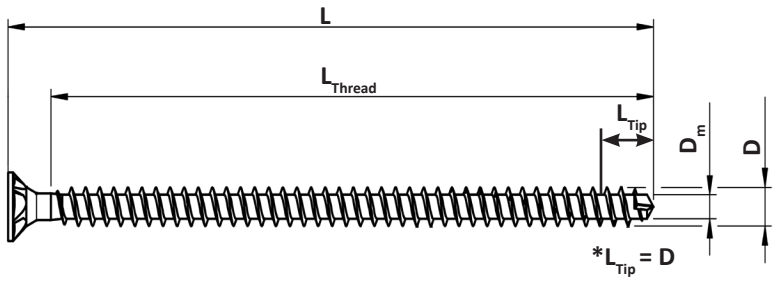
[1] Fully threaded, design for lifting

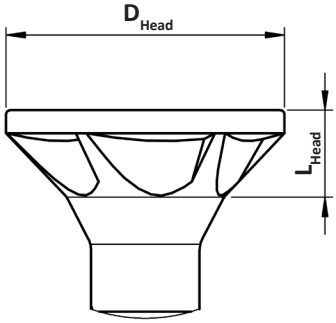
ASSY® VG CSK

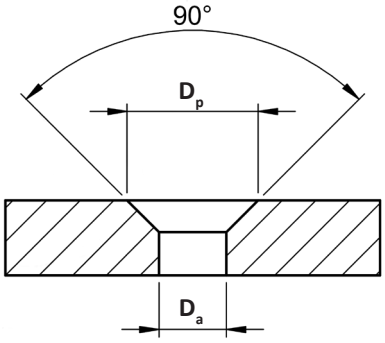


The ASSY® VG Countersunk head (CSK) screw is the multipurpose fully threaded screw, suitable for use in wood-to-wood, steel-to-wood, concrete-to-wood, and reinforcing applications. All fully threaded screws are suitable for timber reinforcements. With the long threaded shank, high withdrawal capacities can be achieved. The drill tip allows for more effective penetration and reduced spacing. Closer end- and edge-distances are possible, which can reduce the required sizes of the timber members. The VG CSK screw is also suitable for use with the 90° cup and 45° wedge washer.

- Countersunk Head
- Drill bit tip
- Self-tapping
- Fully Threaded
- Diameters: 5/16",3/8", 1/2"
- Wood/Wood, Wood/Steel, Wood/Concrete
- Code Approved: ICC, CCMC & LARR







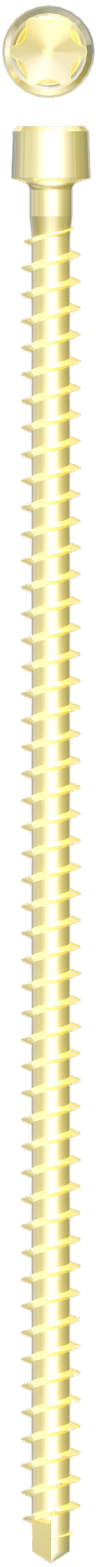
Item#	Box size	D	L		L_{Thread}		D_{Head}	D_m	D_p	D_a	L_{Head}	Bit
#	pieces	in. [mm]	in.	[mm]	in.	[mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	
14080080000	75	5/16 [8]	3-1/8	[80]	2-1/2	[61]	0.591 [15]	0.196 [5]	0.748 [19]	0.354 [9]	0.181 [4.6]	AW 40
14080120000	75		4-3/4	[120]	4	[103]						
14080140000	75		5-1/2	[140]	4-7/8	[123]						
14080160000	75		6-1/4	[160]	5-5/8	[143]						
14080180000	75		7-1/8	[180]	6-3/8	[163]						
14080200000	75		7-7/8	[200]	7-1/4	[183]						
14080220000	75		8-5/8	[220]	8	[203]						
14080240000	75		9-1/2	[240]	8-3/4	[223]						
14080260000	75		10-1/4	[260]	9-5/8	[243]						
14080280000	75		11	[280]	10-3/8	[263]						
14080300000	75		11-7/8	[300]	11-1/8	[283]						

ASSY® VG CSK

Item#	Box size	D	L		L_{Thread}		D_{Head}	D_m	D_p	D_a	L_{Head}	Bit
#	pieces	in. [mm]	in.	[mm]	in.	[mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	
14100100000	50	3/8 [10]	4	[100]	3	[77]	0.728 [18.5]	0.244 [6.2]	0.944 [24]	0.433 [11]	0.255 [6.5]	AW 50
14100140000	50		5-1/2	[140]	4-7/8	[125]						
14100160000	50		6-1/4	[160]	5-3/4	[145]						
14100180000	50		7-1/8	[180]	6-1/2	[165]						
14100200000	50		7-7/8	[200]	7-1/4	[185]						
14100220000	50		8-5/8	[220]	8-1/8	[205]						
14100240000	50		9-1/2	[240]	8-7/8	[225]						
14100260000	50		10-1/4	[260]	9-5/8	[245]						
14100280000	50		11	[280]	10-3/8	[265]						
14100300000	50		11-7/8	[300]	11-1/4	[285]						
14100320000	50		12-5/8	[320]	12	[305]						
14100340000	50		13-3/8	[340]	12-3/4	[325]						
14100360000	50		14-1/4	[360]	13-5/8	[345]						
14100380000	50		15	[380]	14-3/8	[365]						
14100400000	50		15-3/4	[400]	15-1/8	[385]						
14100430000	25		16-7/8	[430]	16-3/8	[415]						
14100480000	25		19	[480]	18-1/4	[465]						
14100530000	25		20-7/8	[530]	20-1/8	[512]						
14100580000	25		22-7/8	[580]	22-1/8	[562]						
14100650000	25		25-5/8	[650]	24-7/8	[632]						
14100700000	25		27-5/8	[700]	26-7/8	[682]						
14100750000	25		29-1/2	[750]	28-7/8	[732]						
14100800000	25		31-1/2	[800]	30-3/4	[782]						

Item#	Box size	D	L		L_{Thread}		D_{Head}	D_m	D_p	D_a	L_{Head}	Bit
#	pieces	in. [mm]	in.	[mm]	in.	[mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	in. [mm]	
14120120000	50	1/2 [12]	4-3/4	[120]	4-1/8	[105]	0.885 [22.5]	0.280 [7.1]	1.024 [26]	0.512 [13]	0.264 [6.7]	AW 50
14120140000	50		5-1/2	[140]	4-7/8	[125]						
14120160000	50		6-1/4	[160]	5-3/4	[145]						
14120180000	50		7-1/8	[180]	6-1/2	[165]						
14120200000	50		7-7/8	[200]	7-1/4	[185]						
14120220000	50		8-5/8	[220]	8-1/8	[205]						
14120240000	50		9-1/2	[240]	8-7/8	[225]						
14120260000	50		10-1/4	[260]	9-5/8	[245]						
14120280000	50		11	[280]	10-3/8	[265]						
14120300000	50		11-7/8	[300]	11-1/4	[285]						
14120380000	50		15	[380]	14-3/8	[365]						
14120480000	25		19	[480]	18-1/4	[465]						
14120600000	25		23-5/8	[600]	23	[585]						

ASSY® VG Cyl

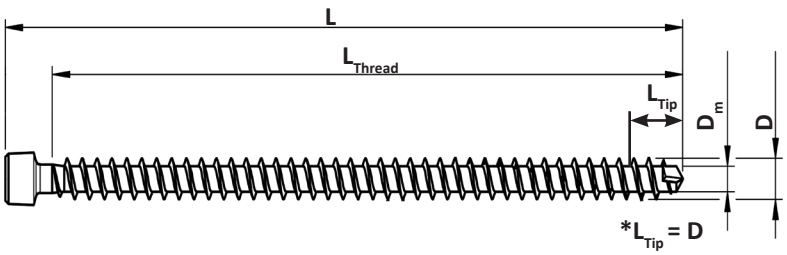


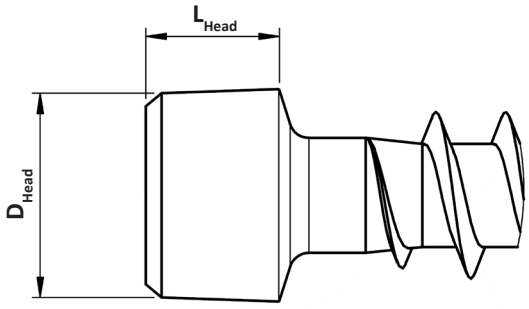
The ASSY® VG Cylinder head (Cyl) screw is engineered for timber reinforcements, beam repair and connections where a small screw head is required for a clean, concealed architectural finish. The head diameter is reduced to a minimum and can easily be concealed by a wooden plug if required. Typical reinforcing applications involve checked or cracked members, which can be restored to nearly their original strength. The drill tip allows for more effective penetration and reduced spacing. Closer end- and edge-distances are also possible.

Item#	Box size	D	L		L_{Thread}		D_{Head}	D_m	L_{Head}	Bit
#	pieces	in. [mm]	in.	[mm]	in.	[mm]	in. [mm]	in. [mm]	in. [mm]	
15060080000	100	1/4 [6]	3-1/8	[80]	2-7/8	[73]	0.323 [8.2]	0.150 [3.8]	0.185 [4.7]	AW 30
15060100000	100		4	[100]	3-5/8	[93]				
15060120000	100		4-3/4	[120]	4-1/2	[113]				
15060140000	100		5-1/2	[140]	5-1/4	[133]				
15060160000	100		6-1/4	[160]	6	[153]				
15060180000	100		7-1/8	[180]	6-3/4	[173]				
15060200000	100		7-7/8	[200]	7-5/8	[193]				

Item#	Box size	D	L		L_{Thread}		D_{Head}	D_m	L_{Head}	Bit
#	pieces	in. [mm]	in.	[mm]	in.	[mm]	in. [mm]	in. [mm]	in. [mm]	
15080120000	50	5/16 [8]	4-3/4	[120]	4	[104]	0.394 [10]	0.196 [5]	0.295 [7.5]	AW 40
15080140000	50		5-1/2	[140]	4-7/8	[124]				
15080160000	50		6-1/4	[160]	5-5/8	[144]				
15080180000	50		7-1/8	[180]	6-1/2	[164]				
15080200000	75		7-7/8	[200]	7-1/4	[184]				
15080220000	75		8-5/8	[220]	8	[204]				
15080240000	75		9-1/2	[240]	8-7/8	[224]				
15080260000	75		10-1/4	[260]	9-5/8	[244]				
15080280000	75		11	[280]	10-3/8	[264]				
15080300000	75		11-7/8	[300]	11-1/8	[284]				
15080330000	50		13	[330]	12-3/8	[314]				
15080360000	50		14-1/4	[360]	13-1/2	[344]				
15080380000	50		15	[380]	14-3/8	[364]				
15080430000	25		17	[430]	16-1/4	[414]				
15080480000	25		19	[480]	18-1/4	[464]				
15080530000	25		20-7/8	[530]	20-1/4	[514]				
15080580000	25		22-7/8	[580]	22-1/4	[564]				

ASSY® VG Cyl

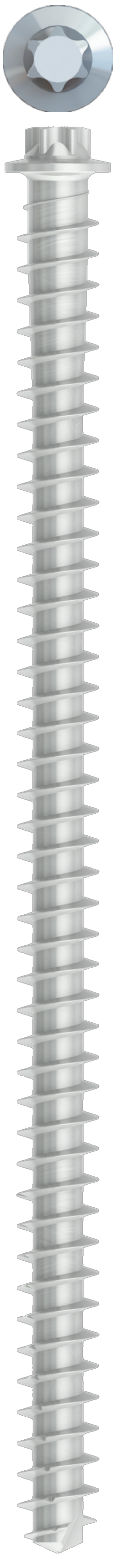




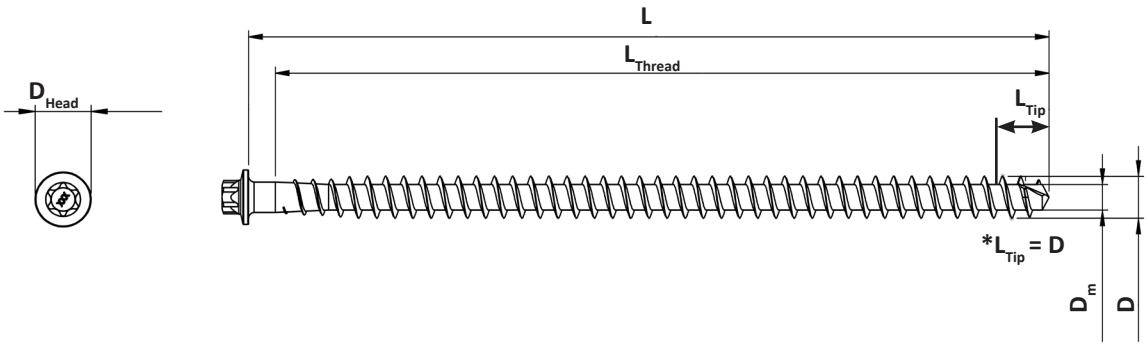
- Cylinder Head
- Self-tapping
- Fully Threaded
- Diameter: 1/4”, 5/16”, 3/8”
- Wood/Wood, Wood/Concrete, Wood Reinforcement
- Code Approved: ICC, CCMC & LARR

Item#	Box size	D	L		L_{Thread}		D_{Head}	D_m	L_{Head}	Bit
#	pieces	in. [mm]	in.	[mm]	in.	[mm]	in. [mm]	in. [mm]	in. [mm]	
15100120000	50	3/8 [10]	4-3/4	[120]	4-1/8	[105]	0.528 [13.4]	0.244 [6.2]	0.314 [8]	AW 50
15100140000	50		5-1/2	[140]	4-7/8	[125]				
15100160000	50		6-1/4	[160]	5-3/4	[145]				
15100180000	50		7-1/8	[180]	6-1/2	[165]				
15100200000	50		7-7/8	[200]	7-1/4	[185]				
15100220000	50		8-5/8	[220]	8-1/8	[205]				
15100240000	50		9-1/2	[240]	8-7/8	[225]				
15100260000	50		10-1/4	[260]	9-5/8	[245]				
15100280000	50		11	[280]	10-3/8	[265]				
15100300000	50		11-7/8	[300]	11-1/4	[285]				
15100320000	50		12-5/8	[320]	12	[305]				
15100340000	50		13-3/8	[340]	12-3/4	[325]				
15100360000	50		14-1/4	[360]	13-5/8	[345]				
15100380000	50		15	[380]	14-3/8	[365]				
15100400000	50		15-3/4	[400]	15-1/8	[385]				
15100430000	25		17	[430]	16-3/8	[415]				
15100480000	25		19	[480]	18	[456]				
15100530000	25		20-7/8	[530]	19-7/8	[506]				
15100580000	25		22-7/8	[580]	21-7/8	[556]				
15100650000	25		25-5/8	[650]	24-5/8	[626]				
15100700000	25		27-5/8	[700]	26-5/8	[676]				
15100750000	25		29-1/2	[750]	28-5/8	[726]				
15100800000	25		31-1/2	[800]	30-1/2	[776]				

ASSY® VG RH



The ASSY® VG RH (Reverse Head) is the longest fully threaded wood screw in the world. Similar to the VG CYL, its head is engineered to the smallest diameter possible, maintaining a clean look on large-scale reinforcing projects, wood-to-wood and steel-to-wood connections. The fastener is driven with a specialty socket drive that safely secures the bit to the screw head and avoids stripping bits.



Item#	Box size	D	L		L_{Thread}		D_{Head}	D_m	Bit
#	pieces	in. [mm]	in.	[mm]	in.	[mm]	in. [mm]	in. [mm]	
35140800000	15	9/16 [14]	31-1/2	[800]	30-3/4	[780]	0.709 [18]	0.335 [8.5]	Star drive socket
35140850000	15		33-1/2	[850]	32-5/8	[830]			
15140900000	15		35-3/8	[900]	34-5/8	[880]			
15140950000	15		37-3/8	[950]	36-5/8	[930]			
15141000000	15		39-3/8	[1000]	38-5/8	[980]			
35141050000	15		41-3/8	[1050]	40-1/2	[1030]			
15141100000	15		43-1/4	[1100]	42-1/2	[1080]			
35141200000	15		47-1/4	[1200]	46-1/2	[1180]			
35141300000	15		51-1/8	[1300]	50-3/8	[1280]			
15141400000	15		55-1/8	[1400]	54-3/8	[1380]			
15141500000	15		59	[1500]	58-1/4	[1480]			

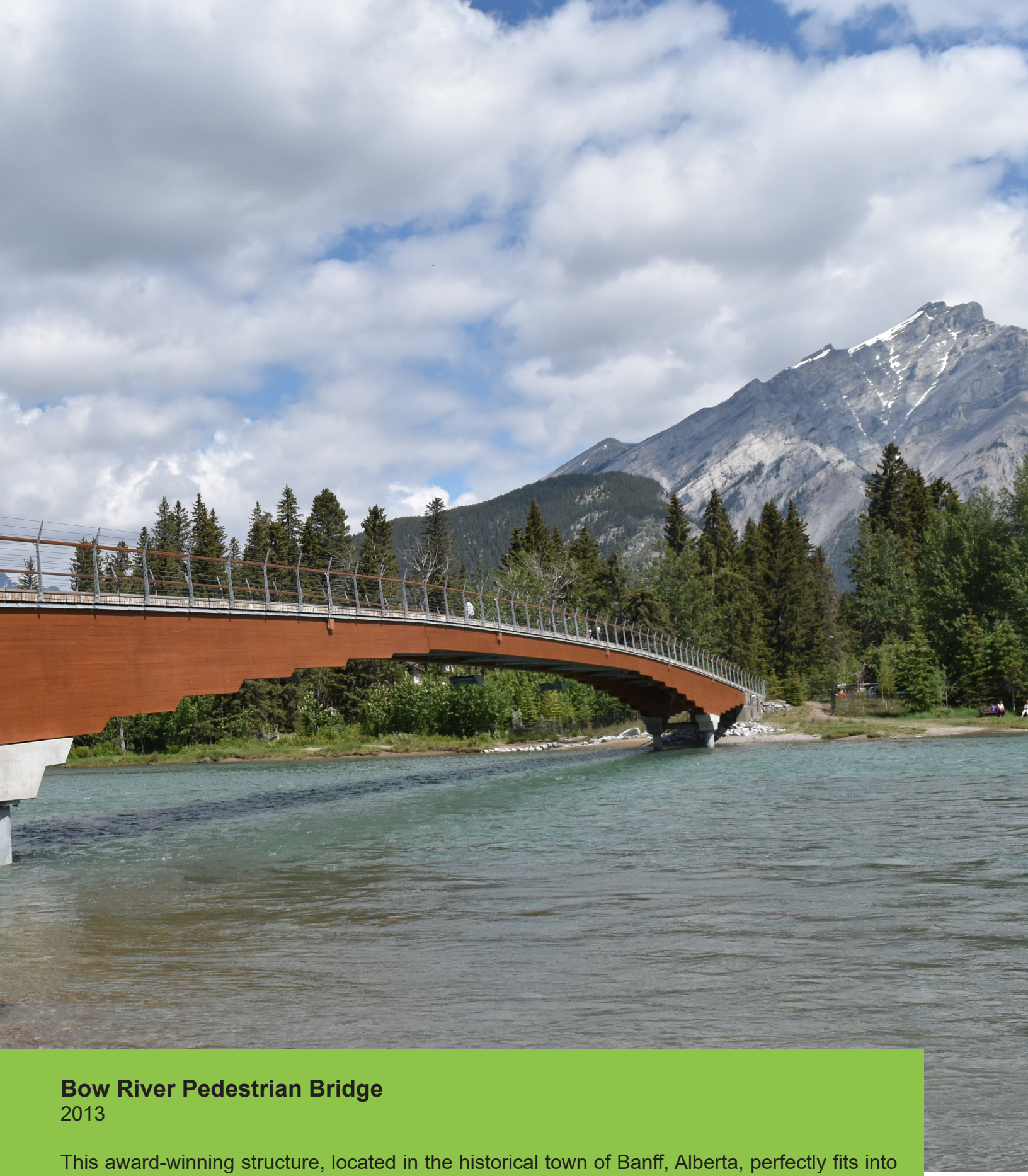
Did you know?

VG is short for “Vollgewinde”, a German word that means fully threaded. Or, if you dare, you can say “Selbstbohrende Vollgewindeschraube”, the translation for self-tapping fully threaded wood screw.

Harry Rowlinson Community Natatorium
Renovated in 2013

The community center located in Plano, Texas, has a 25 m. indoor swimming pool facility, which had to go under renovation in 2013. The glulam roof structure was reinforced through a framing repair project, extending the lifespan of the structure.

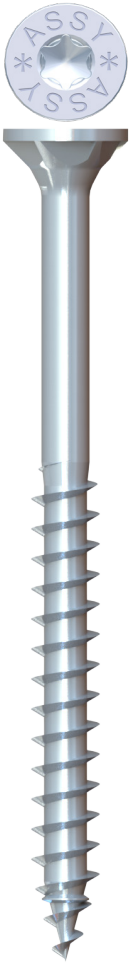
Picture provided by Conley Group, US and International



Bow River Pedestrian Bridge
2013

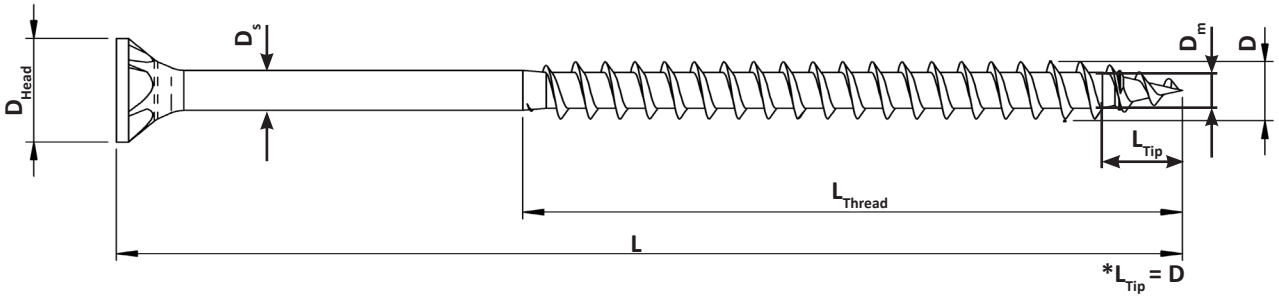
This award-winning structure, located in the historical town of Banff, Alberta, perfectly fits into the postcard scenery of the nearby Rocky Mountains. The 370 ft (113m) structure achieves an incredible clear span of 262 ft (80m) over the magnificent Bow River using twinned sets of glulam girders which range in depth from 8.5 ft (2.6m) at the piers to 3 ft (0.9m) at centre span.

ASSY A2® Ecofast



The ASSY A2® Stainless Steel Ecofast is a structural, corrosion resistant, self-tapping screw. The ring-thread tip reduces wood splitting and promotes precise setting. The countersunk head with milling pockets is engineered for a clean, flush architectural finish.

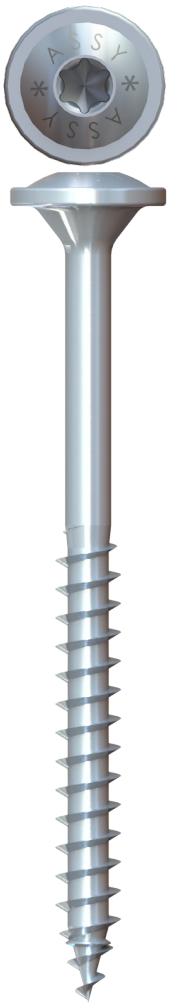
Applications include outdoor fencing, rails, solar panels, cladding, fascia board, strapping and decking.



Item#	Box size	D	L		L_{Thread}		D_{Head}	D_m	D_s	Bit
#	pieces	in. [mm]	in.	[mm]	in.	[mm]	in. [mm]	in. [mm]	in. [mm]	
21060060000	200	1/4 [6]	2-3/8	[60]	1-1/2	[37]	0.472 [12]	0.157 [3.9]	0.173 [4.4]	AW 30
21060080000	100		3-1/8	[80]	2	[50]				
21060100000	100		4	[100]	2-3/8	[60]				
21060120000	100		4-3/4	[120]	2-3/4	[70]				
21060140000	100		5-1/2	[140]	2-3/4	[70]				

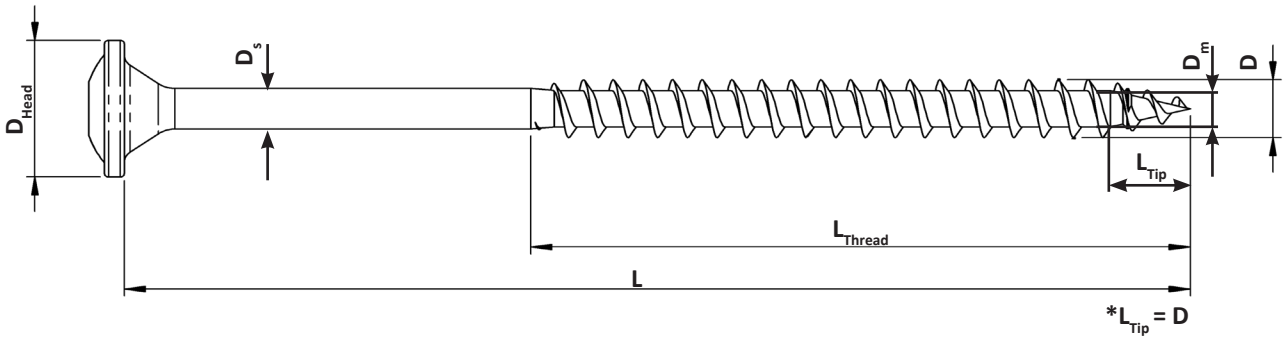
Item#	Box size	D	L		L_{Thread}		D_{Head}	D_m	D_s	Bit
#	pieces	in. [mm]	in.	[mm]	in.	[mm]	in. [mm]	in. [mm]	in. [mm]	
21080080000	75	5/16 [8]	3-1/8	[80]	2	[50]	0.591 [15]	0.197 [5]	0.234 [5.95]	AW 40
21080100000	75		4	[100]	2-3/8	[60]				
21080120000	75		4-3/4	[120]	3-1/8	[80]				
21080140000	75		5-1/2	[140]	3-1/8	[80]				
21080160000	75		6-1/4	[160]	3-1/8	[80]				
21080180000	75		7-1/8	[180]	3-1/8	[80]				
21080200000	75		7-7/8	[200]	3-1/8	[80]				
21080220000	75		8-5/8	[220]	4	[100]				
21080240000	75		9-1/2	[240]	4	[100]				
21080260000	75		10-1/4	[260]	4	[100]				
21080280000	75		11	[280]	4	[100]				
21080300000	75		11-7/8	[300]	4	[100]				

ASSY A2® SK



The ASSY A2® Stainless Steel SK is a structural, corrosion resistant, self-tapping screw. The ring thread tip reduces wood splitting and promotes precise setting. The large washer head provides high pulling power and head pull-in resistance.

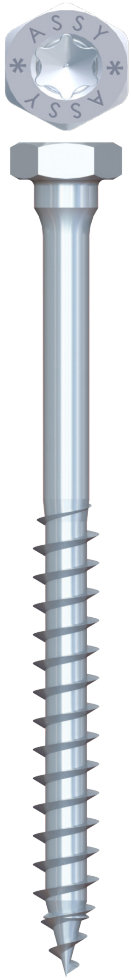
Applications include exposed timber frame structures, carpentry and boardwalks.



Item#	Box size	D	L		L_{Thread}		D_{Head}	D_m	D_s	Bit
#	pieces	in. [mm]	in.	[mm]	in.	[mm]	in. [mm]	in. [mm]	in. [mm]	
22060080000	100	1/4 [6]	3-1/8	[80]	2	[50]	0.551 [14]	0.157 [3.9]	0.173 [4.4]	AW 30
22060090000	100		3-1/2	[90]	2	[50]				
22060100000	100		4	[100]	2-3/8	[60]				
22060120000	100		4-3/4	[120]	2-3/4	[70]				
22060140000	100		5-1/2	[140]	2-3/4	[70]				

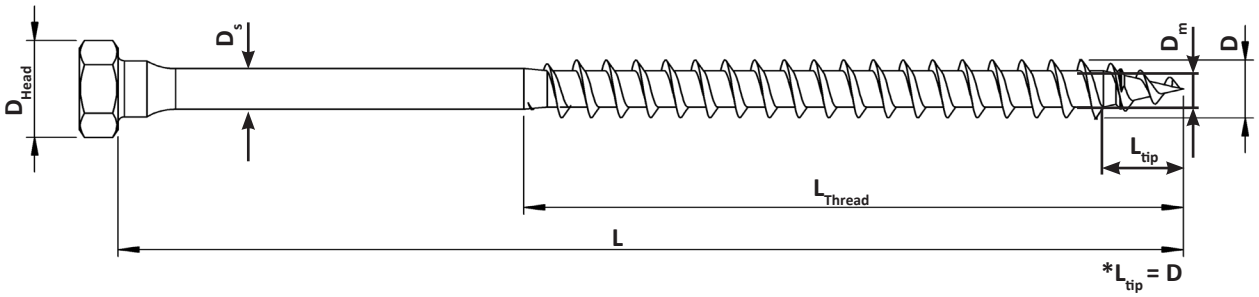
Item#	Box size	D	L		L_{Thread}		D_{Head}	D_m	D_s	Bit
#	pieces	in. [mm]	in.	[mm]	in.	[mm]	in. [mm]	in. [mm]	in. [mm]	
22080080000	50	5/16 [8]	3-1/8	[80]	2	[50]	0.744 [18.9]	0.197 [5]	0.234 [5.95]	AW 40
22080100000	50		4	[100]	2-3/8	[60]				
22080120000	50		4-3/4	[120]	3-1/8	[80]				
22080140000	50		5-1/2	[140]	3-1/8	[80]				
22080160000	50		6-1/4	[160]	3-1/8	[80]				
22080180000	50		7-1/8	[180]	3-1/8	[80]				
22080200000	50		7-7/8	[200]	3-1/8	[80]				
22080220000	50		8-5/8	[220]	3-1/8	[80]				
22080260000	50		10-1/4	[260]	4	[100]				
22080300000	50		11-7/8	[300]	4	[100]				
22080360000	50		14-1/4	[360]	4	[100]				

ASSY A2® Kombi



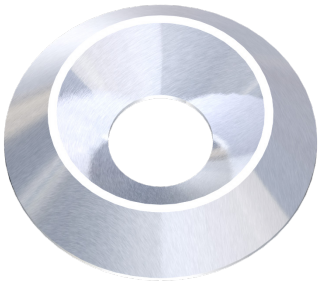
The ASSY A2® Stainless Steel Kombi is a multipurpose structural, corrosion resistant, self-tapping screw. Its head is engineered for installation by a socket or a bit.

Applications include exposed steel-to-wood connections, timber framing and log work.



Item#	Box size	D	L		L_{Thread}		D_{Head}	D_m	D_s	Bit
#	pieces	in. [mm]	in.	[mm]	in.	[mm]	in. [mm]	in. [mm]	in. [mm]	
23080080000	75	5/16 [8]	3-1/8	[80]	2	[50]	0.472 [12]	0.197 [5]	0.234 [5.95]	AW 40 or 1/2" socket
23080100000	75		4	[100]	2-3/8	[60]				
23080120000	75		4-3/4	[120]	3-1/8	[80]				
23080140000	75		5-1/2	[140]	3-1/8	[80]				
23080160000	75		6-1/4	[160]	3-1/8	[80]				
23080180000	75		7-1/8	[180]	3-1/8	[80]				
23080200000	75		7-7/8	[200]	3-1/8	[80]				

Item#	Box size	D	L		L_{Thread}		D_{Head}	D_m	D_s	Bit
#	pieces	in. [mm]	in.	[mm]	in.	[mm]	in. [mm]	in. [mm]	in. [mm]	
23100100000	50	3/8 [10]	4	[100]	2 3/8	[60]	0.591 [15]	0.236 [6]	0.283 [7.2]	AW 40 or 19/32" socket
23100120000	50		4-3/4	[120]	3-1/8	[80]				
23100140000	50		5-1/2	[140]	3-1/8	[80]				
23100160000	50		6-1/4	[160]	3-1/8	[80]				
23100180000	50		7-1/8	[180]	3-1/8	[80]				
23100200000	50		7-7/8	[200]	3-1/8	[80]				



90° washer

The 90° cup washer is a machined steel part suitable for use with all ASSY® countersunk head screw types. The washer provides proper bearing for the screw head in steel-to-wood connections without the need to ream out the steel plate to receive the countersunk head.

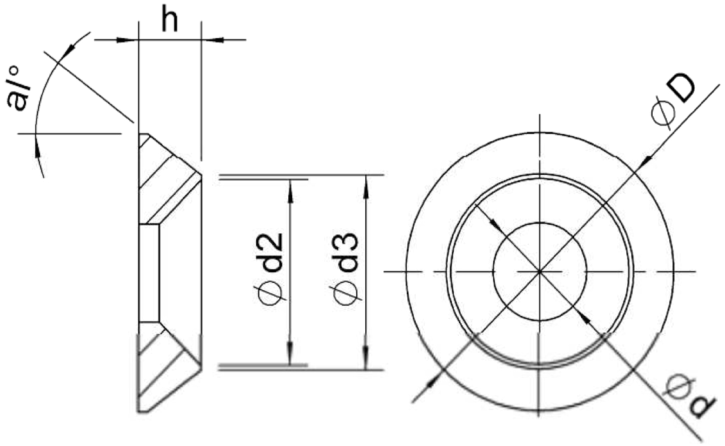


Table W.1.1, 1/4”, 5/16” and 3/8” Cup Washer

Screw Diameter	Ø d	Ø D	h	al	Ø d2	Ø d3
in. [mm]	**in.** [mm]	**in.** [mm]	**in.** [mm]	**degree**	**in.** [mm]	**in.** [mm]
1/4 [6]	**0.252** [6.4]	**0.866** [22]	**0.177** [4.5]	**[45°]**	**0.551** [14]	**0.591** [15]
5/16 [8]	**0.331** [8.4]	**0.984** [25]	**0.197** [5]	**[41°]**	**0.669** [17]	**0.709** [18]
3/8 [10]	**0.409** [10.4]	**1.181** [30]	**0.276** [7]	**[37°]**	**0.787** [20]	**0.827** [21]

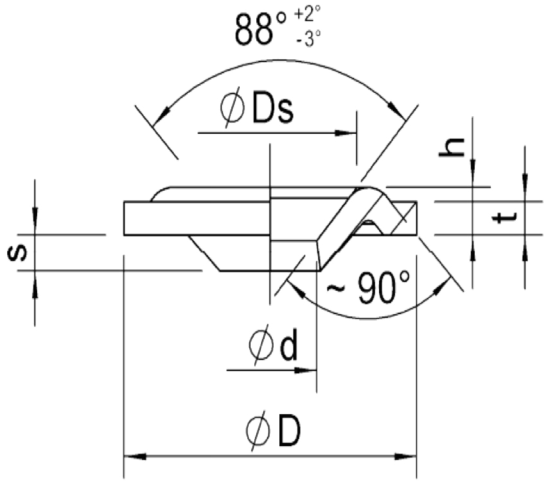
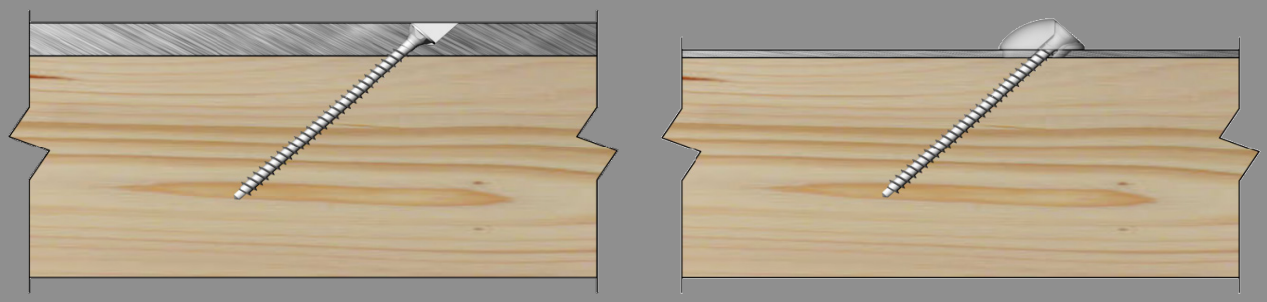


Table W.1.2, 1/2” Cup Washer

Screw Diameter	Ø d	Ø D	h	t	Ø Ds	s
in. [mm]	**in.** [mm]	**in.** [mm]	**in.** [mm]	**in.** [mm]	**in.** [mm]	**in.** [mm]
1/2 [12]	**0.492** [12.5]	**1.654** [42]	**0.197** [5.0]	**0.157** [4.0]	**0.906** [23]	**0.118** [3.0]

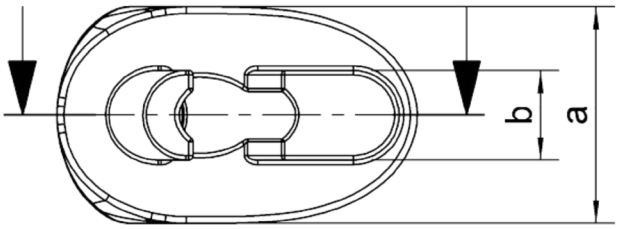


Did you know?

With the 45° washer you can significantly reduce the cost of steel plate machining. The washer only requires a milled slotted hole rather than a 45° machined hole. This significantly reduces the minimum thickness requirements for the screw head housing.

45° washer

The 45° cup washer is a cast-iron part suitable for use with all ASSY® Countersunk head screw types. Use of the washer eliminates the need for inclined pre-drilled countersunk holes in steel plates and thus offers cost reductions by using standard slotted holes. The possibility of setting a wood screw with its washer at a 45° angle enables engineers and designers to achieve high-performance connection systems.



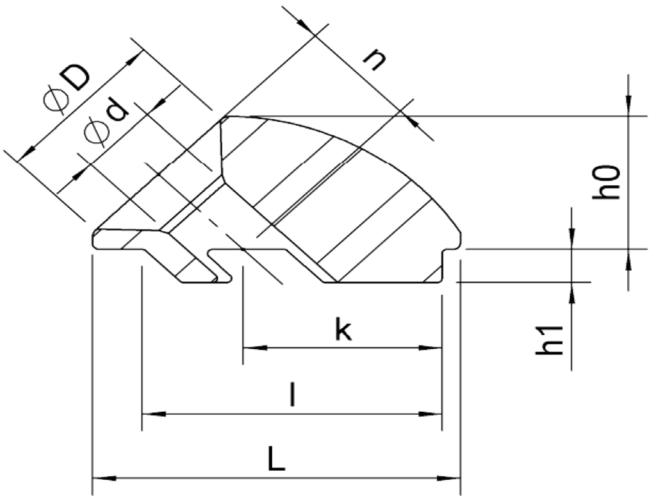
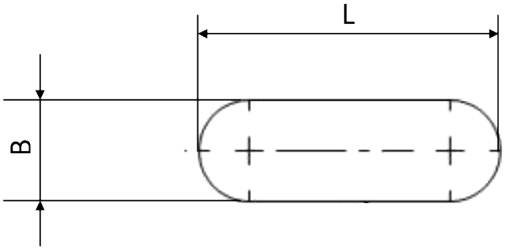


Table W.2.1, 45° Washer

Screw Diameter	Ø d	Ø D	L	a	h0	h1	b	l	k	n	Steel plate thickness min.	Steel plate thickness max.
in. [mm]	**in.** [mm]	**in.** [mm]	**in.** [mm]	**in.** [mm]	**in.** [mm]	**in.** [mm]	**in.** [mm]	**in.** [mm]	**in.** [mm]	**in.** [mm]	**in.** [mm]	**in.** [mm]
5/16 [8]	**0.335** [8.5]	**0.748** [19]	**1.535** [39]	**0.945** [24]	**0.630** [16]	**0.142** [3.6]	**0.390** [9.9]	**1.248** [31.7]	**0.827** [21]	**0.500** [12.7]	**0.157** [4]	**0.591** [15]
3/8 [10]	**0.421** [10.7]	**0.945** [24]	**2.047** [52]	**1.142** [29]	**0.843** [21.4]	**0.185** [4.7]	**0.425** [10.8]	**1.720** [43.7]	**1.130** [28.7]	**0.724** [18.4]	**0.197** [5]	**0.787** [20]
1/2 [12]	**0.500** [12.7]	**1.024** [26]	**2.323** [59]	**1.181** [30]	**0.925** [23.5]	**0.220** [5.6]	**0.504** [12.8]	**1.957** [49.7]	**1.339** [34]	**0.780** [19.8]	**0.236** [6]	**0.984** [25]

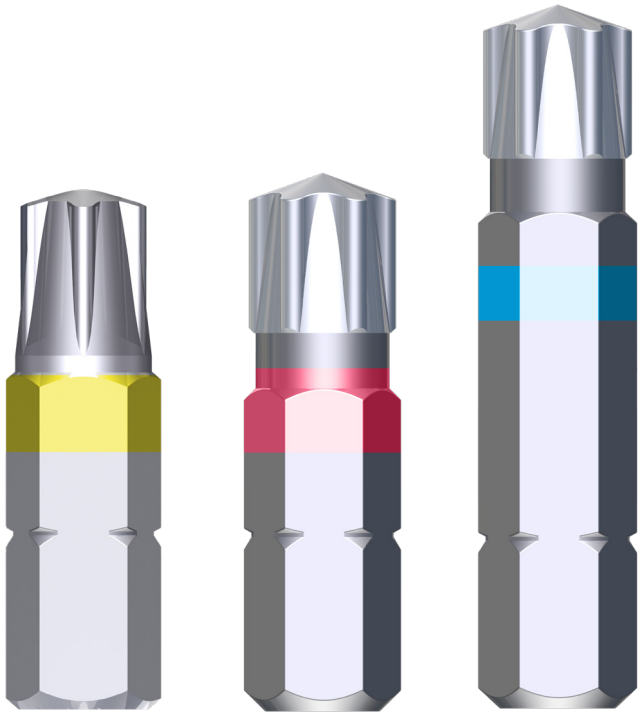
Table W.2.2, 45° Washer Steel Plate Hole

Screw Diameter	B min	B max	L min	L max
inch [mm]	**inch** [mm]			
5/16” [8]	**0.394** [10]	**0.433** [11]	**1.260** [32]	**1.299** [33]
3/8” [10]	**0.433** [11]	**0.472** [12]	**1.732** [44]	**1.772** [45]
1/2” [12]	**0.512** [13]	**0.551** [14]	**1.969** [50]	**2.008** [51]



Note: For coated steel plates the hole size needs to be oversized taking the thickness of the coating into account. Test fitting of wedge washers into steel plate holes is required to assure required tolerances are in place.

AW® Drive Bits



AW® 30 AW® 40 AW® 50

The AW® Bits are engineered and patented for proper installation of all ASSY® screws and offer exceptional fit and durability. They are available in three standard sizes.

The AW® Bit series is engineered for:

- Optimum torque transfer
- Snug fit
- Self centering
- Reduced wobbling

Our bits are hardened to assure long life with low-rpm, high-torque drills.

Drill recommendation

Use low rpm drill with high torque

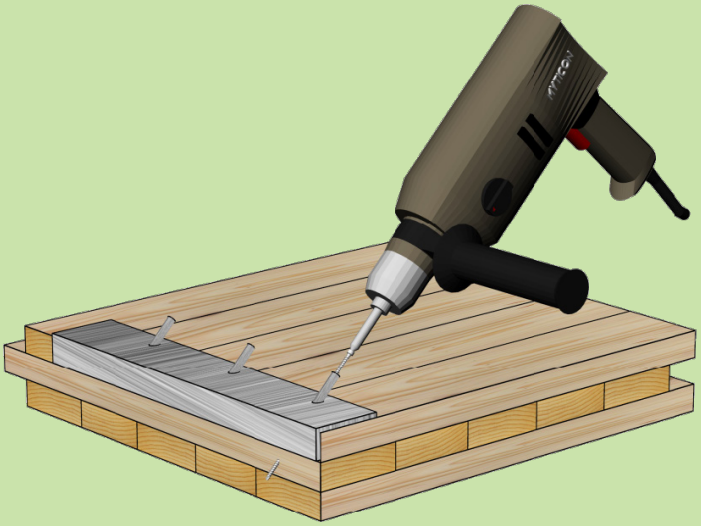
- ½" drill for 6mm and 8mm screws
- ¾" drill for 10mm and 12mm screws

Avoid use of impact drills, do not over-torque.

Use AW drive bits for all ASSY® screws.

During installation

- Do not stop drill during installation. ASSY® screws shall be installed without stopping in one run
- Use safety gear as required.
- Use drill with torque clutch when installing screws in steel-to-wood connections.



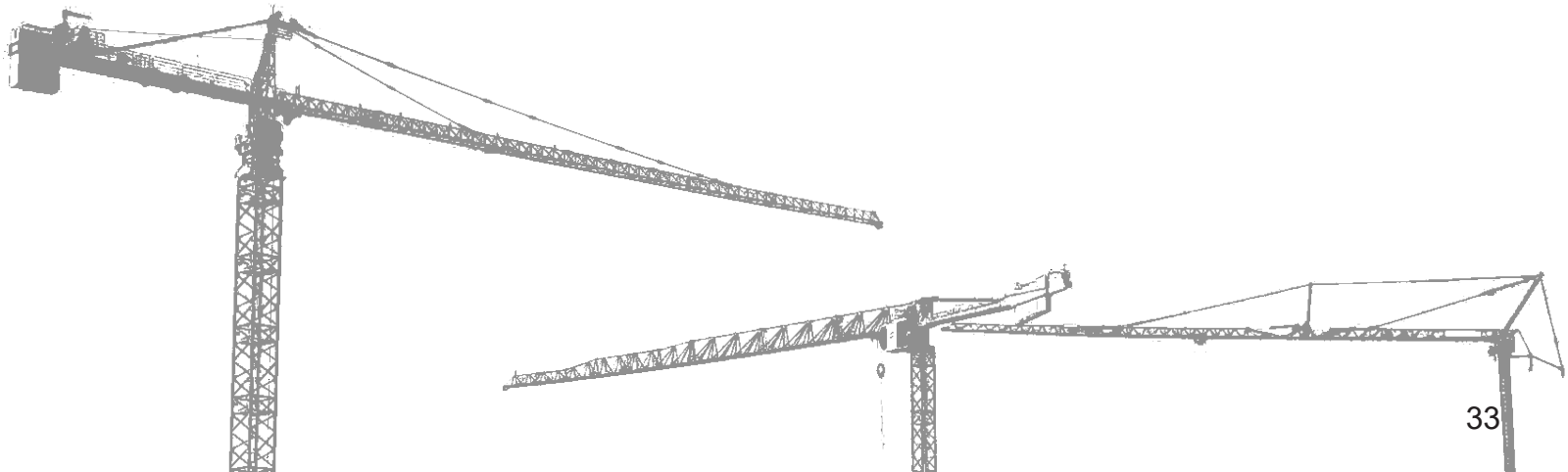
Material Handling

YOKE 1T

The Yoke 1T is a system designed and tested for the material- handling needs of mass timber projects. All Yoke 1T anchors are screwed onto panel materials such as CLT using ½" Kombi screws. Through a variety of screw lengths available, light- and medium-weight CLT panels of up to 7,000lbf can be lifted into place quickly and efficiently.

YOKE 5T

The Yoke 5T is a system designed and tested for the material- handling needs of mass timber projects. All Yoke 5T anchors are screwed onto panel materials such as CLT using ½" Kombi screws. Through a variety of screw lengths available, even the heaviest CLT panels of up to 20,000lbf can be lifted into place quickly and efficiently.



CARBON 12
2017

Carbon 12 is a cutting edge mass timber structure located in Portland, Oregon, providing 2,700 sq. ft. of commercial retail space and 21,000 sq. ft. of residential area. All major beam-to-column connections utilize modern, pre-engineered, concealed connection systems that achieve high load carrying capacity with ease of installation, all while maintaining a clean appearance with the exposed mass timber elements.

Carbon 12 project rendering provided by its creator, Scott Baumberger, of PATH Architecture, Inc.

NOTES TO THE DESIGNER

1. Basic factored lateral resistance values (N'_r) are based on CSA O86 2016, Chapter 12.6, CCMC-13677-R as well as boundary conditions outlined in the ETA-11/0190, unless noted otherwise. ASSY® screws may be used alone or with other timber connectors where approved by a qualified designer.

2. All suggestions and details shown are to be treated as general and can not be assumed to be valid for all construction requirements and specific site conditions.

3. For standard term loading, load duration factor K_D=1.0. For short term loading K_D=1.15 as per CSA O86 Clause 5.3.2.2. All factored lateral resistance values must be multiplied by all applicable modification factors in accordance with CSA O86 2016.

4. Carbon Steel ASSY® fasteners are intended to be used in untreated wood where service conditions are specified as "dry", such that K_{SF} =1.0, K_T = 1.0. Only Stainless Steel ASSY A2® fasteners can be used in wet service conditions or treated wood, in which case dimensional change of the wood must be taken into consideration in the design of the connection.

5. Some connection details shown may have the potential to exceed wood member limit states. The specifying designer must verify the capacity of all members of the connection accordingly.

6. In all connections where perpendicular to grain splitting or longitudinal to grain shear failure may occur, reinforcement shall be applied. Mechanical reinforcement may be provided with at least two fully threaded ASSY® VG screws driven in perpendicular or at an angle to the wood grain, unless the screw is embedded at least 20·d on either side of the assumed crack location. A detailed design is required.

7. Listed basic factored lateral resistance values (N'_r) apply to different timber species according to their respective mean relative densities (G). Resistances shown are derived on the assumption of permanently dry service conditions throughout the service life of the structural element (K_{SF} =1.0).

8. If splitting of the wood or wood-based material is observed during installation or prior to installation of the fastener, a design professional must be contacted immediately, and appropriate measures must be taken. In case of fastener damage or breakage, a design professional must also be notified.

9. Pre-drilling may be required in cases involving unusually dry wood, aged timbers, installation close to the edges of the wood members, or other special conditions. If pre-drilling is required, the hole diameter must not exceed the respective sizes specified for each fastener diameter in the instructions given in Table S.2.1.

10. A pilot hole may be used to facilitate the installation of long self-tapping fasteners for the sake of greater precision. A pilot hole may also be used when screws are installed near the edge of the wood member or in end grain. Pilot holes of at least 3" (76mm) in depth shall be provided in such cases.

11. A load bearing connection should always consist of at least two (2) ASSY® fasteners.

12. Minimum member thicknesses according to the nominal fastener diameter (d) are:
    - For lumber and timber members:
        For screws with d = 6 mm t = 24 mm
        For screws with d = 8 mm t = 30 mm
        For screws with d = 10 mm t = 40 mm
        For screws with d = 12 mm t = 80 mm

    - For structural wood based members such as Plywood or OSB:
        For screws with d = 6 mm t = 12.5 mm
        For screws with d = 8 mm t = 19 mm

    - For CLT, minimum member thickness shall be 8·d.

    * Exceptions apply for head pull-through resistances (see table F.R.2.4).

13. The embedment strength of the side member, f_1, or the main member, f_2, is calculated as follows:
    - Embedment strength for fasteners loaded parallel to the wood grain (θ = 0°) in the shear plane:
      $f_1, f_2 = 50 \cdot G \cdot (1 - 0.01 \cdot d_F) \cdot J_x$ [MPa]
    - Embedment strength for fasteners loaded perpendicular to the wood grain (θ = 90°) in the shear plane:
      $f_1, f_2 = 22 \cdot G \cdot (1 - 0.01 \cdot d_F)$ [MPa]
    - Embedment strength for fasteners driven in the panel edge of a CLT panel or end grain:
      $f_1, f_2 = 22 \cdot G \cdot (1 - 0.01 \cdot d_F)$ [MPa]
    - Embedment strength for steel side plates:
      $f_1 = K_{sp} \cdot (\phi_{steel} / \phi_{wood}) \cdot f_u$ [MPa]

14. The minimum thread penetration length for withdrawal design applications is 4·d, not including the tapered tip. The minimum embedment length for lateral design applications is 5·d, not including the tapered tip. To ensure full connection capacity, the fastener should penetrate plies of an engineered wood product to the largest extent possible.

15. Specified minimum tensile strength of steel, f_u, is given in the relevant standards. For the purpose of calculation in this design guide, a specified minimum tensile strength of f_u = 400 MPa is assumed.

16. ASSY® carbon steel screws and ASSY A2® stainless steel screws have different factored tensile resistances, shear resistances, and bending yield strengths (f_y). These different fastener strengths must be considered in the design, as they can influence lateral load carrying capacities (N_r) and withdrawal capacities (P_{rw}) of a fastener in a connection.

17. Factored lateral strength resistance calculation (N_r):

$$N_r = N'_r \cdot n_F \cdot n_R \cdot J' \cdot K'$$

N'_r Basic factored lateral resistance value given in the provided design tables or calculated according to CSA O86, including resistance factor, ϕ.

n_F Number of effective fasteners in a row, accounting for group effect:
- Inclined axially loaded screws: $n_F = \max \{n^{0.9}; 0.9 \cdot n\}$
- Laterally loaded screws: $n_F = n^{0.9}$
- For screws as compression reinforcement or inclined screws as fasteners in mechanically jointed beams or columns or for the fixing of thermal insulation material, $n_F = n$.

n Number of screws acting together in a row

n_R Number of rows in a connection

J' Composite modification factor for fastener installation; composed of: J_x ; J_E ; J_G ; J_{PL}

J_X Reduction factor for the use of CLT (Applied to embedment strengths only):
- for CLT $J_X = 0.9$
- In all other cases $J_X = 1.0$

J_E End grain factor:
- Application in end grain or panel edge of CLT (wood side member) $J_E = 0.67$
- Application in end grain or panel edge of CLT (steel side member) $J_E = 0.50$
- In all other cases $J_E = 1.00$

J_G may be ignored when calculating with n_F

J_{PL} may be ignored when minimum penetration lengths are considered

K' Composite modification factor for connections, composed of: K_D ; K_{SF} ; K_T

18. Factored withdrawal resistance calculation (P_{rw}):

$$P_{rw} = P'_{rw,90} \cdot R_{\alpha} \cdot L_{ef} \cdot n_F \cdot J' \cdot K'$$

$P'_{rw,90}$ Perpendicular to grain unit factored withdrawal resistance given in the provided design tables, including resistance factor, ϕ.

R_{α} Angle to grain reduction factor for withdrawal, given in FR.1.2

- Angle to grain (α) between 90° and 30°: Can be subjected to long term loading; $J_E = 1.0$
- Angle to grain (α) between 30° and 15°: Can be subjected to short term loading only; $J_E = 0.75$ or 0.67
- Angle to grain (α) between 15° and 0°: Should not be loaded

L_{ef} Effective length of embedment: $L_{ef} = L_{Thread} - L_{Tip}$

n_F Number of effective fasteners, accounting for group effect:

- Axially loaded screws: $n_F = n^{0.9}$
- For screws as compression reinforcement or inclined screws as fasteners in mechanically jointed beams or columns or for the fixing of thermal insulation material, $n_F = n$.

n Number of screws acting together in a connection

J' Composite modification factor for fastener installation; composed of: J_x ; J_E

J_X Reduction factor for the use of CLT:

- for CLT $J_X = 0.9$
- In all other cases $J_X = 1.0$

J_E End grain factor:

- Application in end grain $J_E = 0.75$
- Application in CLT panel edge $J_E = 0.67$
- In all other cases $J_E = 1.00$

K' Composite modification factor for connections, composed of: K_D ; K_{SF} ; K_T

Lateral Connection Design

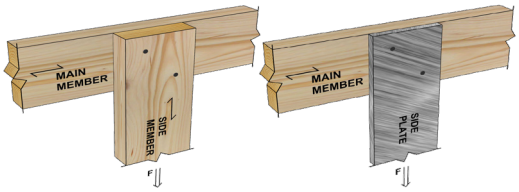
Factored lateral resistance values listed for Douglas Fir-Larch, Spruce/Pine/Fir, Western Cedar and Southern Pine refer to connections where main and side members are made from equivalent density species.

$N_{r,||}$ (θ = 0°)

Factored lateral strength resistance $N_{r,||}$: Loading main and side member parallel to grain. (CSA O86: P_r)

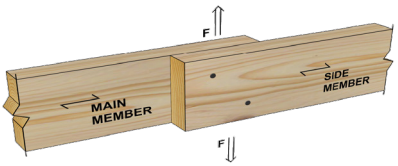
$N_{r,m\perp}$ (θ = 90°)

Factored lateral strength resistance $N_{r,m\perp}$: Loading main member perpendicular and side member parallel to grain. (CSA O86: Q_r)



$N_{r,\perp}$ (θ = 90°)

Factored lateral strength resistance $N_{r,\perp}$: Loading main and side member perpendicular to grain. (CSA O86: Q_r)



Assigned Relative Densities (G)

Western Cedar
G = 0.35

S-P-F
G = 0.42

Douglas Fir
G = 0.49

PSL
G = 0.50

Southern Pine
G = 0.55

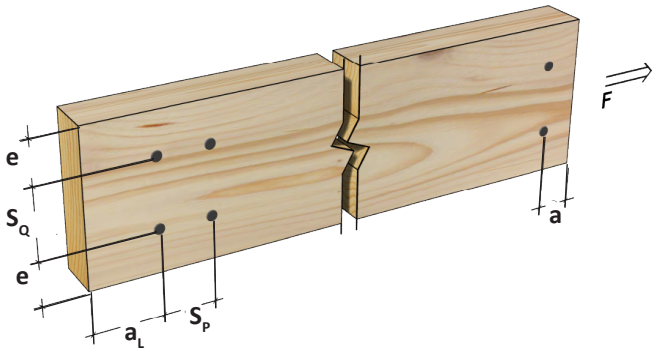
Note: As per CSA O86 2016, Table A.12.1. All connection design must meet all relevant requirements of the Notes to the Designer section.

SPACING AND EDGE DISTANCE REQUIREMENTS

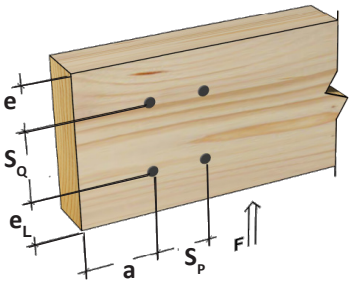
Fastener spacing, end and edge distance requirements ensure that stresses will be transmitted through the wood fiber to the fastener in a safe manner. Self-tapping screws displace wood fiber as the screw is driven into the member, while pre-drilling removes wood fiber. The spacing and edge distance requirements for self-tapping screws, therefore, are larger to prevent any splitting of the wood member. If pre-drilling is implemented, the spacing and edge distance requirements as per CSA O86 2016 may be used instead.

Timber Requirements for Non Pre-drilled Self-Tapping Fasteners

Lateral Loading Parallel to Grain:



Lateral Loading Perpendicular to Grain:



Axial Loading:

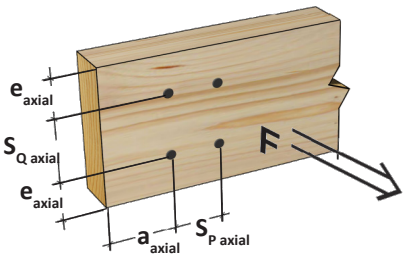


Table S.1.1, Timber Connection Geometry Requirements without Pre-drilling

		End Distance			Edge Distance			Spacing Parallel to Grain		Spacing Perpendicular to Grain	
		a_L	a	a_{axial}	e_L	e	e_{axial}	S_P	$S_{P\ axial}$	S_Q	$S_{Q\ axial}$
Partial Thread	SG ≤ 0.42	15 d	10 d	10 d	10 d	5 d	5 d	12 d	12 d	5 d	5 d
	0.42 < SG ≤ 0.55	20 d	15 d	15 d	12 d	7 d	7 d	15 d	15 d	7 d	7 d
	D-Fir	30 d	22.5 d	22.5 d	12 d	7 d	7 d	22.5 d	22.5 d	7 d	7 d
Full Thread	SG ≤ 0.42	12 d	7 d	5 d	7 d	3 d	3 d	5 d	5 d	3 d	2.5 d
	0.42 < SG ≤ 0.55	12 d	7 d	5 d	7 d	3 d	3 d	5 d	5 d	3 d	2.5 d
	D-Fir	18 d	10.5 d	7.5 d	7 d	3 d	3 d	7.5 d	7.5 d	3 d	2.5 d

Notes:
1. In accordance with CCMC 13677-R.
2. Tabulated values above are intended to prevent splitting in wood. If splitting be observed, a design professional must be consulted immediately.
3. Within a row, fasteners may be staggered up to 2·d to further reduce the potential for splitting, with d = major diameter of the fastener.
4. All connection design must meet all the relevant requirements of the Notes to the Designer section.

CLT Requirements for Non Pre-drilled Self-Tapping Fasteners

Fasteners in Panel Face **Fasteners in Panel Edge**

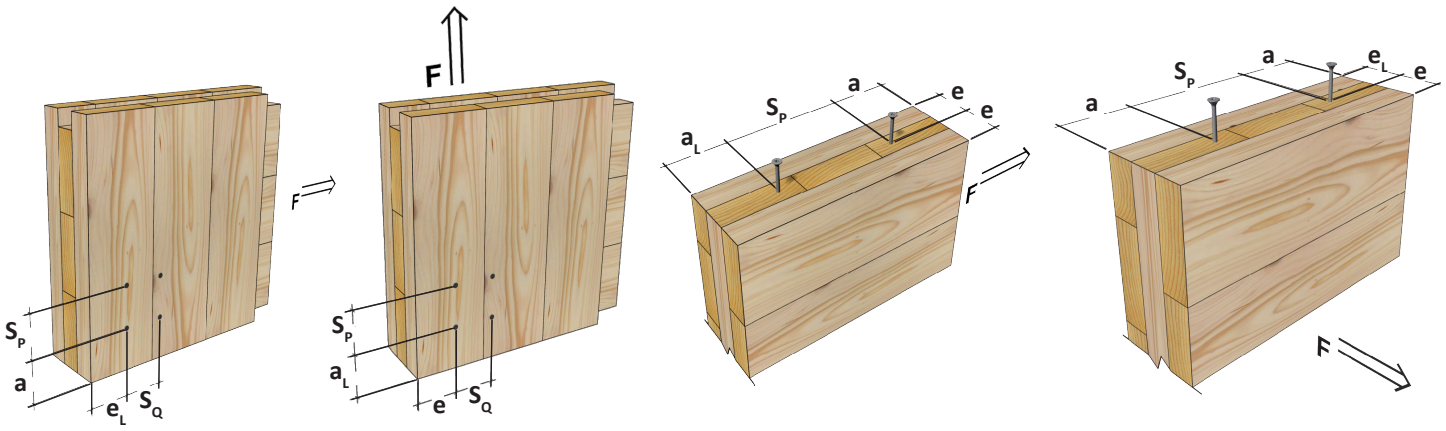
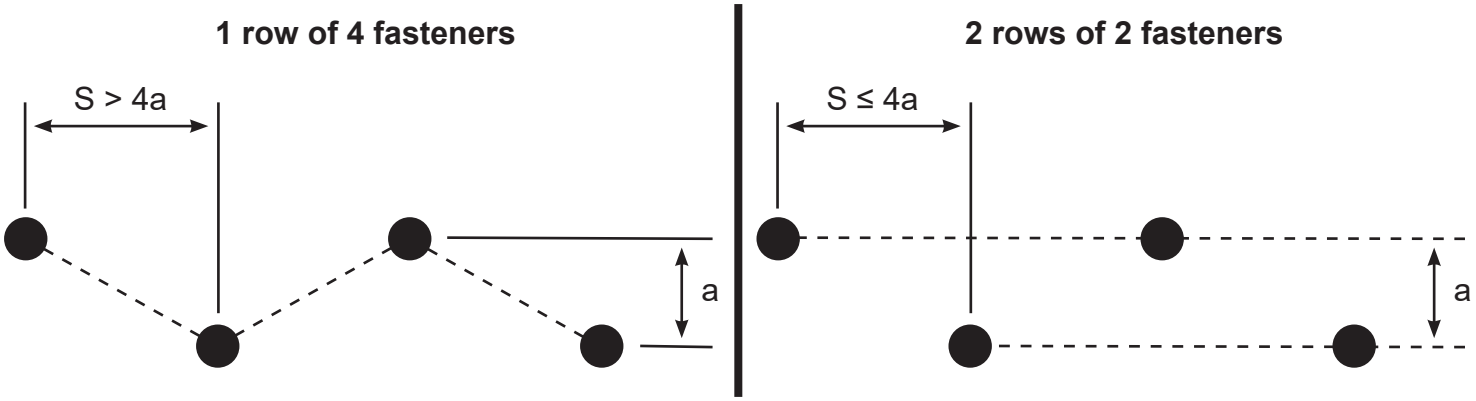


Table S.1.2, CLT Connection Geometry Requirements without Pre-drilling

CLT Plane	End Distance		Edge Distance		Spacing Parallel to Grain	Spacing Perpendicular to Grain
	a_L	a	e_L	e	S_P	S_Q
Fastener in Panel Face	6 d	6 d	6 d	2.5 d	4 d	2.5 d
Fastener in Panel Edge	12 d	7 d	6 d	3 d	10 d	4 d

Notes:
1. Spacing, end and edge distance requirements in the above tables were derived according to the methods described in the European Technical Approval ETA-11/0190 for self-tapping wood screws.
2. The listed values are applicable when the CLT panel thickness is at least 10·d.
3. The minimum penetration depth of the screw into the panel edge of CLT is at least 10·d, with d = major diameter of the fastener.
4. Connection design must meet all relevant requirements of the Notes to the Designer section.

Group Action for Staggered Fasteners

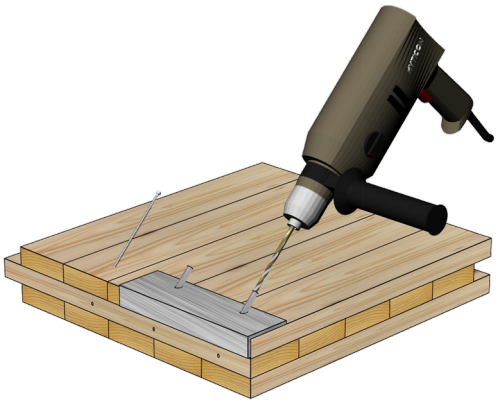


Note: In accordance with 12.2.2.3.3 CSA O86 2016.

Pre-drilling Recommendations

Table S.2.1, Pre-drilling hole diameter

Major Diameter (d)	Softwood	Hardwood	Steel Plate
in. [mm]	in. [mm]	in. [mm]	in. [mm]
1/4" [6]	5/32" [4]	5/32" [4]	9/32" [7]
5/16" [8]	3/16" [5]	15/64" [6]	23/64" [9]
3/8" [10]	15/64" [6]	17/64" [7]	7/16" [11]
1/2" [12]	17/64" [7]	5/16" [8]	33/64" [13]



Notes:
1. Consult a qualified design professional before pre-drilling.
2. Pre-drilled holes that exceed the diameters listed above may reduce the capacity of the screws.
3. Recommendations only applicable to SWG ASSY® screws.
4. Connection design must meet all the relevant requirements outlined in the Notes to the Designer section.

Pilot Hole Recommendations

Table S.2.2, ASSY® Pilot Hole Length Recommendation

ASSY Pilot Hole Length Recommendation

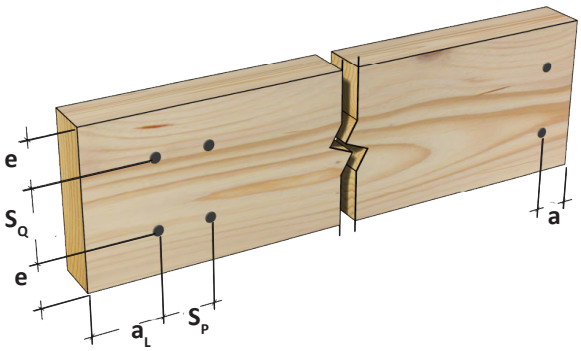
% of the fastener length

Wood Fiber Type	Fastener Type	Fastener Major Diameter							
		1/4" [6 mm]	5/16" [8 mm]			3/8" [10 mm]			1/2" [12 mm]
			Fastener Length			Fastener Length			Fastener Length
		N/A	≥ 13-3/8" [≥ 340 mm]	≥ 19" [≥ 480 mm]	≥ 20-1/2" [≥ 520 mm]	≥ 13-3/8" [≥ 340 mm]	≥ 19" [≥ 480 mm]	≥ 20-1/2" [≥ 520 mm]	≥ 15" [≥ 380 mm]
Low density species	Partially Threaded	-	-	-	-	-	-	-	-
	Fully Threaded	-	-	-	-	-	-	-	-
High density species	Partially Threaded	-	-	-	-	-	-	-	-
	Fully Threaded	-	-	15%	15%	-	15%	15%	25%
Old growth and aged wood	Partially Threaded	-	-	-	-	-	-	-	20%
	Fully Threaded	-	20%	25%	25%	20%	25%	25%	30%
Engineered wood product	Partially Threaded	-	-	-	50%	-	-	50%	50%
	Fully Threaded	-	25%	25%	50%	30%	30%	50%	50%

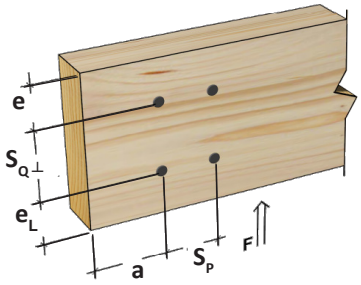
Notes:
1. Consult a qualified design professional before pre-drilling or drilling a pilot hole.
2. Other pilot hole requirements may apply depending on site conditions.
3. An oversized pilot hole may reduce the capacity of the screw.
4. Pilot hole recommendations only applicable to SWG ASSY fasteners.
5. All connection design must meet all the relevant requirements of the Notes to the Designer section.
6. Wood fiber type may be considered as:
   - Low density species: S-P-F, Western red cedar, nothern species, etc.
   - High density species: Hem-Fir, Douglas Fir, Black Spruce, etc.
   - Old growth and aged wood: Old growth, wood in existing structures, etc.
   - Engineered wood product: LVL, PSL, etc.

Timber Requirements with Pre-drilled Holes

Lateral loading parallel to grain



Lateral loading perpendicular to grain



Axial loading

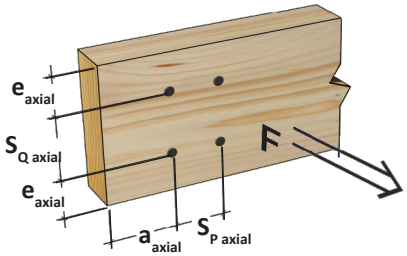


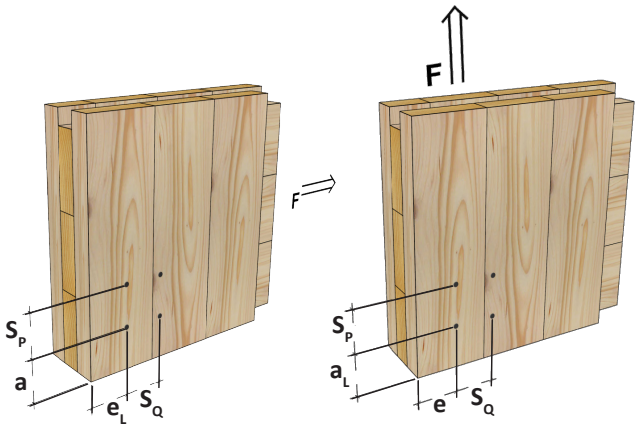
Table S.3.1, Timber Connection Geometry Requirements with Pre-drilled Holes

End Distance			Edge Distance			Spacing Parallel to Grain		Spacing Perpendicular to Grain	
a_L	a	a_{axial}	e_L	e	e_{axial}	S_P	$S_{P\ axial}$	S_Q	$S_{Q\ axial}$
max(7 d; 50mm)	max(4 d; 50mm)	max(4 d, 50mm)	4 d	3 d	3 d	4 d	4 d	3 d	3 d

Notes:
1. In accordance with CSA O86 2016.
2. Full penetration length must be pre-drilled with a hole diameter according to the pre-drilling recommendations.
3. All connection design must meet all relevant requirements of the Notes to the Designer section.

CLT Requirements with Pre-Drilled Holes

Fasteners in Panel Face



Fasteners in Panel Edge

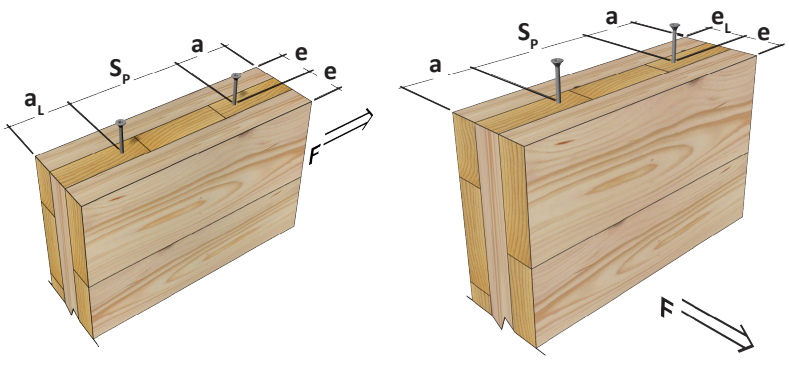
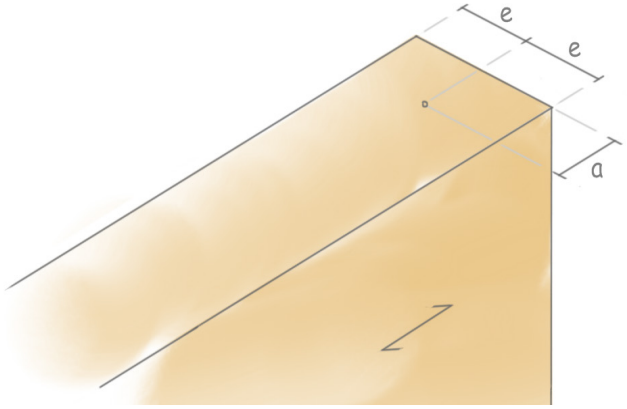


Table S.3.2, CLT Connection Geometry Requirements with Pre-drilled Holes

CLT Plane	End Distance		Edge Distance		Spacing Parallel to Grain	Spacing Perpendicular to Grain
	a_L	a	e_L	e	S_P	S_Q
Fastener in Plane Surface	max(5 d; 50mm)	max(4 d; 50mm)	4 d	3 d	3 d	3 d
Fastener in Narrow Edge	max(5 d; 50mm)	max(4 d; 50mm)	5 d	3 d	4 d	3 d

Notes:
1. In accordance with CSA O86 2016.
2. Full penetration length must be pre-drilled with a hole diameter according to the pre-drilling recommendations.
3. Connection design must meet all relevant requirements of the Notes to the Designer section.

Special Considerations for Spacing, End & Edge Distance Requirements

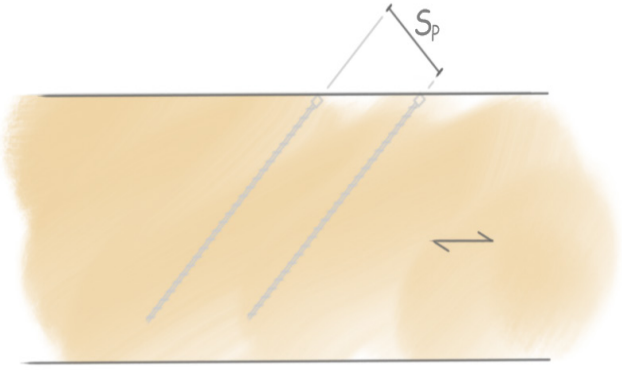


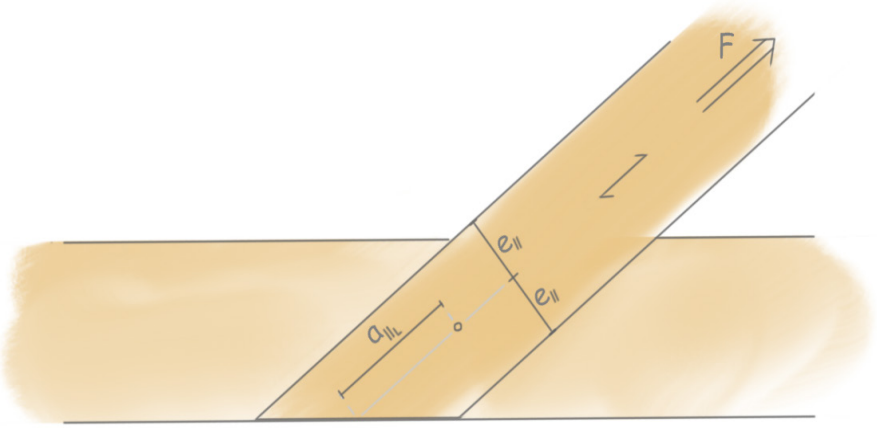
Screws in narrow edge of lumber

For connections in the narrow edge of regular “2x” lumber, screw selection is often limited by edge distance requirements. Fasteners with D > 6 mm cannot be installed without pre-drilling.

Spacing requirement for inclined screws

For fasteners installed at an angle, the distance prescribed by screw spacing requirements (S_P) refers to the distance between fasteners as measured perpendicular to the fastener axes.



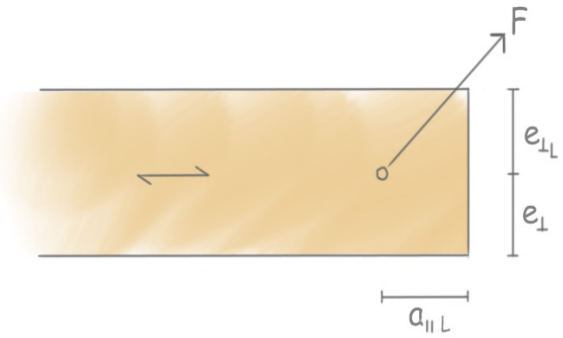


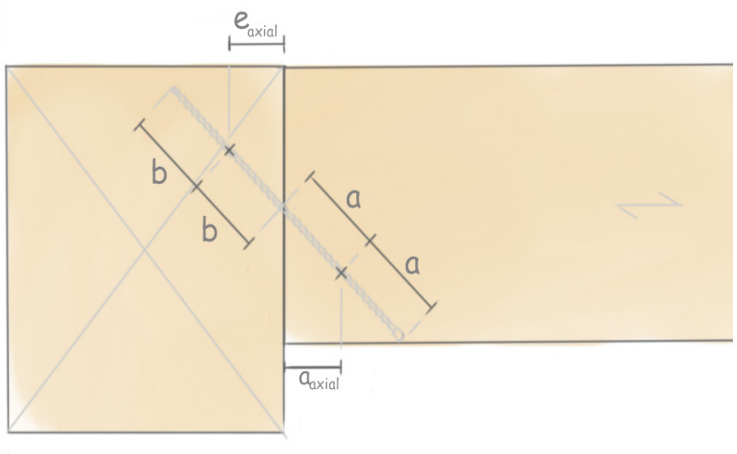
Wood members at an angle

Where fasteners are installed in members with miter cuts, the corresponding end and edge distances are measured along the grain, and across the grain, respectively

Forces at an angle

The direction of the fastener force must be considered when identifying loaded ends and loaded edges.



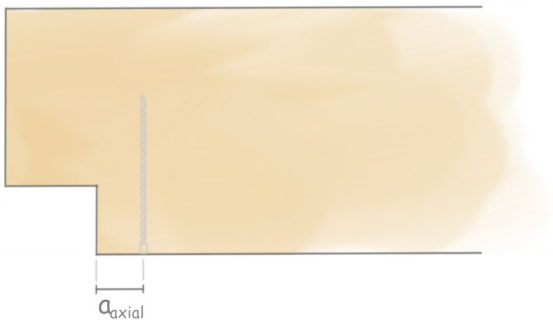


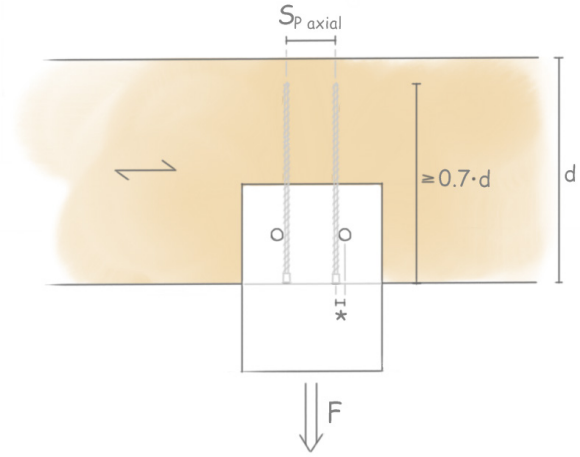
End and edge distance requirements for inclined screws

For toe screw or inclined screw connections, the center of gravity of the portion of the screw in each member is used when applying end and edge distance requirements.

End and edge distance requirements for reinforcing screws

Reinforcing screws should be placed as close to the expected force as possible. Minimum end and edge distances, however, still apply.



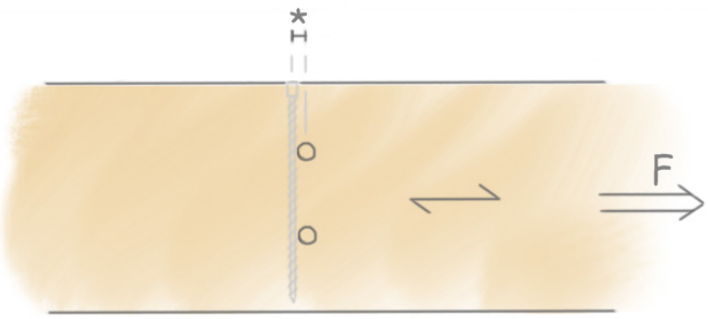


Spacing requirements for screws reinforcing bolt connections loaded perpendicular to grain

No minimum distance is required between the reinforcing screws and the bolts, as long as the screw and bolt axes are oriented perpendicular to one another. The spacing between the screws follows the usual spacing requirements for axially loaded fasteners.

Spacing requirements for screws reinforcing bolt connections loaded parallel to grain

No minimum distance is required between the reinforcing screws and the bolts, as long as the respective axes are oriented perpendicular to each other. Reinforcing screws must be placed on the same side of the bolt that bears against the wood member (as shown) to resist splitting along the grain.

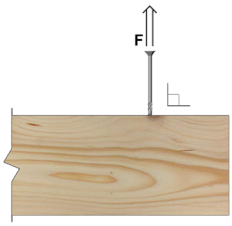


ASSY® FACTORED RESISTANCE AND STRENGTH

ASSY® Withdrawal Design (P_{rw})

Table FR.1.1, ASSY® Unit Factored Withdrawal Resistance with Angle to Grain of 90° ($P'_{rw, 90}$)

Major Diameter (d)		Unit Factored Withdrawal Resistance with Angle to Grain of 90° ($P'_{rw, 90}$) N/mm				
in.	[mm]	G = 0.35	G = 0.42	G = 0.49	PSL (G = 0.50)	G = 0.55
1/4"	[6]	32	46	60	35	76
5/16"	[8]	42	61	80	47	101
3/8"	[10]	53	76	100	59	126
1/2"	[12]	63	91	120	70	151
9/16"	[14]	74	107	140	82	176



Note: see notes under the table FR.1.2.

Table FR.1.2, ASSY® Angle to Grain Reduction Factor for Withdrawal at an angle of α° (R_α)

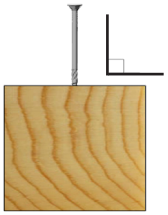
tens	ones									
	_9°	_8°	_7°	_6°	_5°	_4°	_3°	_2°	_1°	_0°
9_°	N/A									1.000
8_°	1.000	1.000	0.999	0.998	0.997	0.996	0.995	0.994	0.992	0.990
7_°	0.988	0.986	0.983	0.981	0.978	0.975	0.972	0.969	0.966	0.962
6_°	0.959	0.955	0.952	0.948	0.944	0.940	0.936	0.932	0.927	0.923
5_°	0.919	0.914	0.910	0.906	0.901	0.897	0.892	0.888	0.883	0.879
4_°	0.875	0.870	0.866	0.861	0.857	0.853	0.849	0.845	0.840	0.836
3_°	0.832	0.829	0.825	0.821	0.817	0.814	0.810	0.807	0.803	0.800

Notes:
1. Tabulated unit factored withdrawal resistance values ($P'_{rw, 90}$) apply to screws installed perpendicular to the grain of the wood member. For screws installed at an angle to the grain in the range between 90° and 30°, $P'_{rw, 90}$ shall be reduced by the appropriate angle to grain reduction factor (R_α) to obtain the applicable factored angle to grain withdrawal resistance value ($P_{rw, \alpha}$).
2. Values must be multiplied by all applicable modification factors, as specified for lag screws in accordance with CSA O86 2016. Values apply to dry service conditions only.
3. Values listed must be multiplied by the thread penetration length in the wood member.
4. A minimum thread penetration length of 4·d (d = major thread diameter) must be applied.
5. G refers to the relative density assigned to the wood species. ESG must be the equivalent relative density given in the CCMC evaluation report of PSL.
6. All connection design must meet all relevant requirements of the Notes to the Designer section.
7. The factored axial load for a single screw subject to tension shall not exceed the lesser of the factored withdrawal resistance, the factored head pull-through resistance, or the factored tensile resistance of the fastener specified in Table FR.3.1, as applicable to connection design.

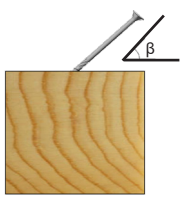
Fastener loaded in withdrawal: view from end grain

The angle α represents the relative angle between the fastener axis and the grain orientation, **not** necessarily the lowest angle (β) to the surface of the member.

Withdrawal angle to the grain is **90°**



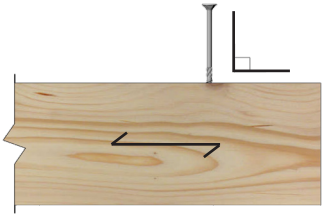
Withdrawal angle to the grain is **90°**



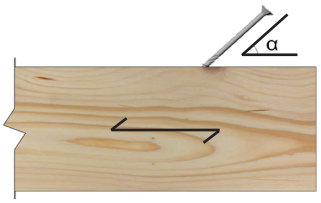
Fastener loaded in withdrawal: view from side grain

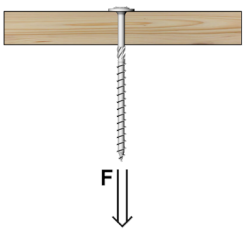
The angle α can easily be identified by establishing the intersection of the line along the fastener axis with the line along the grain orientation.

Withdrawal angle to the grain is **90°**



Withdrawal angle to the grain is **α°**





ASSY® Head Pull-Through Design (P_{pt})

Table FR.2.1, ASSY® Ecofast Factored Head Pull-Through Resistance (P'_{pt})

Major Diameter (d)		ASSY Ecofast Factored Head Pull-Through Resistance (P'_{pt}) kN				
in.	[mm]	G = 0.35	G = 0.42	G = 0.49	PSL (G = 0.50)	G = 0.55
1/4"	[6]	1.15	1.32	2.56	2.17	1.97
5/16"	[8]	1.50	2.15	2.69	3.36	3.33
3/8"	[10]	1.89	2.71	4.63	3.99	3.10

Note: see notes under the table FR.2.4.

Table FR.2.2, ASSY® SK Factored Head Pull-Through Resistance (P'_{pt})

Major Diameter (d)		ASSY SK Factored Head Pull-Through Resistance (P'_{pt}) kN				
in.	[mm]	G = 0.35	G = 0.42	G = 0.49	PSL (G = 0.50)	G = 0.55
1/4"	[6]	2.69	2.61	4.04	4.44	2.77
5/16"	[8]	2.88	5.25	6.86	6.78	4.59
3/8"	[10]	4.67	6.01	6.07	7.29	5.82
1/2"	[12]	4.77	6.42	8.14	10.00	5.90

Note: see notes under the table FR.2.4.

Table FR.2.3, ASSY® F.W.H. Factored Head Pull-Through Resistance (P'_{pt})

Major Diameter (d)		ASSY F.W.H. Factored Head Pull-Through Resistance (P'_{pt}) kN	
in.	[mm]	G = 0.42	G = 0.49
5/16"	[8]	3.48	4.29

Note: see notes under the table FR.2.4.

Table FR.2.4, ASSY® Kombi Factored Head Pull-Through Resistance (P'_{pt})

Major Diameter (d)		ASSY Kombi Factored Head Pull-Through Resistance (P'_{pt}) kN				
in.	[mm]	G = 0.35	G = 0.42	G = 0.49	PSL (G = 0.50)	G = 0.55
5/16"	[8]	1.31	1.74	2.62	2.95	2.28
3/8"	[10]	1.82	2.65	3.66	3.56	2.70
1/2"	[12]	2.33	2.81	3.66	4.40	3.66

Notes:
1. Tabulated factored head pull-through resistance values (P'_{PT}) must be multiplied by all applicable modification factors as specified for lag screws in CSA O86 2016. Design values apply to connections with minimum side member thickness (t_s). Design values apply to dry service conditions only.
2. G refers to the relative density assigned to the wood species. ESG must be the equivalent relative density given in the CCMC evaluation report of PSL.
3. The factored withdrawal resistance of ASSY VG screws in the side member can be considered in lieu of the factored head pull-through resistance if sufficient thread penetration length is achieved. Factored head pull-through resistances and factored withdrawal resistances in the side member must not be summed up for design purposes.
4. Minimum side member thickness required to assume tabulated resistance is 35 mm.
5. All connection design must meet all relevant requirements of the Notes to the Designer section.
6. The factored axial load for a single screw subject to tension shall not exceed the lesser of the factored withdrawal resistance, the factored head pull-through resistance, or the factored tensile resistance of the fastener specified in Table FR.3.1, as applicable to connection design.

Did you know?

Head pull-through resistances generally only applies to partially threaded screws. For fully threaded screws, the withdrawal resistance of the screw in the side member must be considered.

ASSY® Factored Tensile Strength

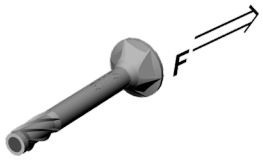


Table FR.3.1, ASSY® Factored Tensile Strength

Major Diameter (d)		ASSY Partial Thread	ASSY Full Thread (VG)
in.	[mm]	kN	kN
1/4”	[6]	9.04	9.04
5/16”	[8]	15.12	15.12
3/8”	[10]	19.20	19.20
1/2”	[12]	24.00	24.00
9/16”	[14]	N/A	37.00

Note: Connection design must meet all the relevant requirements outlined in the Notes to the Designer section.

ASSY® Shear Strength

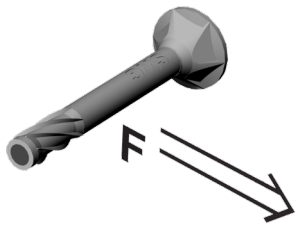


Table FR.3.2, ASSY® Shear Strength and Bending Yield Strength

Major Diameter (d)		ASSY Partial Thread		ASSY Full Thread (VG)	
		Unfactored Screw Shear Strength	Bending Yield Strength f_y	Unfactored Screw Shear Strength	Bending Yield Strength f_y
in.	[mm]	MPa	MPa	MPa	MPa
1/4”	[6]	578	969	578	969
5/16”	[8]	641	1,015	641	1,015
3/8”	[10]	691	942	691	942
1/2”	[12]	536	1,147	536	1,147

Note: Connection design must meet all the relevant requirements outlined in the Notes to the Designer section.

ASSY® Factored Torsional Strength

Table FR.3.3, ASSY® Factored Torsional Strength

Major Diameter (d)		ASSY Partial Thread	ASSY Full Thread (VG)
in.	[mm]	N · m	N · m
1/4”	[6]	7.27	7.27
5/16”	[8]	16.73	16.73
3/8”	[10]	32.73	32.73
1/2”	[12]	47.27	54.55
9/16”	[14]	N/A	83.64

Note: Connection design must meet all the relevant requirements of the Notes to the Designer section.

ASSY® Factored Lateral Resistances (N_r)

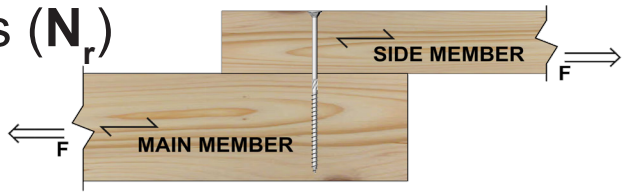


Table FR.4.1, Basic Factored Lateral Strength Resistance (N'_r) for Partially Threaded Fasteners with Wood Side Member

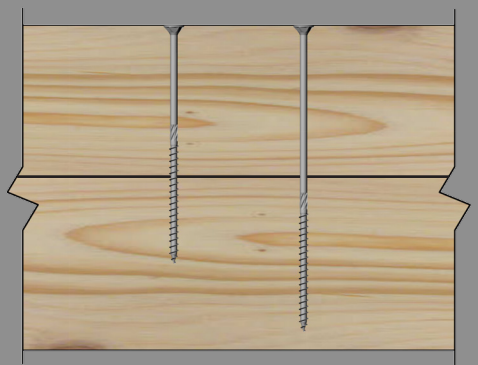
Fastener	Side Member Thickness	Minimum Fastener Penetration into Main Member	Basic Factored Lateral Strength Resistance (N'_r) for Mean Relative Density of: N											
			G=0.35			G=0.42			G=0.49			G=0.55		
mm	mm	mm	$N'_{r,II}$	$N'_{r,mH}$	$N'_{r,H}$	$N'_{r,II}$	$N'_{r,mH}$	$N'_{r,H}$	$N'_{r,II}$	$N'_{r,mH}$	$N'_{r,H}$	$N'_{r,II}$	$N'_{r,mH}$	$N'_{r,H}$
6 x 100	38	56	731	522	344	871	664	438	975	775	511	1,063	837	574
6 x 120	51	63	829	648	418	935	731	532	1,010	790	613	1,070	837	667
6 x 140	70	64	829	648	491	935	731	609	1,010	790	670	1,070	837	710
8 x 100	38	54	995	668	438	1,267	850	557	1,478	992	650	1,630	1,114	730
8 x 140	51	81	1,284	937	628	1,528	1,193	800	1,711	1,392	933	1,864	1,477	1,031
8 x 160	64	88	1,424	1,111	724	1,651	1,291	921	1,784	1,394	1,044	1,890	1,477	1,134
10 x 140	51	79	1,720	1,135	757	2,075	1,444	963	2,316	1,685	1,124	2,517	1,891	1,261
10 x 180	64	106	1,925	1,464	990	2,294	1,863	1,259	2,571	2,054	1,425	2,784	2,177	1,544
10 x 200	89	101	2,157	1,686	1,106	2,433	1,902	1,408	2,628	2,054	1,641	2,784	2,177	1,787
10 x 220	102	108	2,157	1,686	1,222	2,433	1,902	1,556	2,628	2,054	1,743	2,784	2,177	1,847
10 x 240	140	90	2,157	1,686	1,239	2,433	1,902	1,474	2,628	2,054	1,650	2,784	2,177	1,797
10 x 260	140	110	2,157	1,686	1,356	2,433	1,902	1,614	2,628	2,054	1,743	2,784	2,177	1,847
12 x 200	89	99	2,802	1,976	1,233	3,420	2,515	1,569	3,741	2,925	1,831	3,964	3,098	2,055
12 x 220	102	106	3,055	2,215	1,364	3,464	2,708	1,736	3,741	2,925	2,025	3,964	3,098	2,273
12 x 240	140	108	3,070	2,400	1,626	3,464	2,708	2,050	3,741	2,925	2,292	3,964	3,098	2,495

Note: see notes under the table FR.4.2.

Did you know?

Shear connections are commonly designed using partially threaded fasteners, as they allow the side member to be pulled tightly against the main member.

It is generally advisable to select the proper fastener size so that the threaded portion of the fastener is fully embedded into the main member, with the smooth shank portion intersecting the shear plane.



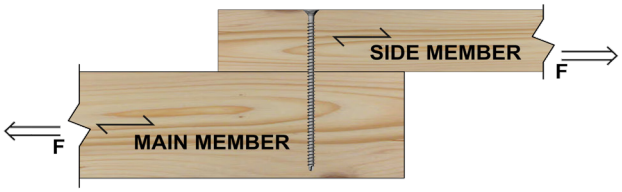
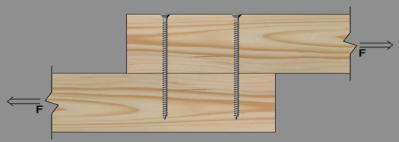


Table FR.4.2, Basic Factored Lateral Strength Resistance (N'_r) for Fully Threaded Fasteners with Wood Side Member

Fastener	Side Member Thickness	Minimum Fastener Penetration into Main Member	Basic Factored Lateral Strength Resistance N'_r for Mean Relative Density of:											
			N											
			G=0.35			G=0.42			G=0.49			G=0.55		
mm	mm	mm	$N'_{r,II}$	$N'_{r,m\perp}$	$N'_{r,\perp}$	$N'_{r,II}$	$N'_{r,m\perp}$	$N'_{r,\perp}$	$N'_{r,II}$	$N'_{r,m\perp}$	$N'_{r,\perp}$	$N'_{r,II}$	$N'_{r,m\perp}$	$N'_{r,\perp}$
6 x 100	38	56	585	453	299	700	547	381	756	591	430	801	626	467
6 x 120	51	63	620	485	363	700	547	439	756	591	492	801	626	531
6 x 140	70	64	620	485	410	700	547	464	756	591	501	801	626	531
8 x 120	38	74	904	664	463	1,071	845	590	1,196	985	675	1,301	1,102	730
8 x 140	51	81	1,026	815	546	1,227	963	677	1,331	1,041	755	1,410	1,102	819
8 x 160	64	88	1,092	854	627	1,232	963	746	1,331	1,041	835	1,410	1,102	909
10 x 140	51	79	1,391	988	659	1,654	1,257	838	1,852	1,466	978	2,017	1,623	1,098
10 x 180	64	106	1,541	1,257	858	1,814	1,418	1,014	1,959	1,532	1,131	2,076	1,623	1,229
10 x 200	89	101	1,608	1,257	963	1,814	1,418	1,176	1,959	1,532	1,300	2,076	1,623	1,377
10 x 220	102	108	1,608	1,257	1,050	1,814	1,418	1,203	1,959	1,532	1,300	2,076	1,623	1,377
10 x 240	140	90	1,608	1,257	989	1,814	1,418	1,182	1,959	1,532	1,300	2,076	1,623	1,377
10 x 260	140	110	1,608	1,257	1,067	1,814	1,418	1,203	1,959	1,532	1,300	2,076	1,623	1,377
12 x 200	89	99	2,315	1,731	1,080	2,612	2,042	1,375	2,821	2,206	1,604	2,989	2,337	1,801
12 x 220	102	106	2,315	1,810	1,195	2,612	2,042	1,521	2,821	2,206	1,775	2,989	2,337	1,968
12 x 240	140	88	2,307	1,810	1,274	2,612	2,042	1,510	2,821	2,206	1,687	2,989	2,337	1,834

Note:
1. Values are only applicable for ASSY® fasteners made from carbon steel. (Not applicable to stainless steel ASSY A2®)
2. Fiber orientation ($N'_{r,II}$, $N'_{r,m\perp}$ and $N'_{r,\perp}$) of the main member versus the side member is specified in the Lateral Connection Design section in the Notes to the Designer.
3. Values must be multiplied by all applicable modification factors, as specified for lag screws in accordance with CSA O86 2016. Values apply to dry service conditions only.
4. The fastener penetration lengths corresponding to a specified lateral capacity are a minimum. Tabulated values may be applied to longer fasteners with greater penetration lengths.
5. Minimum side member thicknesses are given in the Notes to the Designer section under point 12. Pre-drilling may be required to reduce splitting.
6. Basic factored lateral resistances listed for G = 0.35; 0.42; 0.49 and 0.55 refer to connections where main and side members are made from equivalent density species.
7. G refers to the relative density assigned to the wood species. ESG must be the equivalent relative density given in the CCMC evaluation report of PSL.
8. For connections with steel side plate(s), ASTM A36 steel is used to calculate tabulated design values. Round holes with a diameter 1 mm greater than the outer thread diameter of the screws must be milled in the steel plate.
9. Connection design must meet all relevant requirements of the Notes to the Designer section.

Did you know?



α = 90°

- Designed according to yield limit equations
- Lower ultimate capacity
- Capacity tends to decrease at predictable rates
- Ductile failure with large ultimate displacement

α = 45°

- Designed according to axial capacities
- Higher ultimate capacity
- Ultimate capacity limited by screw withdrawal, steel tensile fracture, or head pull-through
- Stiff connection with small ultimate displacement

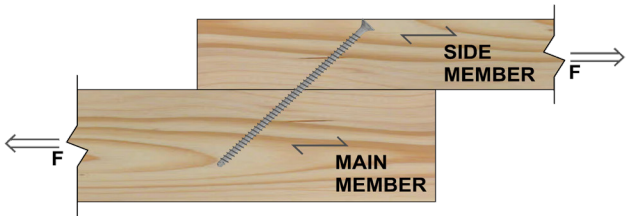


Table FR.4.3, Basic Factored Lateral Strength Resistance (N'_r) for Inclined Fully Threaded Fasteners with Wood Side Member

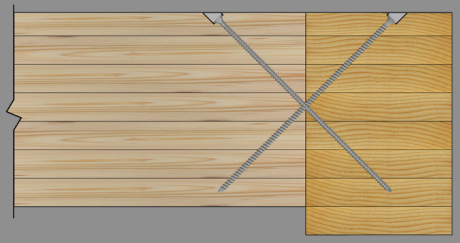
Fastener	Side Member Thickness	Minimum Main Member Thickness	Basic Factored Lateral Strength Resistance N'_r for Mean Relative Density of: N			
			G = 0.35	G = 0.42	G = 0.49	G = 0.55
mm	mm	mm	$N'_{r,II}$	$N'_{r,II}$	$N'_{r,II}$	$N'_{r,II}$
6 x 120	38	43	1,102	1,482	1,938	2,470
6 x 160	51	58	1,479	1,989	2,601	3,315
6 x 180	64	60	1,712	2,302	3,011	3,837
8 x 180	64	58	2,190	2,996	3,976	4,956
8 x 260	89	90	3,382	4,628	6,141	7,654
8 x 330	114	114	4,320	5,912	7,844	9,777
8 x 380	140	124	4,676	6,398	8,490	10,582
8 x 430	159	140	5,297	7,249	9,619	10,691*
10 x 260	89	88	4,213	5,705	7,549	9,480
10 x 300	102	104	4,896	6,630	8,772	11,016
10 x 400	140	136	6,517	8,825	11,676	13,576*
10 x 480	159	174	7,632	10,335	13,576*	13,576*
10 x 530	184	184	8,817	11,940	13,576*	13,576*
10 x 700	235	253	11,280	13,576*	13,576*	13,576*
12 x 380	140	121	6,972	9,377	12,382	15,628
12 x 480	159	172	9,222	12,402	16,377	16,971*
12 x 600	184	232	10,672	14,352	16,971*	16,971*
12 x 600	235	181	10,485	14,101	16,971*	16,971*

Note:
1. Tabulated values are only applicable for ASSY® VG fasteners made from carbon steel inclined at 45° relative to the shear plane.
2. Fiber orientation $N'_{r,II}$ specified in the Lateral Connection Design section in Notes to the Designer. Factored withdrawal resistance for loading at 45° relative to grain direction in both members is considered.
3. Values must be multiplied by all applicable modification factors, as specified for lag screws in accordance wih CSA O86 2016. Values apply to dry service conditions only.
4. The lower thread penetration length between the main member and the side member will govern the design value.
5. The penetration lengths shown per lateral capacity are a minimum. Tabulated values may be applied to longer fasteners with greater penetration lengths.
6. G refers to the relative density assigned to the wood species. ESG must be the equivalent relative density given in the CCMC evaluation report of PSL.
7. Connection design must meet all relevant requirements of the Notes to the Designer section.

* The upper limit of the factored withdrawal resistance of the fastener is set by the factored tensile resistance of the fastener. Therefore, the factored withdrawal resistance used for design purposes cannot exceed the factored tensile strength of the respective fastener.

Did you know?

Inclined fully threaded screws can be arranged as symmetrical screw crosses, engaging the withdrawal strength of both screws. For each screw cross, one screw carries the load in tension, while the other screw carries the load in compression. Both screws can be assumed to contribute equally to the connection strength.



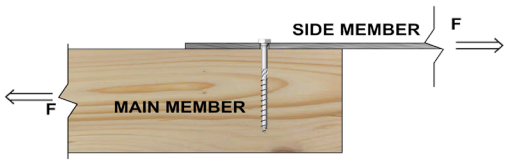


Table FR.4.4, Basic Factored Lateral Strength Resistance (N'_r) for Partially Threaded Fasteners with Steel Side Member

Fastener	Side Member Thickness		Minimum Fastener Penetration into Main Member	Basic Factored Lateral Strength Resistance (N'_r) for Mean Relative Density of: N					
				G = 0.35		G = 0.42		G = 0.49	
mm	in.	[mm]	mm	$N'_{r,II}$	$N'_{r,⊢}$	$N'_{r,II}$	$N'_{r,⊢}$	$N'_{r,II}$	$N'_{r,⊢}$
6 x 60	5/32"	[3.97]	50	1,167	776	1,315	875	1,418	945
6 x 60	1/4"	[6.35]	48	1,167	776	1,315	875	1,418	945
6 x 70	5/16"	[7.94]	56	1,167	776	1,315	875	1,418	945
6 x 70	3/8"	[9.53]	54	1,167	776	1,315	875	1,418	945
8 x 80	1/4"	[6.35]	66	2,060	1,370	2,321	1,545	2,504	1,668
8 x 80	1/2"	[12.70]	59	2,060	1,370	2,321	1,545	2,504	1,668
10 x 100	5/32"	[3.97]	86	3,036	2,019	3,420	2,276	3,691	2,458
10 x 100	1/2"	[12.70]	77	3,036	2,019	3,420	2,276	3,691	2,458
12 x 100	5/32"	[3.97]	84	4,321	2,755	4,869	3,241	5,254	3,499
12 x 100	1/4"	[6.35]	82	4,321	2,677	4,869	3,241	5,254	3,499
12 x 120	5/16"	[7.94]	100	4,321	2,874	4,869	3,241	5,254	3,499
12 x 120	1/2"	[12.70]	95	4,321	2,874	4,869	3,241	5,254	3,499

Note: see notes under the table FR.4.2.

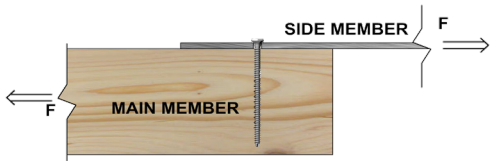


Table FR.4.5, Basic Factored Lateral Strength Resistance (N'_r) for Fully Threaded Fasteners with Steel Side Plate

Fastener	Side Member Thickness		Minimum Fastener Penetration into Main Member	Basic Factored Lateral Strength Resistance (N'_r) for Mean Relative Density of: N					
				G = 0.35		G = 0.42		G = 0.49	
mm	in.	[mm]	mm	$N'_{r,II}$	$N'_{r,⊢}$	$N'_{r,II}$	$N'_{r,⊢}$	$N'_{r,II}$	$N'_{r,⊢}$
8 x 80	5/32"	[3.97]	68	1,537	1,023	1,732	1,153	1,869	1,245
8 x 80	1/4"	[6.35]	66	1,537	1,023	1,732	1,153	1,869	1,245
10 x 100	5/32"	[3.97]	86	2,263	1,505	2,550	1,697	2,751	1,832
10 x 100	1/4"	[6.35]	84	2,263	1,505	2,550	1,697	2,751	1,832
10 x 100	5/16"	[7.94]	82	2,263	1,505	2,550	1,697	2,751	1,832
12 x 100	5/32"	[3.97]	84	3,259	2,168	3,672	2,444	3,962	2,639
12 x 100	1/4"	[6.35]	82	3,259	2,168	3,672	2,444	3,962	2,639
12 x 120	5/16"	[7.94]	100	3,259	2,168	3,672	2,444	3,962	2,639
12 x 120	3/8"	[9.53]	98	3,259	2,168	3,672	2,444	3,962	2,639
12 x 120	1/2"	[12.70]	95	3,259	2,168	3,672	2,444	3,962	2,639

Note: see notes under the table FR.4.2.

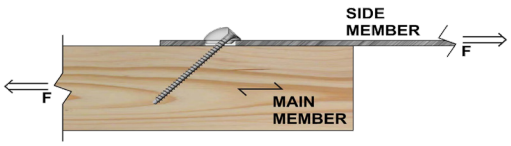


Table FR.4.6, Basic Factored Lateral Strength Resistance (N'_r) for Inclined Fully Threaded Fasteners with Steel Side Member

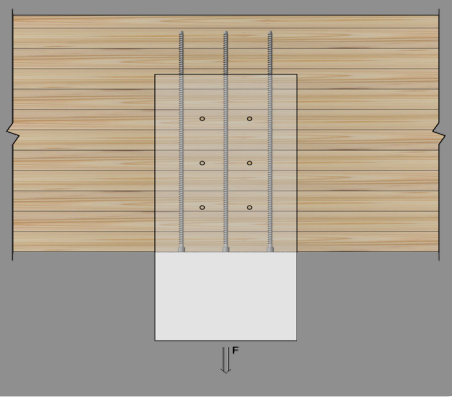
Fastener	Side Member Thickness				Minimum Main Member Thickness	Basic Factored Lateral Strength Resistance N'_r for Mean Relative Density of:			
	min		max			N			
						G = 0.35	G = 0.42	G = 0.49	G = 0.55
mm	in.	[mm]	in.	[mm]	mm	$N'_{r,II}$	$N'_{r,II}$	$N'_{r,II}$	$N'_{r,II}$
8 x 120	5/32"	[3.97]	1/2"	[12.70]	76	2,186	2,991	3,969	4,946
8 x 160	5/32"	[3.97]	1/2"	[12.70]	105	3,260	4,462	5,920	7,379
8 x 200	5/32"	[3.97]	1/2"	[12.70]	133	4,335	5,932	7,872	9,811
8 x 240	5/32"	[3.97]	1/2"	[12.70]	161	5,410	7,403	9,823	10,691*
8 x 280	5/32"	[3.97]	1/2"	[12.70]	189	6,485	8,874	10,691*	10,691*
8 x 300	5/32"	[3.97]	1/2"	[12.70]	203	7,022	9,609	10,691*	10,691*
10 x 160	1/4"	[6.35]	3/4"	[19.05]	100	3,552	4,810	6,364	7,993
10 x 200	1/4"	[6.35]	3/4"	[19.05]	129	4,910	6,649	8,797	11,047
10 x 240	1/4"	[6.35]	3/4"	[19.05]	157	6,268	8,487	11,229	13,576*
10 x 280	1/4"	[6.35]	3/4"	[19.05]	185	7,625	10,326	13,576*	13,576*
10 x 320	1/4"	[6.35]	3/4"	[19.05]	214	8,983	12,164	13,576*	13,576*
10 x 360	1/4"	[6.35]	3/4"	[19.05]	242	10,340	13,576*	13,576*	13,576*
12 x 200	1/4"	[6.35]	1"	[25.40]	128	5,425	7,296	9,634	12,160
12 x 240	1/4"	[6.35]	1"	[25.40]	156	7,066	9,502	12,547	15,837
12 x 280	1/4"	[6.35]	1"	[25.40]	184	8,706	11,708	15,461	16,971*
12 x 380	1/4"	[6.35]	1"	[25.40]	255	12,807	16,971*	16,971*	16,971*
12 x 480	1/4"	[6.35]	1"	[25.40]	326	16,908	16,971*	16,971*	16,971*
12 x 600	1/4"	[6.35]	1"	[25.40]	411	16,971*	16,971*	16,971*	16,971*

Note:
1. Tabulated values are only applicable for ASSY® VG CSK fasteners made from carbon steel using the corresponding 45° washer.
2. Fiber orientation $N'_{r,II}$ is specified in the Lateral Connection Design section in Notes to the Designer. Factored withdrawal resistance values for loading at 45° relative to grain direction is considered.
3. Values must be multiplied by all applicable modification factors, as specified for lag screws in accordance with CSA O86 2016. Values apply to dry service conditions only.
4. The fastener penetration lengths corresponding to a specified lateral capacity are a minimum. Tabulated values may be applied to longer fasteners with greater penetration lengths.
5. G refers to the relative density assigned to the wood species. ESG must be the equivalent relative density given in the CCMC evaluation report of PSL.
6. The steel side plates are considered to be made from ASTM A36 grade steel; slotted holes need to be milled in order to accept the 45° washer.
7. Connection design must meet all relevant requirements of the Notes to the Designer section.

* The upper limit of the factored withdrawal resistance of the fastener is set by the factored tensile resistance of the fastener. Therefore, the factored withdrawal resistance used for design purposes cannot exceed the factored tensile strength of the respective fastener.

Did you know?

Where perpendicular to grain splitting is a concern, fully threaded ASSY VG screws may be used to engage a greater depth in the primary member. This reinforcing application can prevent splitting and increase the capacity of the connection.

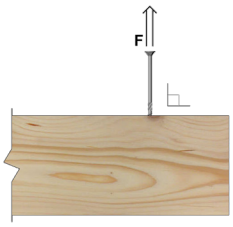


ASSY A2® FACTORED RESISTANCE AND STRENGTH

ASSY A2® Withdrawal Design (P_{rw})

Table FR.5.1, ASSY A2® Unit Factored Withdrawal Resistance Values ($P'_{rw, 90}$)

Major Diameter (d)		Unit Factored Withdrawal Resistance with Angle to Grain of 90° ($P'_{rw, 90}$) N/mm				
in.	[mm]	G = 0.35	G = 0.42	G = 0.49	PSL (G = 0.50)	G = 0.55
1/4"	[6]	32	46	60	35	76
5/16"	[8]	42	61	80	47	101
3/8"	[10]	53	76	100	59	126

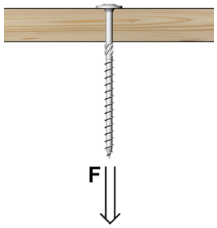


Notes:
1. Tabulated unit factored withdrawal resistance values ($P'_{rw, 90}$) apply to screws installed perpendicular to the grain of the wood member. For screws installed at an angle to the grain in the range between 90° and 30°, $P'_{rw, 90}$ shall be reduced by the appropriate angle to grain reduction factor (R_α) to obtain the applicable factored angle to grain withdrawal resistance value ($P_{rw, \alpha}$).
2. Values must be multiplied by all applicable modification factors, as specified for lag screws in accordance with CSA O86 2016. Values apply to dry service conditions only.
3. Values listed must be multiplied by the thread penetration length in the wood member.
4. A minimum thread penetration length of 4·d (d = major thread diameter) must be applied , not including the tapered tip.
5. G refers to the relative density assigned to the wood species. ESG must be the equivalent relative density given in the CCMC evaluation report of PSL.
6. All connection design must meet all relevant requirements of the Notes to the Designer section.
7. The factored axial load for a single screw subject to tension shall not exceed the lesser of the factored withdrawal resistance, the factored head pull-through resistance, or the factored tensile resistance of the fastener specified in Table FR.6.1, as applicable to connection design.

ASSY A2® Head Pull-Through Design (P_{pt})

Table FR.5.2, ASSY A2® Factored Head Pull-Through Resistance (P'_{pt})

Major Diameter (d)		ASSY A2® Factored Head Pull-Through Resistance (P'_{pt}) kN								
		Ecofast			SK			Kombi		
in.	[mm]	G = 0.35	G = 0.42	G = 0.49	G = 0.35	G = 0.42	G = 0.49	G = 0.35	G = 0.42	G = 0.49
1/4"	[6]	1.15	1.32	2.56	2.69	2.61	4.04	N/A	N/A	N/A
5/16"	[8]	1.5	2.15	2.69	2.47	4.51	5.89	1.31	1.74	2.62
3/8"	[10]	N/A	N/A	N/A	N/A	N/A	N/A	1.82	2.65	3.66



Notes:
1. Tabulated factored head pull-through resistance values (P'_{PT}) must be multiplied by all applicable modification factors as specified for lag screws in CSA O86 2016. Design values apply to connections with minimum side member thickness (t_s). Design values apply to dry service conditions only.
2. G refers to the relative density assigned to the wood species. ESG must be the equivalent relative density given in the CCMC evaluation report of PSL.
3. Minimum side member thicknesses are given in the Notes to the Designer section under point 12.
4. Connection design must meet all relevant requirements of the Notes to the Designer section.
5. The factored axial load for a single screw subject to tension shall not exceed the lesser of the factored withdrawal resistance, the factored head pull-through resistance, or the factored tensile resistance of the fastener specified in Table FR.6.1, as applicable to connection design.

ASSY A2® Factored Tensile and Bending Yield Strength

Table FR.6.1, ASSY A2® Factored Tensile Strength and Bending Yield Strength

Major Diameter (d)		Factored Tensile Strength	Bending Yield Strength f_y
in.	[mm]	kN	Mpa
1/4"	[6]	5.1	697
5/16"	[8]	8.7	850
3/8"	[10]	13.7	789

Note: Connection design must meet all the relevant requirements of the Notes to the Designer section.

ASSY A2® Factored Torsional Strength

Table FR.6.2, ASSY A2® Factored Torsional Strength

Major Diameter (d)		Factored Torsional Strength
in.	[mm]	N · m
1/4”	[6]	4.65
5/16”	[8]	11.64
3/8”	[10]	21.82

Note: Connection design must meet all the relevant requirements of the Notes to the Designer section.

ASSY A2® Factored Lateral Resistance (N_r)

Table FR.7.1, Basic Factored Lateral Strength Resistance (N'_r) for ASSY A2® Partially Threaded Fasteners with Wood Side Member

Fastener	Side Member Thickness	Minimum Fastener Penetration into Main Member	Basic Factored Lateral Strength Resistance N'_r for Mean Relative Density of: N					
			G = 0.42			G = 0.49		
mm	mm	mm	$N'_{r,\parallel}$	$N'_{r,m\perp}$	$N'_{r,\perp}$	$N'_{r,\parallel}$	$N'_{r,m\perp}$	$N'_{r,\perp}$
6 x 100	38	56	793	620	438	857	670	491
6 x 120	51	63	793	620	501	857	670	526
6 x 140	70	64	793	620	526	857	670	568
8 x 100	38	54	1,297	871	571	1,483	1,016	666
8 x 140	51	81	1,514	1,222	819	1,697	1,342	938
8 x 160	64	88	1,589	1,242	924	1,716	1,342	1,033
8 x 200	89	103	1,589	1,242	1,054	1,716	1,342	1,138
10 x 160	64	86	2,191	1,715	1,111	2,405	1,880	1,296
10 x 180	89	81	2,227	1,741	1,259	2,405	1,880	1,469
10 x 200	102	88	2,227	1,741	1,390	2,405	1,880	1,558
10 x 200	140	50	1,955	1,712	1,109	2,185	1,880	1,230

Notes:
1. Values are only applicable for ASSY A2® fasteners made from stainless steel. (Not applicable to carbon steel ASSY®).
2. Fiber orientation ($N'_{r,\parallel}$, $N'_{r,m\perp}$ and $N'_{r,\perp}$) of the main member versus the side member is specified in the Lateral Connection Design section in Notes to the Designer.
3. Values must be multiplied by all applicable modification factors, as specified for lag screws in accordance with CSA O86, 2016.
4. The fastener penetration lengths corresponding to a specified lateral capacity are a minimum. Tabulated values may be applied to longer fasteners with greater penetration lengths.
5. Minimum side member thicknesses are given in the Notes to the Designer section under point 12. Pre-drilling may be required to reduce splitting.
6. Basic factored lateral resistances listed for G = 0.35; 0.42 and 0.49 refer to connections where main and side members are made from equivalent density species.
7. G refers to the relative density assigned to the wood species. ESG must be the equivalent relative density given in the CCMC evaluation report of PSL.
8. Connection design must meet all relevant requirements of the Notes to the Designer section.

Check List

For All Connections

- ☐ Check the geometry requirements:
  - ☐ End distances (a)
  - ☐ Edge distance (e)
  - ☐ Spacing Parallel to Grain (S_P)
  - ☐ Spacing Perpendicular to Grain (S_Q)
- ☐ Check the wood species for all members (G)
- ☐ Check the fiber orientation:
  - ☐ Screw axis angle to the grain (α)
  - ☐ Loading direction angle to grain (θ)
  - ☐ Is the screw in the end grain?
- ☐ Check the minimum penetration length for the loading type/direction.
- ☐ Check the minimum member thicknesses
- ☐ Check the local stresses in fastener groups:
  - ☐ Net section tensile capacity
  - ☐ Row tear-out capacity
  - ☐ Group tear-out capacity
- ☐ Check for modification adjustment factors for dowel-type fasteners:
  - ☐ Load duration factor (K_D)
  - ☐ Service condition factor (K_{SF})
  - ☐ Treatment factor (K_t)
  - ☐ End grain factor (J_E)
  - ☐ Reduction factor for CLT (J_X)

For Laterally Loaded Fasteners

- ☐ Check the factored lateral resistance (N_r)
- ☐ Check the fastener shear strength
- ☐ Check the number of effective fasteners: $n_F = n^{0.9}$
- ☐ Check the number of rows (n_R)

For Axially Loaded Fasteners

- ☐ If applicable, check the factored withdrawal resistance (P_{rw})
- ☐ If applicable, check the factored head pull-through resistance (P_{pt})
- ☐ Check the factored fastener tensile strength
- ☐ Check the number of effective fasteners: $n_F = \max\{n^{0.9} ; 0.9 \cdot n\}$

For combined lateral and withdrawal loads

- ☐ Check the combined resistance: $N_{r,c} = \dfrac{P_{rw} \cdot N_r}{P_{rw} \cdot \cos^2 \alpha + N_r \cdot \sin^2 \alpha}$
- ☐ Check the combined load criteria: $\left(\dfrac{V_f}{N_r}\right)^2 + \left(\dfrac{T_f}{P_{rw}}\right)^2 \leq 1$

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