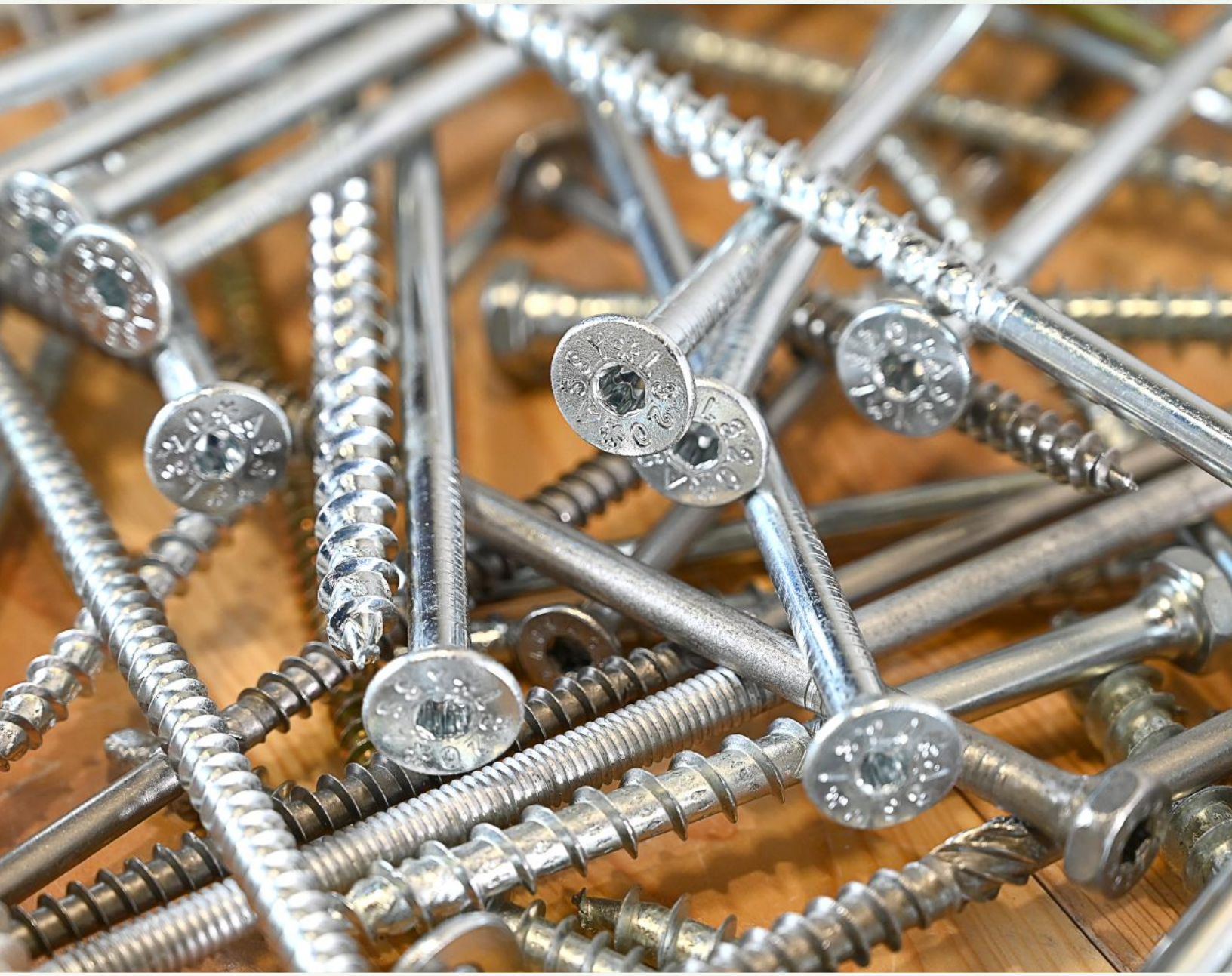
MTC SOLUTIONS



Structural Screw Catalog

ASD & LRFD Design for United States

info@mtcsolutions.com | 1.866.899.4090

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Mass Timber Hardware Specialists

At MTC Solutions, our core focus is to supply structural hardware for modern mass timber applications in commercial, industrial, and residential projects. Our pride lies in collaborating with leading industry experts to offer design solutions and tools for code-compliant, sustainable buildings, continuously pushing the boundaries of the North American construction industry.

Our in-house team of mass timber specialists support professionals in designing customized connections that cater to the specific requirements of each project, resulting in truly innovative and cost-efficient solutions. With our industry-recognized expertise and tested & proven solutions, we stand at the forefront of the industry, driving progress and innovation in mass timber construction.

Expertise

We provide our customers with the knowledge and tools necessary to construct cutting-edge, code-compliant mass timber projects while pushing the boundaries of the North American construction industry.

Commitment

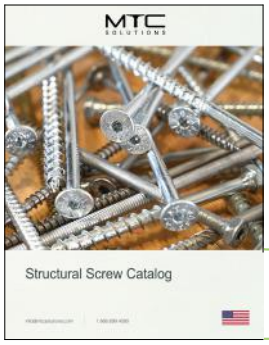
We are dedicated to making your project a success, offering support from design and installation assistance to fast and precise delivery of high-quality products.

Products Tailored for North America

We partner with leading research facilities across North America to ensure that our products are tested and customized to meet the unique needs of the market, including seismic considerations and solutions for large post-and-beam structures in various climates.

Find Your Connection Solution

MTC Solutions provide the right tools to design code-compliant buildings, educating the mass timber industry on connection solutions.



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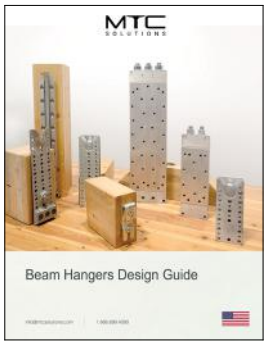

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Beam Hangers

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Fall Arrest Anchor Design Guide

Fall Arrest

WHO ARE WE?

YOUR MASS TIMBER HARDWARE SUPPLIER

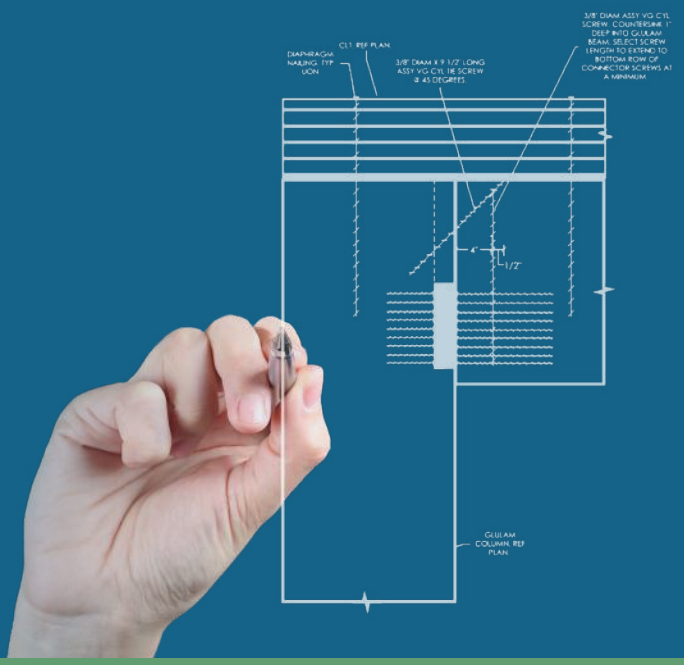
Rely on our distribution team to deliver your North American projects with speed and accuracy.

LEADING WITH INNOVATION & RESEARCH

We are leading the mass timber industry with cutting edge connection solutions and partnering with renowned research facilities.

WE MAKE YOU THE EXPERT

Learn about the right solutions for your projects and Mass Timber connections with our technical resources & support team!



CONNECTIONS DESIGN SUPPORT

Reach out to the technical team for design support, from early design stages to ongoing iterative changes. We help find the most efficient connection solutions.

MANUFACTURERS' HELP DESK

Use our comprehensive & practical resources to find the most cost-effective solutions for your structural elements.

TESTED & PROVEN SOLUTIONS

Count on MTC Solutions' 10+ years of expertise, providing tested & proven ICC approved solutions, support, and resources.

General Notes to the Designer

1. All suggestions and details provided are general guidelines and cannot be assumed to be valid for all construction requirements and specific site conditions.
2. Reference design values must be adjusted in accordance with all applicable adjustment factors of NDS 2024, as outlined in Sections 11.3 and 12.5. The correct adjustment factors for Allowable Stress Design (ASD) and Load and Resistance Factor Design (LRFD) must be applied and these two methods cannot be interchanged.
3. A load-bearing connection shall consist of at least two (2) fasteners.
4. MTC Solutions fasteners are intended to be used at temperatures below 100°F to ensure Temperature Factor (C_t) = 1.0.
5. Load Duration Factor (C_D) does not apply to connections where capacity is controlled by metal or concrete/masonry strength.
6. Connections must respect the geometry requirements as specified in the respective detailing section for each series of fasteners.
7. For connections with multiple closely spaced fasteners, their capacity may be limited by the capacity of the surrounding wood. Applying the minimum geometry requirements does not prevent wood failure such as row tear-out, group tear-out, block tear-out, net tension failure, or splitting perpendicular-to-grain caused by local stresses. These failures should be checked according to principles of engineering mechanics.
8. The designer must ensure that all possible stress limits in the wood members, such as the shear capacity, the rolling shear capacity of the cross-laminated timber (CLT) or other material properties, are not exceeded while maintaining a continuous load path.
9. In wood species sensitive to splitting, the minimum geometry requirements may be required to be increased.
10. Different series of fasteners vary in tensile strength (T_s), shear strength (V), and bending yield strength (F_{yb}). These different fastener strengths must be considered in the design, as they can influence the lateral load-carrying capacity (Z) and withdrawal capacity (W) of a fastener in a connection.
11. For connections with multiple fasteners, the resistance of the fasteners acting in withdrawal and the resistance of the fasteners acting in shear are associated with different stiffnesses and therefore cannot be added together to obtain the total capacity of the connection.
12. For laterally loaded connections with multiple fasteners, only the capacities of screws of the same diameter and exhibiting the same yield mode may be added together to obtain the total capacity of the connection.
13. Where steel side plate members are used, structural steel of ASTM A36 grade with $F_u \geq 58{,}020$ psi should be used.
14. For ASTM A36 steel side plates, dowel bearing strength (F_e) = 87,000 psi (as per NDS 2024).
15. Where steel side plate members are used, the resistance of the steel should exceed the stress induced on the member and at the bearing of the fasteners on the plate.

16. Dowel bearing strength (F_e) for fasteners with a shank diameter of D_s installed in wood members is calculated as follows:
    - For $D_s < 1/4"$, $F_e = 16{,}600 \cdot G^{1.84}$ psi
    - For fasteners with $D_s \geq 1/4"$ loaded parallel to grain, $F_{e\parallel} = 11{,}200 \cdot G$ psi
    - For fasteners with $D_s \geq 1/4"$ loaded perpendicular-to-grain, $F_{e\perp} = 6{,}100 \cdot G^{1.45}/\sqrt{D_S}$ psi
17. Dowel bearing strength (F_e) for fasteners with a shank diameter of D_s installed in narrow edge of CLT panels is calculated as follows:
    - For $D_s < 1/4"$, $F_e = F_e$
    - For $D_s \geq 1/4"$, $F_e = F_{e\perp}$
18. Dowel bearing strength (F_e) for fasteners with a shank diameter of D_s installed in wood structural panels is calculated as follows:
    - For plywood and $D_s < 1/4"$,
        - F_e = 4,650 psi for Structural 1 and Marine (G = 0.5) grades
        - F_e = 3,350 psi for other grades (G = 0.42)
    - For plywood of all grades (G = 0.5) and $D_s > 1/4"$, F_e = 5,600 psi
    - For OSB of all grades (G = 0.5) and $D_s \leq 1/4"$, F_e = 4,650 psi
19. Minimum member thicknesses (t) for lumber and timber members according to the nominal fastener diameter (D) are:
    - For screws with D = 1/4", t ≥ 15/16"
    - For screws with D = 5/16", t ≥ 1 3/16"
    - For screws with D = 3/8", t ≥ 1 9/16"
    - For screws with D = 1/2", t ≥ 3 3/16"
20. The minimum member thickness for structural wood panels, such as plywood or OSB, should be 1/2".
21. The minimum penetration depth of a fastener with a nominal diameter of D into the main member should be:
    - 6D (excluding the tip) for fasteners loaded in shear
    - 8D (excluding the tip) for axially loaded fasteners

    Tip length = D
22. To ensure full connection resistance in CLT panels, it is recommended that fasteners penetrate all panel plies to the largest extent possible.
23. The effective minimum penetration length of the threaded portion l_{eff} of a fastener into a wood-based member is:

$$l_{eff} \geq min\left\{\frac{6 \cdot D}{\sin \alpha}\ ;\ 20 \cdot D\right\}$$

    Where:
    - α = relative angle between the fastener axis and the grain orientation
    - D = nominal diameter of the fastener
24. For specific gravities assigned to different timber species, refer to Table 12.3.3A of NDS 2024.
25. Where predrilling is employed, the smaller geometry requirements for dowel-type connections given in NDS 2024 may be used instead of the geometry requirements for self-tapping screws given in the ICC-ESR approvals. A hole is considered to be predrilled if the entire length of the fastener to be installed is drilled. Refer to Appendix A: Installation Guidelines for more information on predrilling and pilot holes.
26. Predrilling is recommended for installing slender fasteners into SYP.

General Notes to the Installer

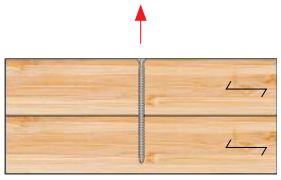
1. Carbon-steel fasteners shall only be used in dry service conditions, as exposure to wet service conditions may lead to premature failure. Refer to the Service Conditions and Corrosion section.
2. Connections designed for dry service conditions should be protected from wetting and excessive moisture during construction and in service.
3. Do not overdrive the fasteners unless approved by a licensed design professional, as it may lead to a reduction in connection resistance.
4. Maximum allowable insertion torque of the fasteners must be respected. Refer to the Reference Design Value tables for the maximum allowable insertion torque values.
5. All the specified fasteners should be installed prior to loading the members.
6. Do not use impact drills for installation of MTC Solutions fasteners. For more information on drill selection, refer to Appendix A: Installation Guidelines.
7. Different types of fasteners vary in strength and corrosion resistance. Installers should avoid substituting one type of fastener for another without consulting a qualified design professional.
8. Fasteners with an appropriate length selected based on their diameter should be used, as fasteners that are too slender may lead to installation problems in dense wood.
9. The use of fully threaded fasteners in green wood shall be avoided to prevent potential wood cracking.
10. If splitting of a wood member or fastener breakage is observed during or prior to fastener installation, the installation process must be stopped, a design professional contacted immediately, and appropriate measures taken.
11. A pilot hole may be used to facilitate the installation of long self-tapping screws or when fasteners are being installed at an angle, near an edge, or in the end grain. Pilot holes should be deep enough to facilitate installation depending on the connection configuration. The pilot hole diameter must not exceed the minor diameter (D_m) of the fastener. For more information on pilot holes, refer to Appendix A: Installation Guidelines.
12. Predrilling may also be required in cases involving unusually dry wood, dense wood, aged timber, end grain installation, installation close to the edges of the wood members, and where large-diameter fasteners are used. For more information on predrilling, refer to Appendix A: Installation Guidelines.
13. Predrilling may help reduce the insertion torque for self-tapping fasteners.
14. Predrilling is recommended for installing slender fasteners into SYP.
15. Screws should be fully driven in an uninterrupted process, from tip insertion to head seating. If necessary, a torque wrench may be used to complete installation immediately after the initial insertion of the screw.

Connection Classification

Axial Connections

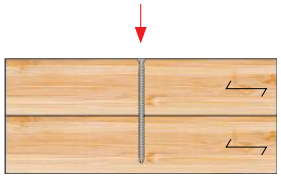
Connections with fasteners loaded axially in tension

These connections transfer axial tensile loads between a side member and a main member with the fastener loaded axially in tension along its axis. Axial connections are typically designed for withdrawal and head pull-through in the wood members, and tensile strength of the fastener.



Connections with fasteners loaded axially in compression

These connections transfer axial compressive loads between a side member and a main member with fastener loaded axially in compression along its axis. When a fastener is loaded in axially in compression, the buckling strength of the fastener must be checked in addition to withdrawal and head pull-through in the wood members.



Lateral Connections

Lateral connections with fasteners loaded in shear

These connections transfer lateral loads between a side member and a main member with the fastener loaded in shear perpendicular to its axis. Lateral connections may offer ductile behavior if designed properly.

Lateral connections with axially loaded inclined fasteners in tension

These connections transfer lateral loads between a side member and a main member with the fastener loaded axially in tension at an angle to the wood fibre grain. Fasteners can be inclined at angles ranging from 30° to 60° to the shear plane. Typically 45° angles are used for these connections. Fasteners should be inclined towards load direction and cannot be subjected to reverse loading. These connections with inclined fasteners are typically stiffer than the connections utilizing fasteners loaded in shear.

Lateral connections with axially loaded inclined fasteners in cross pairs

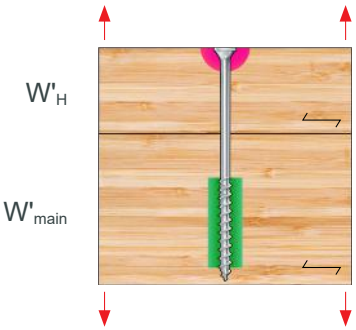
These connections transfer lateral loads between a side member and a main member with a pair of fasteners installed at equal angles to the wood fibre grain in a cross configuration. Fasteners can be inclined at angles ranging from 30° to 60° to the shear plane. Typically 45° angles are used for these connections. This configuration is useful for bi-directional reverse loading.

Connection Resistance for a Single Fastener

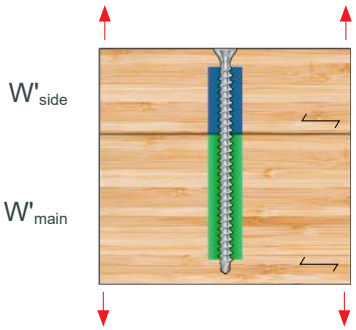
Axial Connection with a Single Fastener Loaded in Tension

Connection resistance for a single fastener loaded axially in tension, W'_r, is the minimum of:

- Adjusted withdrawal design value in the main member (W'_{main}) **(Ref: eq.1)**
- Maximum of adjusted withdrawal design value in the side member (W'_{side}), or adjusted head pull- through design value (W'_H) **(Ref: eq.1 / eq.2)**
- Tensile strength of the fastener (T'_s) **(Ref: eq.3)**



Partially Threaded Fastener in Axial Tension



Fully Threaded Fastener in Axial Tension

Notes:

1. Where steel plate side members are used, the steel plate hole must be the correct size and the thickness of the steel plate shall be taken in consideration to ensure proper bearing of the fastener head.
2. Connection should also meet requirements provided in the General Notes to the Designer section of this guide.
3. The examples represent single fastener connections but in practice, all connections shall consist of at least two (2) fasteners.

Lateral Connection with a Single Fastener Loaded in Shear

Connection resistance for a single fastener loaded in shear in a lateral connection, Z'_r, is the minimum of:

- Adjusted lateral design value, Z' **(Ref: eq.6)**
- Shear strength of the fastener, V' **(Ref: eq.4)**

Lateral Connection with Fastener Loaded in Shear

Notes:

1. Wood brittle failure modes must be checked separately in shear connections. More information about wood brittle failures is provided in Appendix C.
2. Partially threaded fasteners are optimized for shear connections as their smooth shank allows wood members to be pulled tightly together. To achieve this effect, the threaded portion must be fully embedded in the main member.
3. The example represents a single fastener connection but in practice, all connections shall consist of at least two (2) fasteners.

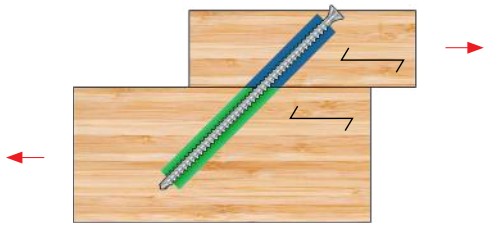
Lateral Connection with a Single Axially Loaded Inclined Fastener

$$Z'_r = W'_r \cdot \cos \beta$$

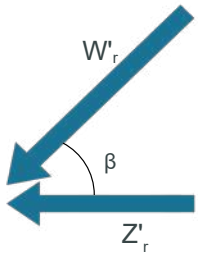
β Angle between screw axis and shear plane, ($30° \leq \beta \leq 60°$)

W'_r Axial resistance of the screw, calculated as minimum of:

- Adjusted withdrawal design value in the main member (W'_{main}) **(Ref: eq.1)**
- Maximum of adjusted withdrawal design value in the side member (W'_{side}), or adjusted head pull-through design value (W') **(Ref: eq.1 / eq.2)**
- Tensile strength of the fastener (T'_s) **(Ref: eq.3)**



Lateral Connection with Axially Loaded Inclined Screw



Force Diagram

Notes:

1. It is feasible to use partially threaded screws as well, however, fully threaded screws are preferred as they typically develop higher withdrawal resistance.
2. The example represents a single fastener connection but in practice, all connections shall consist of at least two (2) fasteners.

Lateral Connection with Axially Loaded Inclined Fasteners in Cross Pair

$$Z'_r = (W'_{rT} + W'_{rC}) \cdot \cos \beta$$

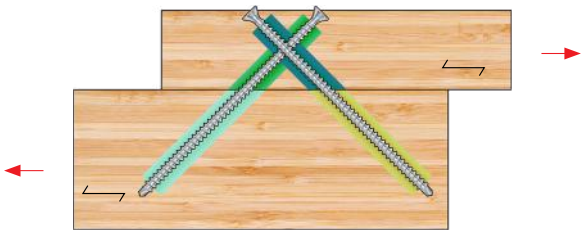
β Angle between screw axis and shear plane, ($30° \leq \beta \leq 60°$)

W'_{rT} Resistance of axially loaded inclined fastener in tension, and is minimum of:

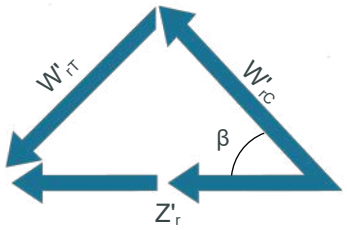
- Adjusted withdrawal design value in the main member (W'_{main}) **(Ref: eq.1)**
- Maximum of adjusted withdrawal design value in the side member (W'_{side}), or adjusted head pull-through design value (W'_H) **(Ref: eq.1 / eq.2)** **(Ref: eq.3)**
- Tensile strength of the fastener (T'_s)

W'_{rC} Resistance of axially loaded inclined fastener in compression and is minimum of:

- Adjusted withdrawal design value in the main member (W'_{main}) **(Ref: eq.1)**
- Maximum of adjusted withdrawal design value in the side member (W'_{side}) **(Ref: eq.1)**
- Adjusted buckling design value of the fastener (W'_C) **(Ref: eq.5)**



Symmetrical Screw Cross



Force Diagram in Side Member

Notes:

1. A Simplified approach by Kevarinmaki (2002) may be used to calculate the adjusted buckling resistance of the screw (W'_c) for a screw cross. Kevarinmaki (2002) suggests, $W'_c \approx 0.8\, T'_s$.
2. Screws acting as a pair should be installed at the same angle, opposite to one another, with the same thread penetration lengths in either member.
3. Screws in a pair need to be offset from one another with at least 1.5D to accommodate on-site tolerances and prevent screw collision.

Connection Resistance for Multiple Fasteners

Resistance of a connection with multiple fasteners is a function of the sum of minimum resistance values of each individual fastener in the connection. Connection resistance for multiple fasteners is calculated as:

For Axially Loaded Fasteners

$$W'_r = \sum_{i=1}^{n} W'_{r,i}$$

$W'_{r,i}$ Connection resistance for each i^{th} fastener in an axial connection, as calculated in "Connection Resistance for a Single Fastener" section

n Total number of fasteners in the connection

For Lateral Connections with Fasteners Loaded in Shear

$$Z'_r = \left(\sum_{i=1}^{n} Z'_{r,i}\right) C_g$$

$Z'_{r,i}$ Connection resistance for each i^{th} fastener in a lateral connection, as calculated in "Connection Resistance for a Single Fastener" section

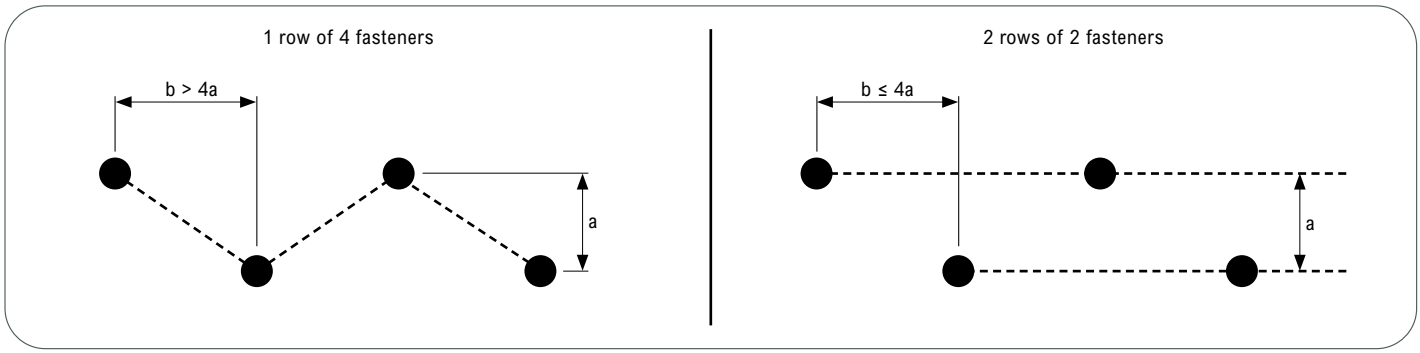
n Total number of fasteners in the connection

C_g Group Action Adjustment Factor provided in NDS 2024

Notes:

1. In closely spaced, multiple fastener connections, the capacity may be limited by the capacity of wood surrounding the connection. Applying the minimum geometry requirements does not prevent wood failure such as row tear-out, group tear-out, block tear-out, net tension failure or splitting perpendicular-to-grain caused by local stresses. These failures should be checked according to principles of engineering mechanics.
2. For determination of C_g where fasteners are arranged in a staggered fashion, a row of fasteners is defined according Section 11.3.6.2 of NDS 2024 as follow:

Spacing Requirements for Fasteners in Rows



For Lateral Connections with Axially Loaded Inclined Fasteners

$$Z'_r = \left(\sum_{i=1}^{n} Z'_{r,i}\right)$$

$Z'_{r,i}$ Connection resistance for each i^{th} fastener (or fastener pairs in case of a cross configuration) in a lateral connection, as calculated in "Connection Resistance for a Single Fastener" section

n Total number of fasteners (or fastener pairs in case of a cross configuration) in the connection

Formula Summary

Adjusted Withdrawal Design Value, W'

Withdrawal strength is proportional to the thread penetration into the wood member. The adjusted withdrawal resistance of single fastener in a connection is calculated as:

$$W' = W_{90} \cdot l_{eff} \cdot R_{\alpha} \cdot K_{\beta v} \cdot C' \qquad \textbf{(eq.1)}$$

W_{90} Reference perpendicular-to-grain withdrawal design value, provided in Tables 2.1, 3.1, 4.1 and 5.1

l_{eff} Effective length of thread embedment in the wood member where withdrawal is being calculated. Note that the length of the fastener tip (L_{Tip} = D) should not be included

R_{α} Angle to grain reduction factor in withdrawal application, see Table 1.1

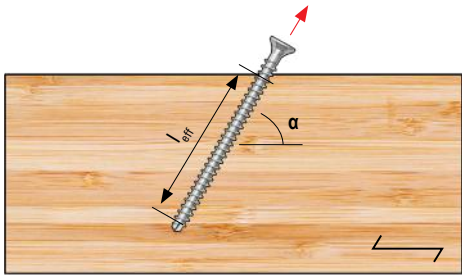
α Angle between the fastener axis & the wood fiber grain orientation

$K_{\beta v}$ Reduction factor for laminated veneer products, see Table 1.2

β_v Angle between the screw axis and the laminated veneer product's wide face

C' Applicable adjustment factors according to Section 11.3 of NDS 2024 for the connection:

- For ASD : C_D, C_M, C_t, C_{eg}
- For LRFD : C_M, C_t, C_{eg}, K_F, Φ, λ



Withdrawal at Angle α to the Grain

1.1 - Angle to Grain Reduction Factor R_{α} for Withdrawal at an Angle α

α	90°	85°	80°	75°	70°	65°	60°	55°	50°	45°	40°	35°	30°	25°	20°	15°	14°	10°	5°	0°
R_{α} *for Timber Products*	1.000	1.000	0.990	0.990	0.980	0.970	0.950	0.940	0.920	0.910	0.890	0.840	0.770	0.750	0.750	0.750	0.750	0.750	0.075	0.750
R_{α} *for LVL, MPP, Plywood*	1.000	0.997	0.990	0.978	0.962	0.944	0.923	0.901	0.879	0.857	0.836	0.817	0.800	0.500	0.500	0.500	0.500	0.500	0.500	0.500

Notes:

1. Timber products in this table refers to members made of lumber, timber, glulam and/or CLT.
2. For α < 15°, a minimum of four (4) screws are required for the connection.
3. For α < 30°, the connection can only be subjected to short term loading.
4. Timber Product values for α ≥ 30° are specified in ICC-ESR 3178-2023. Remaining values were derived according to the methods described in the ETA-11/0190 for self tapping wood screws.

1.2 - Reduction Factor for Withdrawal $K_{\beta v}$ in Laminated Veneer Products at an Angle of β_v to the Wide Face

β_v	90°	85°	80°	75°	70°	65°	60°	55°	50°	45°	40°	35°	30°	25°	20°	15°	10°	5°	0°
$K_{\beta v}$	1	0.996	0.985	0.968	0.945	0.918	0.889	0.859	0.829	0.800	0.773	0.749	0.727	0.709	0.694	0.682	0.673	0.668	0.667

Notes:

1. $K_{\beta v}$ is specified in the in ETA-11/0190, 2018 as K_{β}.
2. Reduction factor $K_{\beta v}$ accounts for end grain effects in laminated veneer products. Therefore, C_{eg} = 1 for laminated veneer products.
3. For lumber, timber, Glulam and CLT products. $K_{\beta v}$ = 1.

Adjusted Head Pull-Through Design Value, W'$_H$

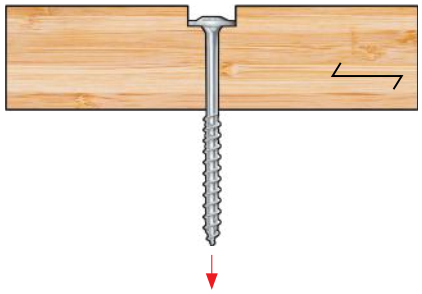
Head pull-through capacity is a function of the shape and size of the fastener head and may be governing where partially threaded fasteners are used in tension. The adjusted head pull-through resistance of single fastener in a connection is calculated as:

$$W'_H = W_H \cdot C' \qquad \textbf{(eq.2)}$$

W_H Reference head pull-through resistance design value, provided in Tables 2.2, 3.2, 4.2 and 5.2

C' Applicable adjustment factors according to Section 11.3 of NDS 2024 for the connection:

- For ASD : C_D, C_M, C_t
- For LRFD : C_M, C_t, K_F, Φ, λ



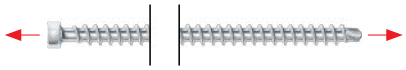
Head Pull-through

Fastener Tensile Strength, T'$_s$

Connection strength may be governed by tension failure of the fastener under axial tension loading. Tensile strength of a single fastener is calculated as:

$$T'_s = T_s \qquad \textbf{(eq.3)}$$

T_s Fastener Tensile Strength value, see reference design value Tables 2.3, 3.3, 4.4 and 5.3



Tensile Splitting

Note:

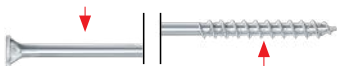
1. Tensile resistance of the screw shall not be multiplied adjustment factors given in NDS 2024 as per Section 11.2.3 of NDS 2024.

Fastener Shear Strength, V'

Fasteners may fail in shear when subjected to lateral loading. Shear strength of a fastener is calculated as:

$$V' = V \qquad \textbf{(eq.4)}$$

V Fastener Shear Strength value, see reference design value Tables 2.3, 3.3, 4.4 and 5.3.



Shear Failure

Note:

1. Shear resistance of the screw shall not be multiplied adjustment factors given in NDS 2024 as per Section 11.2.3 of NDS 2024.

Adjusted Buckling Design Value, W'_C

Under axial compression loading, when a fastener is pushed into the wood member, this is considered the same as withdrawal resistance. If the withdrawal resistance in the wood member is high under axial compressive loading, the fastener may buckle. Adjusted buckling resistance of a single fastener is calculated as:

$$W'_C = W_C \cdot C' \qquad \textbf{(eq.5)}$$

W_C Reference buckling resistance value, provided in Table 4.3

C' Applicable adjustment factors according to Section 11.3 of NDS 2024 for the connection:

- For ASD : C_D, C_M, C_t, C_{eg}
- For LRFD : C_M, C_t, C_{eg}, K_F, Φ, λ

Compressive Buckling

Notes:

1. Load duration factor (C_D), greater than 1.0 shall not apply for calculation of buckling resistance (W'_c) in ASD.
2. Time effect factor (λ), greater than 0.8 shall not apply for calculation of buckling resistance (W'_c) in LRFD.
3. The equation and adjustment factor presented in this section are only valid for Reference Buckling Resistance Values presented in Table 4.3 of this guide.
4. LRFD reference buckling resistance values presented in Table 4.3 already include a Φ factor of 0.65.
5. For LRFD adjustment factor, according to Appendix N.3.1 of NDS 2024, the format conversion factor, KF, shall not apply, as the LRFD reference resistances are determined in accordance with the reliability normalization factor method in ASTM D5457.

Adjusted Lateral Design Value, Z'

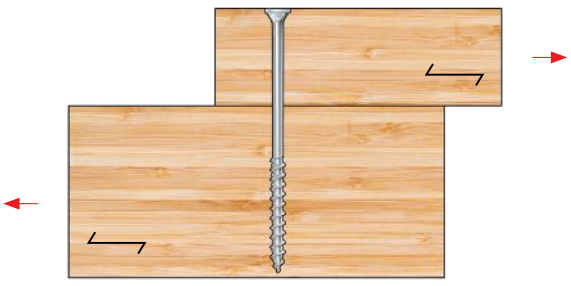
Lateral capacity is primarily a function of the embedment failure in the wood member, yielding failure of the fastener, or a combination of both. The adjusted lateral design resistance of a single fastener connection is calculated as:

$$Z' = Z \cdot C' \qquad \textbf{(eq.6)}$$

Z Reference lateral design value, calculated using bending yield strength (F_{yb}) values provided in Tables 2.3, 3.3, 4.4 and 5.3, and yield equations provided in NDS 2024 Section 12.3.1

C' Applicable adjustment factors according to Section 11.3 of NDS 2024 for the connection:

- For ASD : C_D, C_M, C_t, C_{eg}
- For LRFD : C_M, C_t, C_{eg}, K_F, Φ, λ



Lateral Connection with Fastener in Shear

Note:

1. In addition to the adjust factors mentioned above, Group Action Adjustment Factor C_g needs to be calculated and applied to the connection resistance for multiple fasteners. This information is provided in Connection Resistance for Multiple Fasteners section.

Combined Loads Resistance Calculation

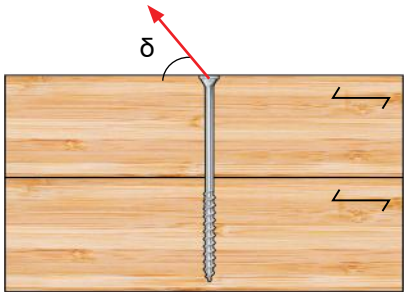
For connections subjected to a combined lateral and withdrawal loading with the fastener perpendicular to the shear plane, the combined resistance value, $Z'_{r\delta}$ can be calculated according to Section12.4.1 of NDS 2024 as

$$Z'_{r\delta} = \frac{W'_r \cdot Z'_r}{W'_r \cos^2 \delta + Z'_r \sin^2 \delta} \quad \textbf{(eq.7)}$$

W'_r Connection resistance for axial loading

Z'_r Connection resistance for lateral loading

δ Angle between wood surface and loading direction



Connection Subjected to Combined Loading

Load Combination Check

Load combination check (Section 12.4.2-2 NDS 2024 Commentary) should be performed for connections subjected to combined loading :

$$\left(\frac{V}{Z'_r}\right) + \left(\frac{T}{W'_r}\right) \leq 1 \quad \textbf{(eq.8)}$$

V Applied lateral force on the connection

T Applied withdrawal force on the connection

Z'_r Adjusted lateral resistance of connection

W'_r Adjusted withdrawal resistance of connection

Fastener Durability

Notes to the Designer

This section offers suggestions to help designers choose the most durable fastener for various service conditions. These guidelines are not exhaustive, and site-specific conditions may warrant differing levels of protection. These recommendations should be validated by a licensed design professional based on the anticipated exposure during the lifespan of the connection.

Designers should consider service conditions and the associated demands for corrosion resistance, structural capacity, accessibility for periodic inspections, ease of fastener replacement, and cost when specifying fasteners. Improper material selection can negatively impact fastener strength and durability, leading to corrosion.

1.3 - Suggested Corrosion Resistance for Common Service Conditions

Service Conditions	Environment	Suggested Corrosion Resistance
Dry	Untreated Wood	Regular
	Preservative-treated Wood	Regular or High
	Fire Retardant-treated Wood	Regular or High
Wet	Untreated Wood	High
	Preservative-treated Wood	High
Increased Corrosion Risks	Marine / Salt Water Exposure	Extreme
	Exposure to Aggressive Chemicals	Extreme

Notes:

1. The corrosion resistance of the fastener must account for the interactions between moisture and specific treatment chemicals.
2. For further details, refer to the specialized product information in Appendix F: Service Conditions and Durability.
3. See the Fastener Steel and Coatings section on the following page for information on the corresponding types of fasteners available at MTC Solutions.

Fastener Steel and Coatings

MTC Solutions offers fasteners in three different types of steel and coating to accommodate different corrosion resistance requirements.

Regular Corrosion-Resistant Fasteners

Blue Passivated Zinc Surface Coating — A3K

The blue passivated zinc alloy coating (8–12 microns in thickness) on high-performance carbon-steel fasteners contains zinc and nickel, delivering standard corrosion protection. The electroplated surface coating is categorized as A3K in accordance with DIN EN ISO 4042 (which specifies the requirements for electroplated coatings and coating systems on steel fasteners). These fasteners are adequate for use in low-corrosive environments, such as dry service conditions.

High Corrosion-Resistant Fasteners

A2 Stainless Steel

A2 is a European designation for chromium–nickel austenitic stainless steel (corrosion resistant) with low carbon content and a copper addition. This grade is generally equivalent to Type 304 stainless steel in North America. As stainless steel is a softer metal than carbon steel, A2 stainless-steel screws exhibit lower strengths compared to carbon-steel screws, which must be accounted for in design. Predrilling may also be required for longer A2 stainless-steel screws. These screws are adequate for use in corrosive environments, such as those involving wet service conditions in certain types of treated lumber.

Extreme Corrosion-Resistant Fasteners

A4 Stainless Steel (Custom Order)

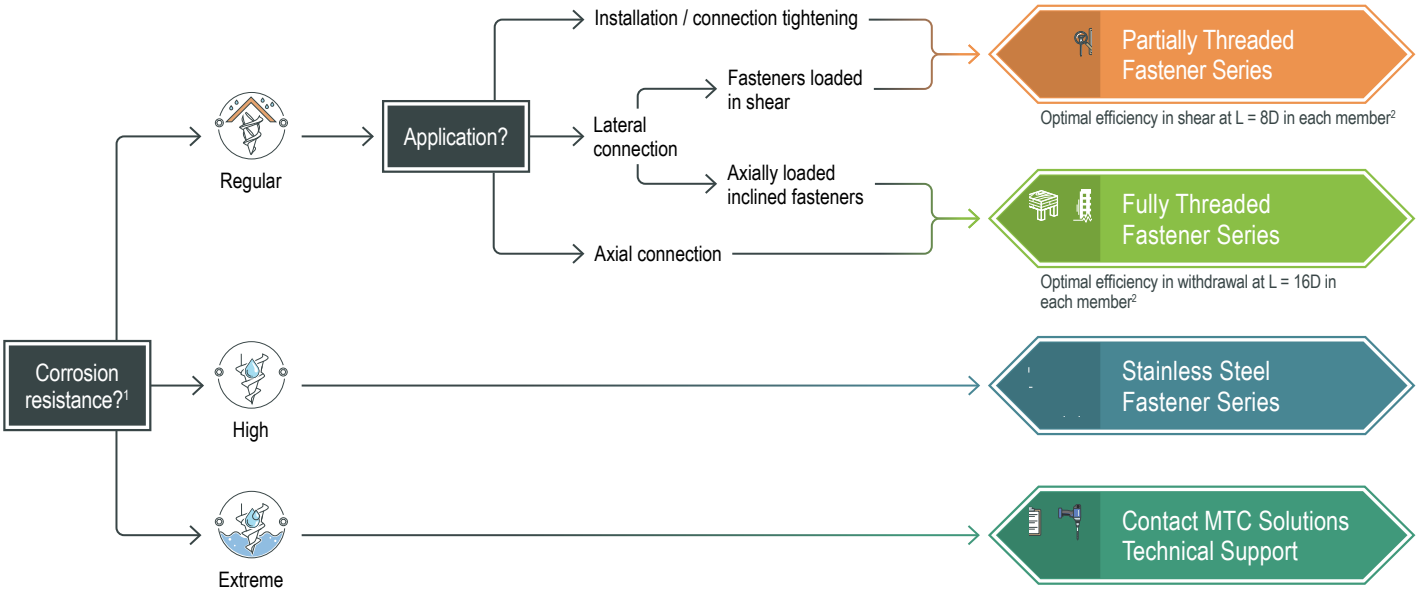
A4 is another European designation for chromium–nickel austenitic stainless steel (corrosion resistant) with low carbon content and a copper addition. This grade generally corresponds to Type 316 stainless steel in North America. A4 fasteners are adequate for use in more corrosive environments, such as those involving wet service conditions with the presence of salt water or other enhanced corrosion risk scenarios.

MTC Solutions only supplies A4 stainless-steel fasteners through custom orders. Clients are therefore advised to factor in an adequate lead time for their orders.

MTC Structural Fastener Selection Process

Ensuring desired connection performance depends on choosing the appropriate screws for the project. Our comprehensive guide below facilitates quick navigation of available options and offers tips to aid selection. Individual project requirements may dictate alternative fasteners. It is advisable to consult with a licensed design professional to ensure the selection of the correct fasteners for the specific application.

Step 1: Fastener Series Selection



Notes:
1. See Appendix F: Service Conditions and Durable Design for more details on service conditions and corrosion resistance.
2. L and D are the thread penetration length and nominal diameter, respectively. This thread penetration length is only a rule of thumb.

Step 2: Fastener Model Selection[1]

Architectural finish ★ Best solution for this connection type ○ Not ideal 💧 Best solution for wet service conditions

Fastener Type		Connection Type		Available Diameters				
		Wood-to-Wood	Steel-to-Wood	in. [mm]				
				1/4 [6]	5/16 [8]	3/8 [10]	1/2 [12]	9/16 [14]
Partially Threaded Fastener Series	Ecofast			✓	✓	✓		
	SK	★	○	✓	✓	✓	✓	
	Kombi	○	★		✓	✓	✓	
	FWH		○		✓			
Fully Threaded Fastener Series	VG CSK				✓	✓	✓	
	VG CYL	[2]		✓	✓	✓		
	VG RH	[2]						✓
Stainless Steel Fastener Series	A2 Ecofast	💧 [2]		✓	✓			
	A2 SK	💧	○	✓	✓			

Notes:
1. The presented selection process serves as guidelines only. The final decision must be made by a licensed design professional.
2. For connections acting in withdrawal that utilize fully threaded fasteners, side-member resistance must be designed based on the thread penetration length.

Bayview Elementary School

Vancouver, British Columbia

MTC Structural Fasteners Overview

Partially Threaded Fasteners 3.0 Series

SK 3.0

Washer Head
Carbon Steel
Page 30

ICC-ESR-3179

Kombi 3.0

Hexagonal Head
Carbon Steel
Page 31

ICC-ESR-3179

Kombi LT 3.0

Hexagonal Head
Carbon Steel
Page 32

ICC-ESR-3179

Partially Threaded Fasteners 4.0 Series

Ecofast 4.0

Countersunk Head
Carbon Steel
Page 38

ICC-ESR-3179

SK 4.0

Washer Head
Carbon Steel
Page 40

ICC-ESR-3179

Kombi 4.0

Hexagonal Head
Carbon Steel
Page 42

ICC-ESR-3179

FWH 4.0

Flat Washer Head
Carbon Steel
Page 44

ICC-ESR-3179

Fully Threaded Fasteners Series

VG CSK

Countersunk Head
Carbon Steel
Page 50

ICC-ESR-3178

VG CYL

Hexagonal Head
Carbon Steel
Page 52

ICC-ESR-3178

VG RH

Reverse Head
Carbon Steel
Page 54

Stainless Steel Fasteners Series

A2 Ecofast

Countersunk Head
Stainless Steel
Page 62

ICC-ESR-3179

A2 SK

Washer Head
Stainless Steel
Page 63

ICC-ESR-3179

Self-Drilling Dowel

SDD

Cylinder Head
Carbon Steel
Page 68

Accessories

90° Cup Washer

Page 71

45° Wedge Washer

Page 72

Pre-Drilling Jig

Page 73

Bits

Page 74

Magnetic Hex Socket

Page 75

Bit Holder Socket

Page 75

Reverse Head Socket

Page 75

Magnetic Bit Case Holder VG RH

Page 76

Bit Holder Socket

Page 76

Kingsway Royal Alex LRT Stations

Edmonton, Alberta

Courtesy of Western Archrib

Partially Threaded Fasteners 3.0 Series

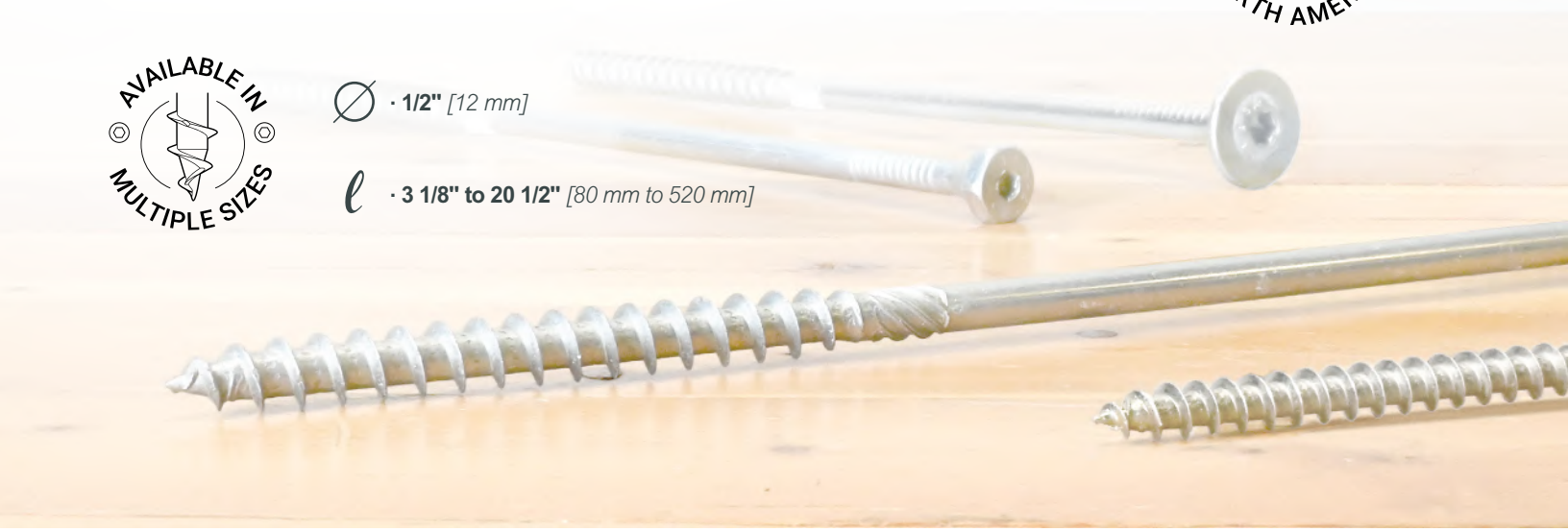
MTC Solutions self-tapping Partially Threaded fasteners are designed to pull members tightly together, often utilized in situations where head pull-through capacity or lateral loading is a critical design consideration.

TESTED IN NORTH AMERICA

AVAILABLE IN MULTIPLE SIZES

∅ · **1/2"** *[12 mm]*

ℓ · **3 1/8" to 20 1/2"** *[80 mm to 520 mm]*



Engineered Heads

Washer Head Hex Head

Case-Hardened Steel

A ductile core with a high density layer on the edge, providing high bending yield strength & ductility

Coated Steel

Fasteners with a zinc and blue passivated coating for use in dry service condition

Shank Cutter

Taps a larger hole for the unthreaded portion of the shank, reducing the insertion torque

Large Thread

Provides high withdrawal resistance

Counter Thread Tip

Reduces the need for predrilling and provides the quickest fastener wood bite

CERTIFICATIONS

ES ICC EVALUATION SERVICE — ICC-ESR-3179

CCMC 13677-R

ISO 50001 Energy Management System

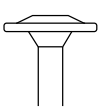
ETA

Product Overview

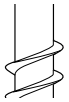
ASSY SK 3.0

Washer Head Self-Tapping Wood Screw

The ASSY SK 3.0 is engineered to support a high head pull-through capacity making it a perfect fit for wood-to-wood applications. The large head of the SK screw eliminates the need for a washer during installation.

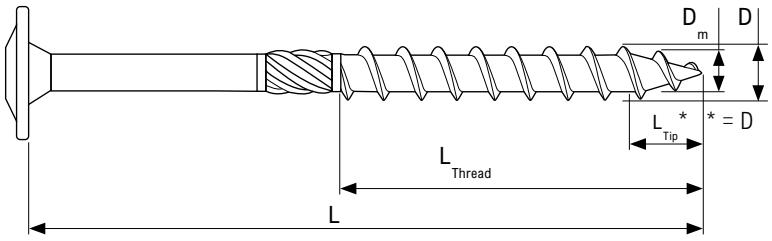

Washer Head

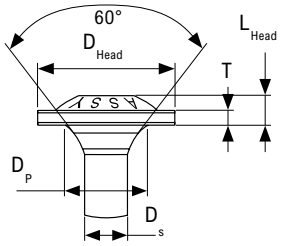

Shank Cutter


Partially Threaded


Counter Thread Tip

Code Approval	ICC, CCMC, ETA
Connection Types	Wood / Wood Steel / Wood





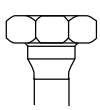
ASSY SK 3.0 - 1/2" [12 mm] DIAMETER

Specification	Packaging Qty.	D	L		L_{Thread}		D_{Head}	D_m	D_s	D_p	T	L_{Head}	Drive Bit
Item #		in. *[mm]*	in.	*[mm]*	in.	*[mm]*	in. *[mm]*						
[3] SK12200	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]*	RW 50
[3] SK12240	25		9-1/2	*[240]*	4-3/4	*[120]*							
[3] SK12260	25		10-1/4	*[260]*	4-3/4	*[120]*							
[3] SK12300	25		11-7/8	*[300]*	4-3/4	*[120]*							
[3] SK12400	25		15-3/4	*[400]*	5-3/4	*[145]*							
[3] SK12480	25		19	*[480]*	5-3/4	*[145]*							
[3] SK12520	25		20-1/2	*[520]*	5-3/4	*[145]*							

ASSY Kombi 3.0

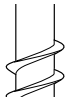
Hex Head Self-Tapping Wood Screw

The ASSY Kombi 3.0 is specifically designed for high-performance steel-to-wood connections. The reinforced and tapered shoulder has the same diameter as the thread of the Kombi, ensuring a tight fit in predrilled steel plate holes while reducing slip.



Hex Head

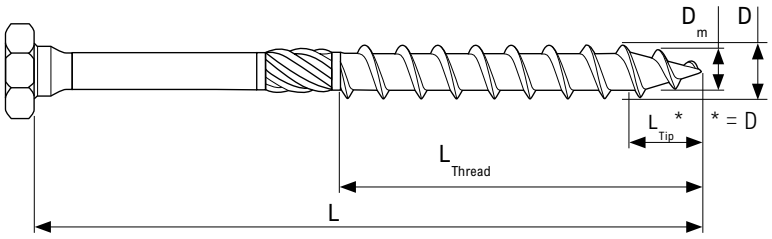
Shank Cutter

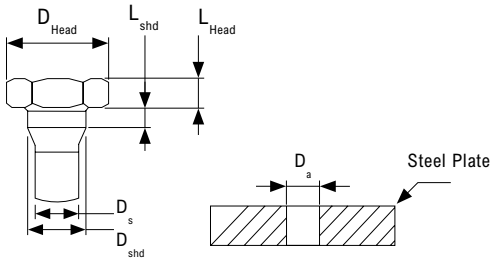


Partially Threaded

Counter Thread Tip

Code Approval	ICC, CCMC, ETA
Connection Types	Steel / Wood Wood / Wood





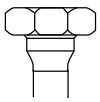
ASSY KOMBI 3.0 - 1/2" [12 mm] DIAMETER

Specification	Packaging Qty.	D	L		L_{Thread}		D_{Head}	D_m	D_s	D_a	D_{shd}	L_{Head}	L_{shd}	Drive Bit
Item #		in. *[mm]*	in.	*[mm]*	in.	*[mm]*	in. *[mm]*							
[3] KPT12100	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]*	**RW 40 or 11/16 Socket**
[3] KPT12140	50		**5-1/2**	*[140]*	**3-1/8**	*[80]*								
[3] KPT12180	50		**7-1/8**	*[180]*	**4**	*[100]*								
[3] KPT12200	50		**7-7/8**	*[200]*	**4**	*[100]*								
[3] KPT12220	50		**8-5/8**	*[220]*	**4-3/4**	*[120]*								
[3] KPT12300	50		**11-7/8**	*[300]*	**4-3/4**	*[120]*								

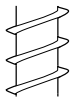
ASSY Kombi LT 3.0

Hex Head Self-Tapping Wood Screw

The ASSY Kombi LT 3.0 is the long threaded version of the ASSY Kombi 3.0, specifically designed for high-performance steel-to-wood connections. Kombi LT 3.0 screws' reinforced and tapered shoulder has the same diameter as the thread, ensuring a tight fit in predrilled steel plate holes while reducing slip.



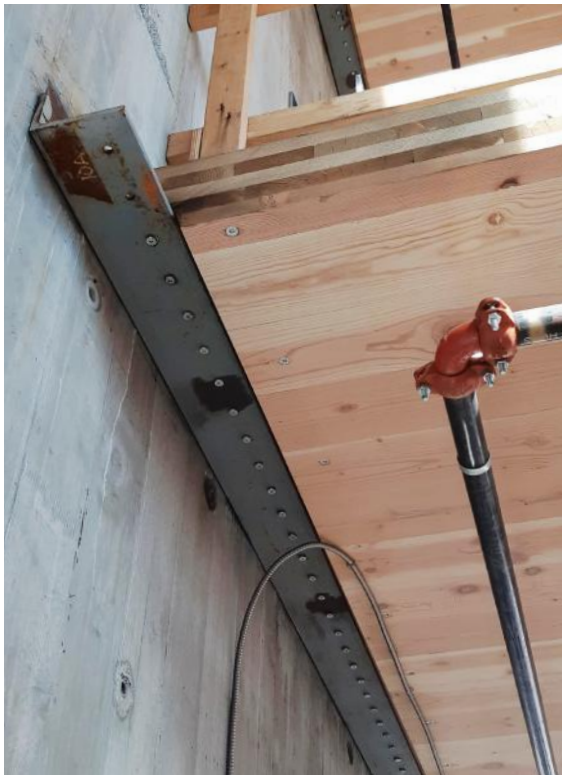
Hex Head

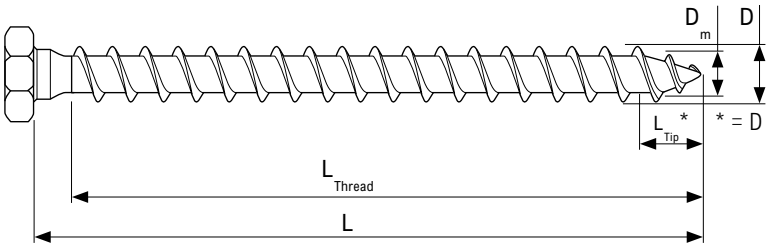


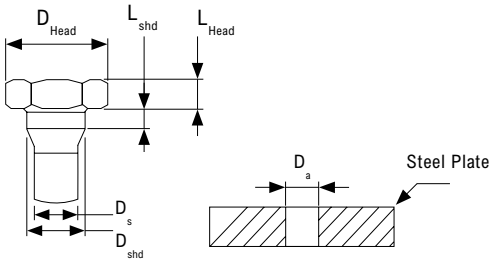
Fully Threaded

Counter Thread Tip

Code Approval	ICC, ETA
Connection Types	Steel / Wood







ASSY KOMBI LT 3.0 - 1/2" [12 mm] DIAMETER

Specification	Packaging Qty.	D	L		L_{Thread}		D_{Head}	D_m	D_s	D_a	D_{shd}	L_{shd}	Drive Bit
Item #		in. *[mm]*	in.	*[mm]*	in.	*[mm]*	in. *[mm]*						
KLT1280	50	1/2 *[12]*	3-1/8	*[80]*	2-3/4	*[70]*	0.669 *[17]*	0.283 *[7.2]*	0.322 *[8.2]*	0.511 *[13]*	0.472 *[12]*	0.126 *[3.2]*	RW 40 or 11/16 Socket
KLT12120	50		4-3/4	*[120]*	4	*[100]*							
KLT12160	50		6-1/4	*[160]*	5-3/4	*[145]*							

Reference Design Values

2.1 - Reference Withdrawal Design Values (W_{90}) For Partially Threaded Fasteners 3.0 Series

Diameter [in.]	W_{90} [lb./in.]				
	Specific Gravity [G]				
	Lumber & Glulam				PSL
	G = 0.35	G = 0.42	G = 0.49	G = 0.55	ESG ≥ 0.50
1/2	211	254	297	334	223

Notes:

1. Reference design values presented in this table are based on the ICC-ESR 3179-2021
2. Tabulated Reference Withdrawal Design Values (W_{90}) apply to screws installed perpendicular to the grain of the wood member. For screws installed at an angle to the wood grain, W_{90} shall be reduced by the appropriate angle to grain reduction factor (R_α) to obtain the applicable angle to grain Withdrawal Design Value [see eq.1].
3. G refers to the specific gravity assigned to the wood species. ESG must be the equivalent specific gravity given in the ICC-ESR evaluation report of PSL.
4. Connection design must meet all relevant requirements of the General Notes to the Designer section.

2.2 - Reference Head Pull-Through Design Values (W_H) For Partially Threaded Fasteners 3.0 Series

Diameter [in.]	Fastener Type	W_H [lb.]				
		Specific Gravity [G]				
		Lumber & Glulam				PSL
		G = 0.35	G = 0.42	G = 0.49	G = 0.55	ESG ≥ 0.50
1/2	SK 3.0	517	627	738	834	939
	Kombi 3.0	257	305	351	390	474

Notes:

1. Reference design values presented in this table are based on the ICC-ESR 3179-2021
2. Design Values are applicable to connections with wood side member thickness of 3 3/16".
3. Connection design must meet all relevant requirements of the Notes to the Designer section.
4. G refers to the specific gravity assigned to the wood species. ESG must be the equivalent specific gravity given in the ICC-ESR evaluation report of PSL.
5. Tabulated head pull-through design values, W_H, are applicable to screws installed perpendicular to the faces of the wood members and must be multiplied by all adjustment factors included in the NDS 2024 for dowel-type fasteners to determine allowable loads for use with ASD and/or design loads for use with LRFD [see eq.2].

2.3 - Fastener Strength Values For Partially Threaded Fasteners 3.0 Series

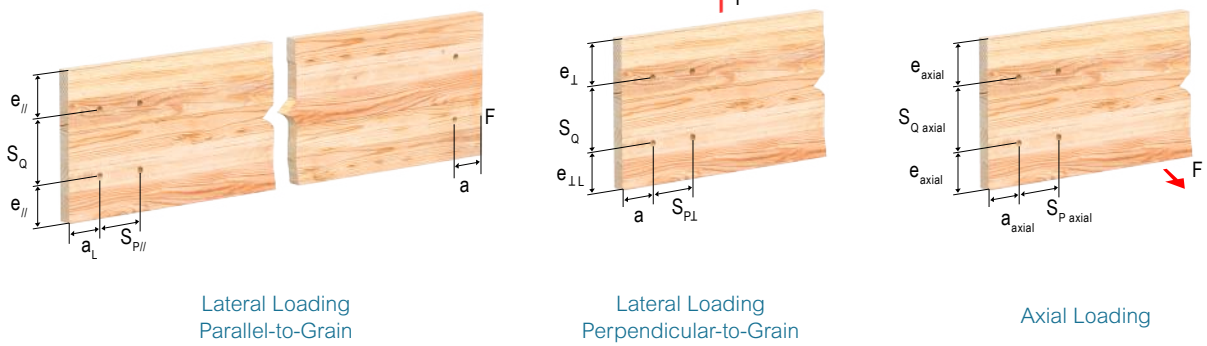
Diameter [in.]	Bending Yield Strength, F_{yb} [psi]	Tensile Strength, T_s [lb.]		Shear Strength, V [lb.]		Allowable Insertion Torque [lb.·ft]
		ASD	LRFD	ASD	LRFD	
1/2	166,300	3,070	4,605	2,095	3,145	32.0

Notes:

1. Connection design must meet all relevant requirements of the General Notes to the Designer section.
2. Bending Yield Strength is determined in accordance with ASTM F1575 using minor diameter of the fastener.
3. The allowable insertion torque is determined in accordance with EAD 130118-01-0603, where the ratio of torsional strength to insertion torque should be at least 1.5.
4. Specified Bending Yield Strength, Tensile resistance and Shear Strength values presented in this table are based on ICC-ESR 3179-2021.

Geometry Requirements

Glulam & Timber



Lateral Loading Parallel-to-Grain

Lateral Loading Perpendicular-to-Grain

Axial Loading

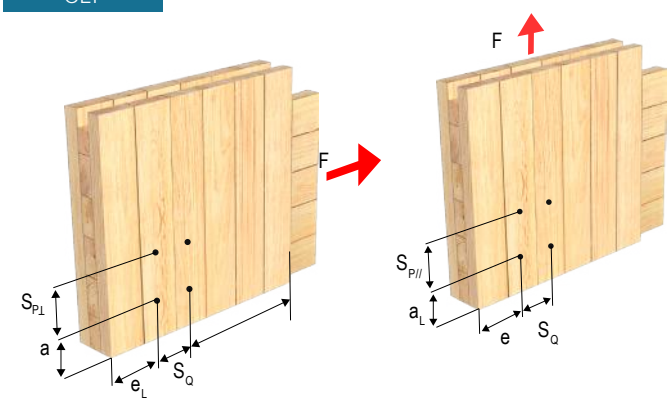
2.4 - Geometry Requirements for Partially Threaded Self-Tapping Screws 3.0 Series

Loading Configuration			Installation Configuration Glulam & Timber			
			Self-Tapping Screws			Predrilling
			G < 0.5	G ≥ 0.5	Douglas Fir	Any G
End Distance	Lateral loading parallel to grain in tension	a_L	15D	20D	22.5D	7D
	Lateral loading parallel to grain in compression	a	10D	15D	22.5D	4D
	Lateral loading perpendicular to grain	a	10D	15D	22.5D	4D
	Axial loading	a_{axial}	10D	10D	15D	4D
Edge Distance	Lateral loading parallel to grain	$e_{//}$	5D	7D	7D	3D
	Lateral loading perpendicular to grain, towards edge	$e_{\perp L}$	10D	12D	12D	4D
	Lateral loading perpendicular to grain, away from edge	$e_{\perp}$	5D	7D	7D	4D
	Axial loading	e_{axial}	4D	4D	7D	3D
Spacing between Fasteners in a Row [parallel to grain]	Lateral loading parallel to grain	$S_{P//}$	15D	15D	15D	4D
	Lateral loading perpendicular to grain	$S_{P\perp}$	10D	10D	10.5D	4D
	Axial loading	$S_{P\ axial}$	7D	7D	10.5D	4D
Spacing between Rows [perpendicular to grain]	Lateral loading parallel to grain	S_Q	5D	7D	7D	5D
	Lateral loading; staggered rows	$S_{Q\,S}$	2.5D	3D	3D	—
	Axial loading (D ≤ 5/16")	$S_{Q\ axial}$	4D	4D	7D	4D
	Axial loading (D > 5/16")	$S_{Q\ axial}$	5D	5D	7D	4D

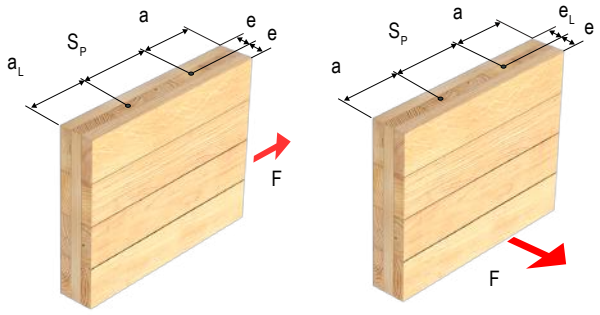
Notes:

1. All connection design must meet all the relevant requirements of the Notes to the Designer section.
2. In wood species sensitive to splitting, minimum geometry requirements may be required to be increased.
3. Values for spacing between staggered rows apply where fasteners in adjacent rows are offset by half of the spacing between fasteners in a row.
4. Within a row, fasteners may be staggered up to 2D to further reduce the potential for splitting.
5. The predrilled geometry requirements are as per NDS 2024, Table 12.5.1.G
6. Minimum geometry requirements provided in this section are meant to provide sufficient end & edge distance as well as spacing between rows and fasteners in a row to prevent splitting.
7. Applying the minimum requirements does not prevent wood failure such as row tear-out, group tear-out, block tear-out, net tension failure or splitting perpendicular-to-grain.

CLT



Fasteners in Plane Surface



Fasteners in Narrow Edge

2.5 - Geometry Requirements for Partially Threaded Self-Tapping Screws 3.0 Series

Loading Configuration			Installation Configuration CLT *[G = 0.42]*			
			Self-Tapping Screws		Predrilling	
			Surface	Edge	Surface	Edge
End Distance	Lateral loading parallel to grain in tension	a_L	6D	12D	6D	7D
	Lateral loading parallel to grain in compression	a	6D	7D	4D	4D
	Lateral loading perpendicular to grain	a	6D	7D	4D	4D
	Axial loading	a_{axial}	6D	7D	4D	4D
Edge Distance	Lateral loading parallel to grain	$e_{//}$	2.5D	3D	3D	3D
	Lateral loading perpendicular to grain, towards edge	$e_{\perp L}$	6D	6D	4D	3D
	Lateral loading perpendicular to grain, away from edge	$e_{\perp}$	2.5D	3D	3D	3D
	Axial loading	e_{axial}	2.5D	3D	3D	3D
Spacing Between Fasteners in a Row [parallel to grain]	Lateral loading parallel to grain	$S_{P//}$	4D	10D	4D	4D
	Lateral loading perpendicular to grain	$S_{P\perp}$	4D	10D	4D	4D
	Axial loading	$S_{P\,axial}$	4D	10D	4D	4D
Spacing Between Rows [perpendicular to grain]	Lateral loading parallel to grain	S_Q	2.5D	4D	4D	4D
	Lateral loading; staggered rows[3,4]	$S_{Q\,S}$	—	—	—	—
	Axial loading (D ≤ 5/16")	$S_{Q\,axial}$	2.5D	4D	4D	4D
	Axial loading (D > 5/16")	$S_{Q\,axial}$	2.5D	4D	4D	4D

Notes:

1. All connection design must meet all the relevant requirements of the Notes to the Designer section.
2. In wood species sensitive to splitting, minimum geometry requirements may be required to be increased.
3. Values for spacing between staggered rows apply where fasteners in adjacent rows are offset by half of the spacing between fasteners in a row.
4. Within a row, fasteners may be staggered up to 2D to further reduce the potential for splitting.
5. The listed values are applicable when the CLT panel thickness is at least 10D.
6. The minimum penetration depth of the screw into the narrow face of the panel shall be at least 10D.
7. Spacing, end and edge distance requirements for self-tapped screws installed in CLT in the tables above were derived according to the methods described in the ETA-11/0190 for self tapping wood screws.
8. The predrilled geometry requirements are as per NDS 2024, Table 12.5.1.G
9. Minimum geometry requirements provided in this section are meant to provide sufficient end & edge distance as well as spacing between rows and fasteners in a row to prevent splitting.
10. Applying the minimum requirements does not prevent wood failure such as row tear-out, group tear-out, block tear-out, net tension failure or splitting perpendicular-to-grain.

Philip J. Currie Dinosaur Museum

Wembley, Alberta

Courtesy of Structurecraft

Partially Threaded Fasteners 4.0 Series

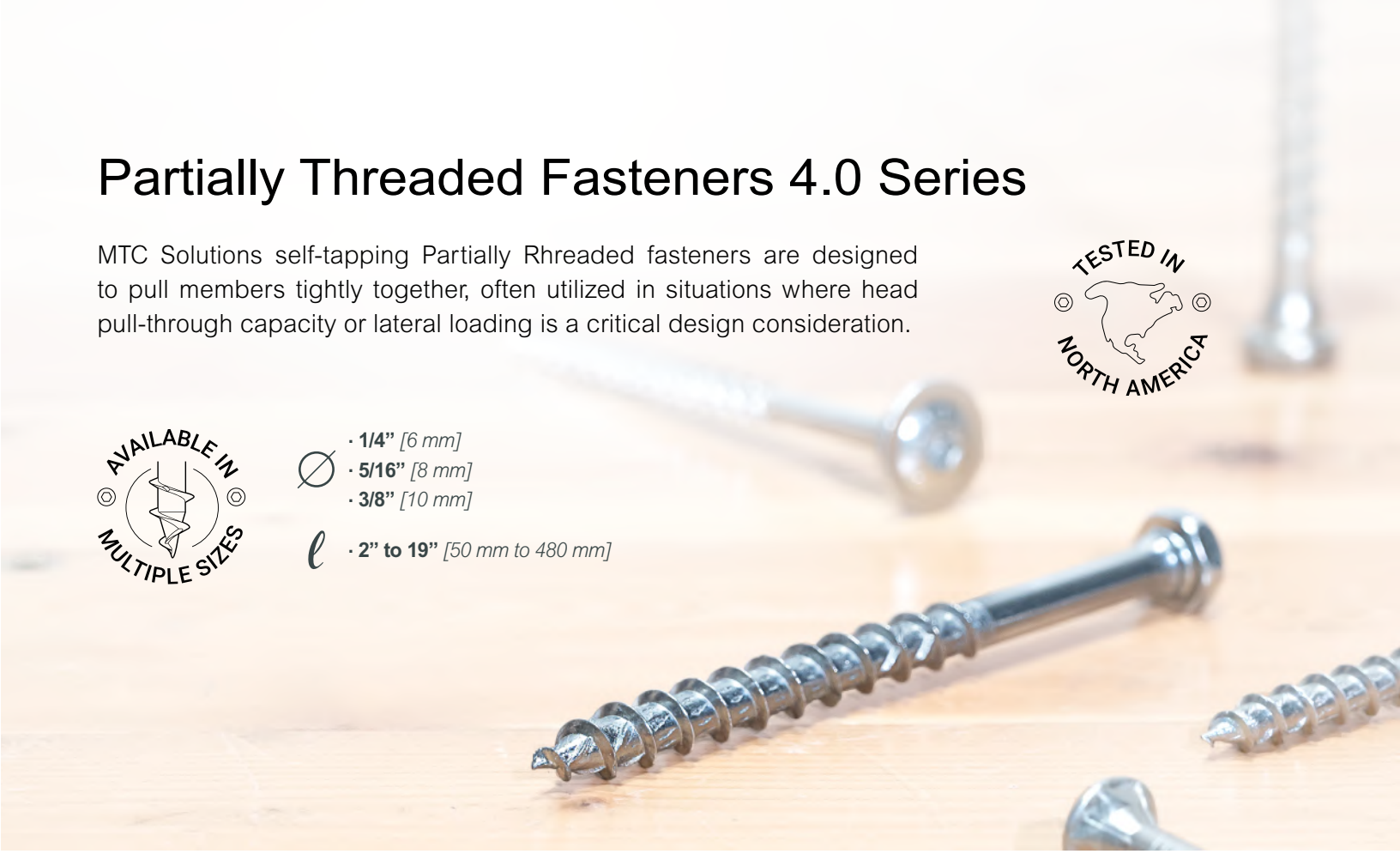
MTC Solutions self-tapping Partially Rhreaded fasteners are designed to pull members tightly together, often utilized in situations where head pull-through capacity or lateral loading is a critical design consideration.

TESTED IN NORTH AMERICA

AVAILABLE IN MULTIPLE SIZES

- **1/4"** *[6 mm]*
- **5/16"** *[8 mm]*
- **3/8"** *[10 mm]*

- **2" to 19"** *[50 mm to 480 mm]*



Engineered Heads


Countersunk Head


Washer Head


Hex Head


Flat Washer Head

Case-Hardened Steel

A ductile core with a high density layer on the edge, providing high bending yield strength & ductility

Coated Steel

Fasteners with a zinc and blue passivated coating for use in dry service conditions

Shank Cutter

Taps a larger hole for the unthreaded portion of the shank, reducing the insertion torque

Large Thread

Provides high withdrawal resistance

Reamer Tip

Reduces the need for predrilling and provides the quickest fastener wood bite

CERTIFICATIONS

ES ICC EVALUATION SERVICE ICC-ESR-3179

ISO 50001
Energy Management System

ETA

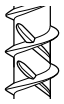
Product Overview

ASSY Ecofast 4.0

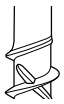
Countersunk Head Self-Tapping Wood Screw

The ASSY Ecofast 4.0 countersunk head is the classic fastener used to achieve a clean and flush architectural finish. The reamer tip of the Ecofast 4.0 reduces wood splitting while offering quick wood fiber engagement.

Countersunk Head with Milling Pockets



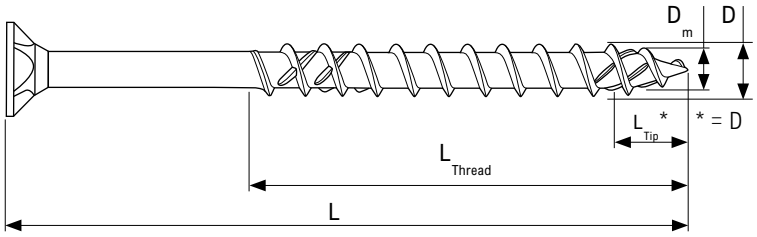
Shank Cutter

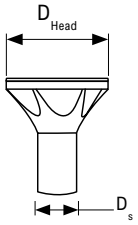


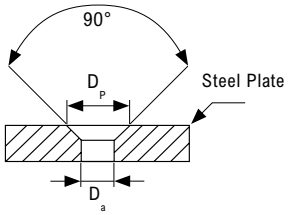
Partially Threaded

Reamer Tip

Code Approval	ICC, ETA
Connection Types	Wood / Wood Steel / Wood







ASSY Ecofast 4.0 - 1/4" [6 mm] DIAMETER

Specification	Packaging Qty.	D	L		L_{Thread}		D_{Head}	D_m	D_s	D_p	D_a	Drive Bit
Item #		in. *[mm]*	in.	*[mm]*	in.	*[mm]*	in. *[mm]*					
[4] ECO0660	200	1/4 *[6]*	2-3/8	*[60]*	1-1/2	*[37]*	0.472 *[12]*	0.154 *[3.9]*	0.173 *[4.4]*	0.634 *[16.1]*	0.278 *[7]*	RW 40
[4] ECO0670	200		2-3/4	*[70]*	1-5/8	*[42]*						
[4] ECO0680	100		3-1/8	*[80]*	2	*[50]*						
[4] ECO0690	100		3-1/2	*[90]*	2	*[50]*						
[4] ECO06100	100		4	*[100]*	2-3/8	*[60]*						
[4] ECO06120	100		4-3/4	*[120]*	2-3/4	*[70]*						
[4] ECO06140	100		5-1/2	*[140]*	2-3/4	*[70]*						
[4] ECO06160	100		6-1/4	*[160]*	2-3/4	*[70]*						
[4] ECO06180	100		7-1/8	*[180]*	2-3/4	*[70]*						
[4] ECO06200	100		7-7/8	*[200]*	2-3/4	*[70]*						
[4] ECO06220	100		8-5/8	*[220]*	2-3/4	*[70]*						
[4] ECO06240	100		9-1/2	*[240]*	2-3/4	*[70]*						
[4] ECO06260	100		10-1/4	*[260]*	2-3/4	*[70]*						
[4] ECO06280	100		11	*[280]*	2-3/4	*[70]*						
[4] ECO06300	100		11-3/4	*[300]*	2-3/4	*[70]*						

ASSY Ecofast 4.0 - 5/16" [8 mm] DIAMETER

Specification	Packaging Qty.	D	L		L_{Thread}		D_{Head}	D_m	D_s	D_p	D_a	Drive Bit
Item #		in. *[mm]*	in.	*[mm]*	in.	*[mm]*	in. *[mm]*					
[4] ECO0880	75	**5/16** *[8]*	**3-1/8**	*[80]*	**2**	*[50]*	**0.583** *[15]*	**0.209** *[5.3]*	**0.228** *[5.8]*	**0.736** *[18.7]*	**0.354** *[9]*	**RW 40**
[4] ECO0890	150		**3-1/2**	*[90]*	**2-3/8**	*[60]*						
[4] ECO08100	75		**4**	*[100]*	**2-3/8**	*[60]*						
[4] ECO08120	75		**4-3/4**	*[120]*	**3-1/8**	*[80]*						
[4] ECO08140	75		**5-1/2**	*[140]*	**3-1/8**	*[80]*						
[4] ECO08160	75		**6-1/4**	*[160]*	**3-1/8**	*[80]*						
[4] ECO08180	75		**7-1/8**	*[180]*	**3-1/8**	*[80]*						
[4] ECO08200	75		**7-7/8**	*[200]*	**3-1/8**	*[80]*						
[4] ECO08220	75		**8-5/8**	*[220]*	**4**	*[100]*						
[4] ECO08240	75		**9-1/2**	*[240]*	**4**	*[100]*						
[4] ECO08260	75		**10-1/4**	*[260]*	**4**	*[100]*						
[4] ECO08280	75		**11**	*[280]*	**4**	*[100]*						
[4] ECO08300	75		**11-7/8**	*[300]*	**4**	*[100]*						
[4] ECO08320	100		**12-5/8**	*[320]*	**4**	*[100]*						
[4] ECO08340	100		**13-3/8**	*[340]*	**4**	*[100]*						
[4] ECO08360	100		**14-1/4**	*[360]*	**4**	*[100]*						
[4] ECO08380	100		**15**	*[380]*	**4**	*[100]*						
[4] ECO08400	100		**15-3/4**	*[400]*	**4**	*[100]*						

ASSY Ecofast 4.0 - 3/8" [10 mm] DIAMETER

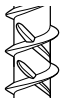
Specification	Packaging Qty.	D	L		L_{Thread}		D_{Head}	D_m	D_s	D_p	D_a	Drive Bit
Item #		in. *[mm]*	in.	*[mm]*	in.	*[mm]*	in. *[mm]*					
[4] ECO1080	50	**3/8** *[10]*	**3-1/8**	*[80]*	**2**	*[50]*	**0.728** *[18.5]*	**0.256** *[6.5]*	**0.283** *[7.2]*	**0.889** *[22.6]*	**0.433** *[11]*	**RW 40**
[4] ECO10100	50		**4**	*[100]*	**2-3/8**	*[60]*						
[4] ECO10120	50		**4-3/4**	*[120]*	**3-1/8**	*[80]*						
[4] ECO10140	50		**5-1/2**	*[140]*	**3-1/8**	*[80]*						
[4] ECO10160	50		**6-1/4**	*[160]*	**4**	*[100]*						
[4] ECO10180	50		**7-1/8**	*[180]*	**4**	*[100]*						
[4] ECO10200	50		**7-7/8**	*[200]*	**4**	*[100]*						
[4] ECO10220	50		**8-5/8**	*[220]*	**4**	*[100]*						
[4] ECO10240	50		**9-1/2**	*[240]*	**4**	*[100]*						
[4] ECO10260	50		**10-1/4**	*[260]*	**4**	*[100]*						
[4] ECO10280	50		**11**	*[280]*	**4**	*[100]*						
[4] ECO10300	50		**11-7/8**	*[300]*	**4**	*[100]*						
[4] ECO10320	50		**12-5/8**	*[320]*	**4-3/4**	*[120]*						
[4] ECO10360	50		**14-1/4**	*[360]*	**4-3/4**	*[120]*						
[4] ECO10400	50		**15-3/4**	*[400]*	**4-3/4**	*[120]*						

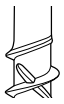
ASSY SK 4.0

Washer Head Self-Tapping Wood Screw

The ASSY SK 4.0 is engineered to support a high head pull-through capacity making it a perfect fit for wood-to-wood applications. The large head of the SK screw eliminates the need for a washer when installing.

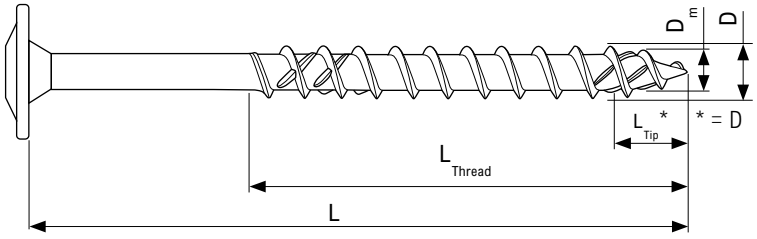

Washer Head

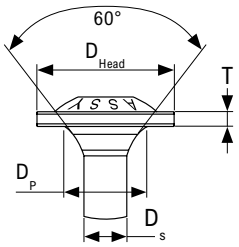

Shank Cutter


Partially Threaded


Reamer Tip

Code Approval	ICC, ETA
Connection Types	Wood / Wood Steel / Wood





ASSY SK 4.0 - 1/4" [6 mm] DIAMETER

Specification	Packaging Qty.	D	L		L_{Thread}		D_{Head}	D_m	D_s	D_p	T	Drive Bit
Item #		in. *[mm]*	in.	*[mm]*	in.	*[mm]*	in. *[mm]*					
[4] SK0650	100	1/4 *[6]*	**2**	*[50]*	**1-3/4**	*[45]*	**0.551** *[14]*	**0.154** *[3.9]*	**0.175** *[4.4]*	**0.315** *[8]*	**0.047** *[1.2]*	**RW 40**
[4] SK0660	100		**2-3/8**	*[60]*	**1-1/2**	*[37]*						
[4] SK0670	100		**2-3/4**	*[70]*	**1-5/8**	*[42]*						
[4] SK0680	100		**3-1/8**	*[80]*	**2**	*[50]*						
[4] SK0690	100		**3-1/2**	*[90]*	**2**	*[50]*						
[4] SK06100	100		**4**	*[100]*	**2-3/8**	*[60]*						
[4] SK06120	100		**4-3/4**	*[120]*	**2-3/4**	*[70]*						
[4] SK06140	100		**5-1/2**	*[140]*	**2-3/4**	*[70]*						
[4] SK06160	100		**6-1/4**	*[160]*	**2-3/4**	*[70]*						
[4] SK06180	100		**7-1/8**	*[180]*	**2-3/4**	*[70]*						
[4] SK06200	100		**7-7/8**	*[200]*	**2-3/4**	*[70]*						
[4] SK06220	100		**8-5/8**	*[220]*	**2-3/4**	*[70]*						
[4] SK06240	100		**9-1/2**	*[240]*	**2-3/4**	*[70]*						
[4] SK06260	100		**10-1/4**	*[260]*	**2-3/4**	*[70]*						
[4] SK06280	100		**11**	*[280]*	**2-3/4**	*[70]*						
[4] SK06300	100		**11-7/8**	*[300]*	**2-3/4**	*[70]*						

ASSY SK 4.0 - 5/16" [8 mm] DIAMETER

Specification	Packaging Qty.	D	L		L_{Thread}		D_{Head}	D_m	D_s	D_p	T	Drive Bit
Item #		in. *[mm]*	in.	*[mm]*	in.	*[mm]*	in. *[mm]*					
[4] SK0860	50	5/16 *[8]*	2-3/8	*[60]*	2	*[50]*	0.870 *[22.1]*	0.209 *[5.3]*	0.228 *[5.8]*	0.394 *[10]*	0.071 *[1.8]*	RW 40
[4] SK0880	50		3-1/8	*[80]*	2	*[50]*						
[4] SK08100	50		4	*[100]*	2-3/8	*[60]*						
[4] SK08120	50		4-3/4	*[120]*	3-1/8	*[80]*						
[4] SK08140	50		5-1/2	*[140]*	3-1/8	*[80]*						
[4] SK08160	50		6-1/4	*[160]*	3-1/8	*[80]*						
[4] SK08180	50		7-1/8	*[180]*	3-1/8	*[80]*						
[4] SK08200	50		7-7/8	*[200]*	3-1/8	*[80]*						
[4] SK08220	50		8-5/8	*[220]*	4	*[100]*						
[4] SK08240	50		9-1/2	*[240]*	4	*[100]*						
[4] SK08260	50		10-1/4	*[260]*	4	*[100]*						
[4] SK08280	50		11	*[280]*	4	*[100]*						
[4] SK08300	50		11-7/8	*[300]*	4	*[100]*						
[4] SK08320	50		12-5/8	*[320]*	4	*[100]*						
[4] SK08340	50		13-3/8	*[340]*	4	*[100]*						
[4] SK08360	50		14-1/4	*[360]*	4	*[100]*						
[4] SK08380	50		15	*[380]*	4	*[100]*						
[4] SK08400	50		15-3/4	*[400]*	4	*[100]*						
[4] SK08420	50		16-1/2	*[420]*	4	*[100]*						
[4] SK08440	50		17-1/4	*[440]*	4	*[100]*						
[4] SK08480	25		19	*[480]*	4	*[100]*						
[4] SK08500	25		19-5/8	*[500]*	4	*[100]*						

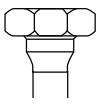
ASSY SK 4.0 - 3/8" [10 mm] DIAMETER

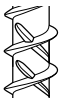
Specification	Packaging Qty.	D	L		L_{Thread}		D_{Head}	D_m	D_s	D_p	T	Drive Bit
Item #		in. *[mm]*	in.	*[mm]*	in.	*[mm]*	in. *[mm]*					
[4] SK10100	50	3/8 *[10]*	4	*[100]*	2-3/8	*[60]*	0.992 *[25.2]*	0.256 *[6.5]*	0.283 *[7.2]*	0.531 *[13.5]*	0.087 *[2.2]*	RW 50
[4] SK10120	50		4-3/4	*[120]*	3-1/8	*[80]*						
[4] SK10140	50		5-1/2	*[140]*	3-1/8	*[80]*						
[4] SK10160	50		6-1/4	*[160]*	4	*[100]*						
[4] SK10180	50		7-1/8	*[180]*	4	*[100]*						
[4] SK10200	50		7-7/8	*[200]*	4	*[100]*						
[4] SK10220	50		8-5/8	*[220]*	4	*[100]*						
[4] SK10240	50		9-1/2	*[240]*	4	*[100]*						
[4] SK10260	50		10-1/4	*[260]*	4	*[100]*						
[4] SK10280	50		11	*[280]*	4	*[100]*						
[4] SK10300	50		11-7/8	*[300]*	4	*[100]*						
[4] SK10320	50		12-5/8	*[320]*	4-3/4	*[120]*						
[4] SK10340	50		13-3/8	*[340]*	4-3/4	*[120]*						
[4] SK10360	50		14-1/4	*[360]*	4-3/4	*[120]*						
[4] SK10380	50		15	*[380]*	4-3/4	*[120]*						
[4] SK10400	50		15-3/4	*[400]*	4-3/4	*[120]*						
[4] SK10460	25		18-1/8	*[460]*	4-3/4	*[120]*						

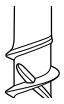
ASSY Kombi 4.0

Hex Head Self-Tapping Wood Screw

The ASSY Kombi 4.0 is specifically designed for high-performance steel-to-wood connections. The reinforced and tapered shoulder has the same diameter as the thread of the Kombi, ensuring a tight fit in predrilled steel plate holes while reducing slip.

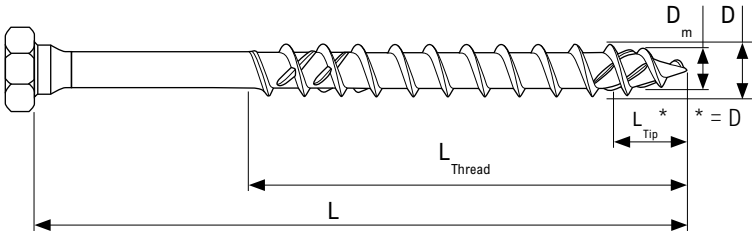

Hex Head

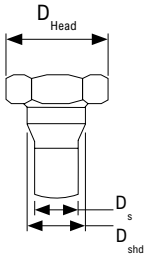

Shank Cutter

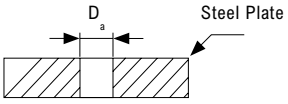

Partially Threaded


Reamer Tip

Code Approval	ICC, ETA
Connection Types	Steel / Wood







ASSY Kombi 4.0 - 5/16" [8 mm] DIAMETER

Specification	Packaging Qty.	D	L		L_{Thread}		D_{Head}	D_m	D_s	D_a	D_{shd}	Drive Bit
Item #		in. *[mm]*	in.	*[mm]*	in.	*[mm]*	in. *[mm]*					
[4] KPT0860	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]*	0.315 *[8]*	RW 40 or 1/2 Hex Socket
[4] KPT0880	75		3-1/8	*[80]*	2	*[50]*						
[4] KPT08100	75		4	*[100]*	2-3/8	*[60]*						
[4] KPT08120	75		4-3/4	*[120]*	3-1/8	*[80]*						
[4] KPT08140	75		5-1/2	*[140]*	3-1/8	*[80]*						
[4] KPT08160	75		6-1/4	*[160]*	3-1/8	*[80]*						
[4] KPT08180	75		7-1/8	*[180]*	3-1/8	*[80]*						
[4] KPT08200	75		7-7/8	*[200]*	3-1/8	*[80]*						
[4] KPT08240	75		9-1/2	*[240]*	4	*[100]*						
[4] KPT08300	75		11-7/8	*[300]*	4	*[100]*						

ASSY Kombi 4.0 - 3/8" [10 mm] DIAMETER

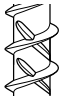
Specification	Packaging Qty.	D	L		L_{Thread}		D_{Head}	D_m	D_s	D_a	D_{shd}	Drive Bit
Item #		in. *[mm]*	in.	*[mm]*	in.	*[mm]*	in. *[mm]*					
[4] KPT1080	50	**3/8** *[10]*	**3-1/8**	*[80]*	**2**	*[50]*	**0.591** *[15]*	**0.256** *[6.5]*	**0.283** *[7.2]*	**0.433** *[11]*	**0.394** *[10]*	**RW 40 or 19/32 Hex Socket**
[4] KPT10100	50		**4**	*[100]*	**2-3/8**	*[60]*						
[4] KPT10120	50		**4-3/4**	*[120]*	**3-1/8**	*[80]*						
[4] KPT10140	50		**5-1/2**	*[140]*	**3-1/8**	*[80]*						
[4] KPT10160	50		**6-1/4**	*[160]*	**4**	*[100]*						
[4] KPT10180	50		**7-1/8**	*[180]*	**4**	*[100]*						
[4] KPT10200	50		**7-7/8**	*[200]*	**4**	*[100]*						
[4] KPT10300	50		**11-7/8**	*[300]*	**4**	*[100]*						

ASSY FWH 4.0

Flat washer-head self-tapping wood screw

The ASSY FWH 4.0 is a multi-purpose fastener that combines the pulling power of the washer-head screw with the clean flush finish of the countersunk-head screws. FWH screws are engineered to accommodate multilayer connections and roof membrane applications.

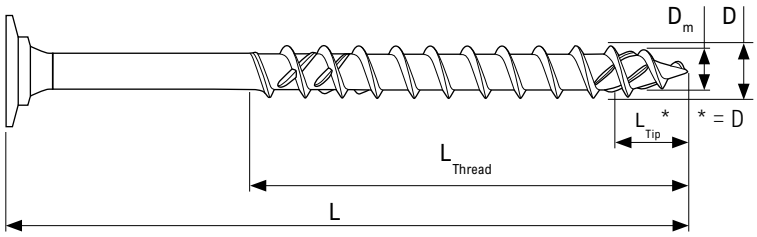

Flat Washer Head

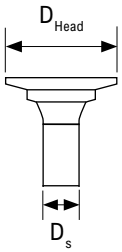

Shank Cutter


Partially Threaded


Reamer Tip

Code Approval	ICC, ETA
Connection Types	Wood / Wood





ASSY FWH 4.0 - 5/16" [8 mm] DIAMETER

Specification	Packaging Qty.	D	L		L_{Thread}		D_{Head}	D_m	D_s	Drive Bit
Item #		in. *[mm]*	in.	*[mm]*	in.	*[mm]*	in. *[mm]*			
[4] FWH08080	50	**5/16** *[8]*	**3-1/8**	*[80]*	**2**	*[50]*	**0.724** *[18.4]*	**0.209** *[5.3]*	**0.228** *[5.8]*	**RW 40**
[4] FWH08100	50		**4**	*[100]*	**2-3/8**	*[60]*				
[4] FWH08160	50		**6-1/4**	*[160]*	**3-1/8**	*[80]*				
[4] FWH08200	50		**7-7/8**	*[200]*	**3-1/8**	*[80]*				
[4] FWH08240	50		**9-1/2**	*[240]*	**4**	*[100]*				
[4] FWH08300	50		**11-7/8**	*[300]*	**4**	*[100]*				
[4] FWH08360	50		**14-1/4**	*[360]*	**4**	*[100]*				
[4] FWH08400	50		**15-3/4**	*[400]*	**4**	*[100]*				

Reference Design Values

3.1 - Reference Withdrawal Design Values (W_{90}) For Partially Threaded Fasteners 4.0 Series

Diameter [in.]	W_{90} [lb./in.]				
	Specific Gravity [G]				
	Lumber & Glulam				PSL
	G = 0.35	G = 0.42	G = 0.49	G = 0.55	ESG ≥ 0.50
1/4	137	169	202	230	156
5/16	176	212	248	279	179
3/8	190	237	280	317	211

Notes:

1. Reference design values presented in this table are based on the ICC-ESR 3179-2021
2. Tabulated Reference Withdrawal Design Values (W_{90}) apply to screws installed perpendicular to the grain of the wood member. For screws installed at an angle to the wood grain, W_{90} shall be reduced by the appropriate angle to grain reduction factor (R_α) to obtain the applicable angle to grain Withdrawal Design Value [see eq.1].
3. G refers to the specific gravity assigned to the wood species. ESG must be the equivalent specific gravity given in the ICC-ESR evaluation report of PSL.
4. Connection design must meet all relevant requirements of the General Notes to the Designer section.

3.2 - Reference Head Pull-Through Design Values (W_H) For Partially Threaded Fasteners 4.0 Series

Diameter [in.]	Fastener Type	W_H [lb.]				
		Specific Gravity [G]				
		Lumber & Glulam				PSL
		G = 0.35	G = 0.42	G = 0.49	G = 0.55	ESG ≥ 0.50
1/4	Ecofast 4.0	133	163	194	221	262
	SK 4.0	244	299	356	407	440
5/16	Ecofast 4.0	187	232	277	318	327
	SK 4.0	410	510	604	685	732
	Kombi 4.0	146	188	233	275	326
	FWH 4.0	—	406	480	—	—
3/8	Ecofast 4.0	246	319	385	445	509
	SK 4.0	513	593	660	710	797
	Kombi 4.0	225	278	327	369	420

Notes:

1. Reference design values presented in this table are based on the ICC-ESR 3179-2021
2. Design Values are applicable to connections with wood side member thickness of 1 3/8".
3. Connection design must meet all relevant requirements of the Notes to the Designer section.
4. G refers to the specific gravity assigned to the wood species. ESG must be the equivalent specific gravity given in the ICC-ESR evaluation report of PSL.
5. Tabulated head pull-through design values, W_H, are applicable to screws installed perpendicular to the faces of the wood members and must be multiplied by all adjustment factors included in the NDS 2024 for dowel-type fasteners to determine allowable loads for use with ASD and/or design loads for use with LRFD [see eq.2].

3.3 - Fastener Strength Values For Partially Threaded Fasteners 4.0 Series

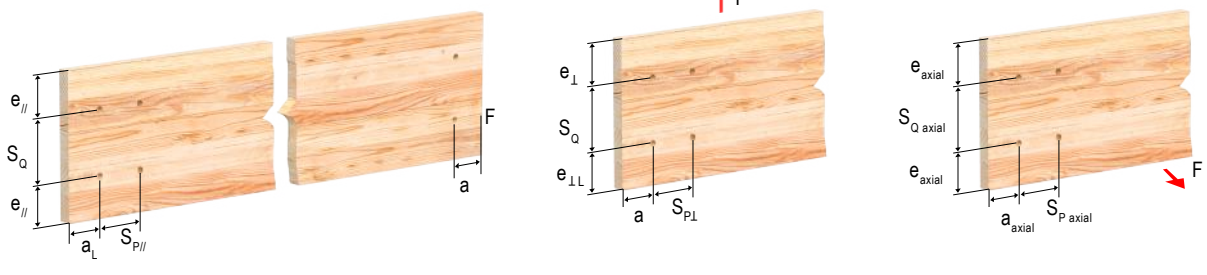
Diameter [in.]	Bending Yield Strength, F_{yb} [psi]	Tensile Strength, T_s [lb.]		Shear Strength, V [lb.]		Allowable Insertion Torque [lb.·ft]
		ASD	LRFD	ASD	LRFD	
1/4	181,200	1,075	1,610	700	1,050	4.9
5/16	164,600	1,790	2,685	1,220	1,830	11.3
3/8	170,200	2,690	4,040	1,930	2,890	22.1

Notes:

1. Connection design must meet all relevant requirements of the General Notes to the Designer section.
2. Bending Yield Strength is determined in accordance with ASTM F1575 using minor diameter of the fastener.
3. The allowable insertion torque is determined in accordance with EAD 130118-01-0603, where the ratio of torsional strength to insertion torque should be at least 1.5.
4. Specified Bending Yield Strength, Tensile resistance and Shear Strength values presented in this table are based on ICC-ESR 3179-2021.

Geometry Requirements

Glulam & Timber



Lateral Loading Parallel-to-Grain

Lateral Loading Perpendicular-to-Grain

Axial Loading

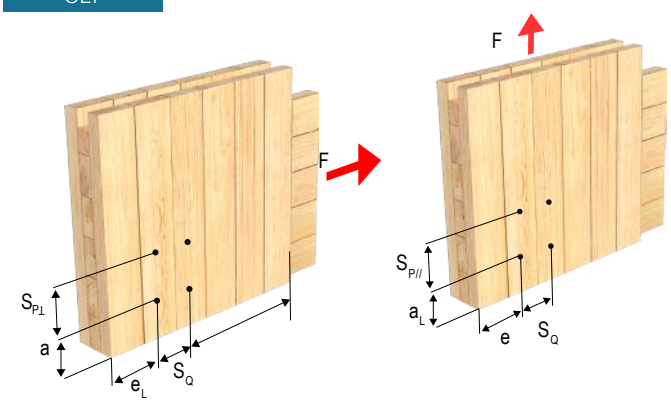
3.4 - Geometry requirements for Partially Threaded Self-Tapping Screws 4.0 Series

Loading Configuration			Installation Configuration Glulam & Timber			
			Self-Tapping Screws			Predrilling
			G < 0.5	G ≥ 0.5	Douglas Fir	Any G
End Distance	Lateral loading parallel to grain in tension	a_L	15D	20D	22.5D	7D
	Lateral loading parallel to grain in compression	a	10D	15D	22.5D	4D
	Lateral loading perpendicular to grain	a	10D	15D	22.5D	4D
	Axial loading	a_{axial}	10D	10D	15D	4D
Edge Distance	Lateral loading parallel to grain	$e_{//}$	5D	7D	7D	3D
	Lateral loading perpendicular to grain, towards edge	$e_{\perp L}$	10D	12D	12D	4D
	Lateral loading perpendicular to grain, away from edge	$e_{\perp}$	5D	7D	7D	4D
	Axial loading	e_{axial}	4D	4D	7D	3D
Spacing between Fasteners in a Row [parallel to grain]	Lateral loading parallel to grain	$S_{P//}$	15D	15D	15D	4D
	Lateral loading perpendicular to grain	$S_{P\perp}$	10D	10D	10.5D	4D
	Axial loading	$S_{P\ axial}$	7D	7D	10.5D	4D
Spacing between Rows [perpendicular to grain]	Lateral loading parallel to grain	S_Q	5D	7D	7D	5D
	Lateral loading; staggered rows	$S_{Q\,S}$	2.5D	3D	3D	—
	Axial loading (D ≤ 5/16")	$S_{Q\ axial}$	4D	4D	7D	4D
	Axial loading (D > 5/16")	$S_{Q\ axial}$	5D	5D	7D	4D

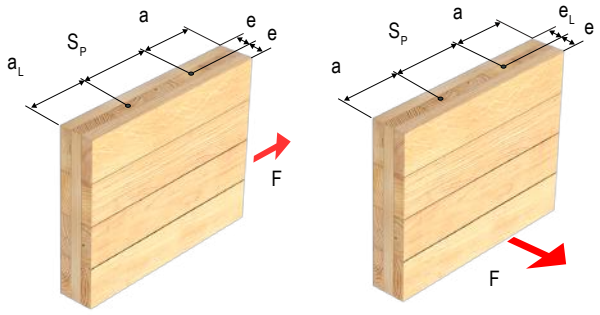
Notes:

1. All connection design must meet all the relevant requirements of the Notes to the Designer section.
2. In wood species sensitive to splitting, minimum geometry requirements may be required to be increased.
3. Values for spacing between staggered rows apply where fasteners in adjacent rows are offset by half of the spacing between fasteners in a row.
4. Within a row, fasteners may be staggered up to 2D to further reduce the potential for splitting.
5. The predrilled geometry requirements are as per NDS 2024, Table 12.5.1.G
6. Minimum geometry requirements provided in this section are meant to provide sufficient end & edge distance as well as spacing between rows and fasteners in a row to prevent splitting.
7. Applying the minimum requirements does not prevent wood failure such as row tear-out, group tear-out, block tear-out, net tension failure or splitting perpendicular-to-grain.

CLT



Fasteners in Plane Surface



Fasteners in Narrow Edge

3.5 - Geometry Requirements for Partially Threaded Self-Tapping Screws 4.0 Series

Loading Configuration			Installation Configuration CLT *[G = 0.42]*			
			Self-Tapping Screws		Predrilling	
			Surface	Edge	Surface	Edge
End Distance	Lateral loading parallel to grain in tension	a_L	6D	12D	6D	7D
	Lateral loading parallel to grain in compression	a	6D	7D	4D	4D
	Lateral loading perpendicular to grain	a	6D	7D	4D	4D
	Axial loading	a_{axial}	6D	7D	4D	4D
Edge Distance	Lateral loading parallel to grain	$e_{//}$	2.5D	3D	3D	3D
	Lateral loading perpendicular to grain, towards edge	$e_{\perp L}$	6D	6D	4D	3D
	Lateral loading perpendicular to grain, away from edge	$e_{\perp}$	2.5D	3D	3D	3D
	Axial loading	e_{axial}	2.5D	3D	3D	3D
Spacing Between Fasteners in a Row [parallel to grain]	Lateral loading parallel to grain	$S_{P//}$	4D	10D	4D	4D
	Lateral loading perpendicular to grain	$S_{P\perp}$	4D	10D	4D	4D
	Axial loading	$S_{P\ axial}$	4D	10D	4D	4D
Spacing Between Rows [perpendicular to grain]	Lateral loading parallel to grain	S_Q	2.5D	4D	4D	4D
	Lateral loading; staggered rows[3,4]	$S_{Q\ S}$	—	—	—	—
	Axial loading (D ≤ 5/16")	$S_{Q\ axial}$	2.5D	4D	4D	4D
	Axial loading (D > 5/16")	$S_{Q\ axial}$	2.5D	4D	4D	4D

Notes:

1. All connection design must meet all the relevant requirements of the Notes to the Designer section.
2. In wood species sensitive to splitting, minimum geometry requirements may be required to be increased.
3. Values for spacing between staggered rows apply where fasteners in adjacent rows are offset by half of the spacing between fasteners in a row.
4. Within a row, fasteners may be staggered up to 2D to further reduce the potential for splitting.
5. The listed values are applicable when the CLT panel thickness is at least 10D.
6. The minimum penetration depth of the screw into the narrow face of the panel shall be at least 10D.
7. Spacing, end and edge distance requirements for self-tapped screws installed in CLT in the tables above were derived according to the methods described in the ETA-11/0190 for self tapping wood screws.
8. The predrilled geometry requirements are as per NDS 2024, Table 12.5.1.G
9. Minimum geometry requirements provided in this section are meant to provide sufficient end & edge distance as well as spacing between rows and fasteners in a row to prevent splitting.
10. Applying the minimum requirements does not prevent wood failure such as row tear-out, group tear-out, block tear-out, net tension failure or splitting perpendicular-to-grain.

First Tech Federal Credit Union

Hillsboro, Oregon

Courtesy of Swinerton

Fully Threaded Fasteners Series

MTC Solutions self-tapping Fully Threaded fasteners are designed to hold wood members firmly in place, often utilized to take advantage of their high withdrawal capacity during axial loading. These fasteners may be used at all installation angles but 90°.

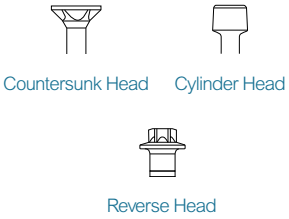
TESTED IN NORTH AMERICA

AVAILABLE IN MULTIPLE SIZES

- ∅ · **1/4”** *[6 mm]*
- ∅ · **5/16”** *[8 mm]*
- ∅ · **3/8”** *[10 mm]*
- ∅ · **1/2”** *[12 mm]*
- ∅ · **9/16”** *[14 mm]*

- ℓ · **3 1/8” to 59”** *[80 mm to 1500 mm]*

Engineered Heads



Case-Hardened Steel

A ductile core with a high density layer on the edge, providing high bending yield strength & ductility

Coated Steel

Fasteners with a zinc and blue passivated coating for use in dry service conditions

Large Thread

Provides high withdrawal resistance

Drilling Tip

Reduces both the need for predrilling and the typical geometry requirements

CERTIFICATIONS

ES ICC EVALUATION SERVICE — ICC-ESR-3178

CCMC 13677-R

ISO 50001 Energy Management System

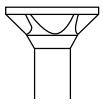
ETA

Product Overview

ASSY VG CSK

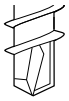
Countersunk Head Self-Tapping Wood Screw

The ASSY VG CSK is a multi-purpose fastener, suitable for wood reinforcement, wood-to-wood and steel-to-wood connections.



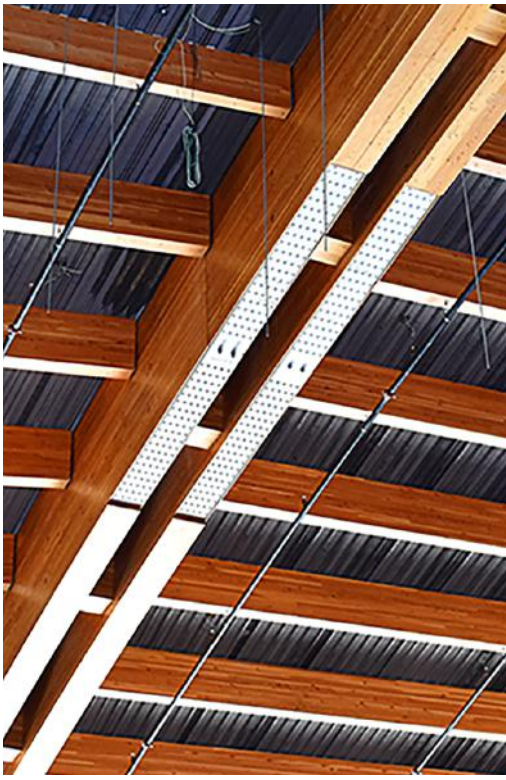
Countersunk Head with Milling Pockets

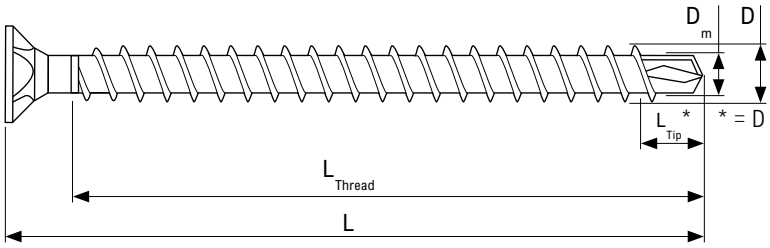
Fully Threaded

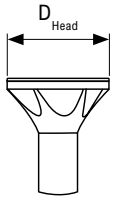


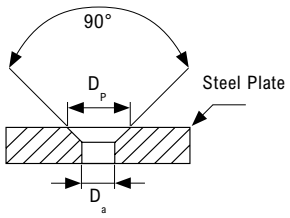
Drilling Tip

Code Approval	ICC, CCMC, ETA
Connection Types	Wood / Wood Steel / Wood Concrete / Wood









ASSY VG CSK - 5/16" [8 mm] DIAMETER

Specification	Packaging Qty.	D	L		L_{Thread}		D_{Head}	D_m	D_a	D_p	Drive Bit
Item #		in. *[mm]*	in.	*[mm]*	in.	*[mm]*	in. *[mm]*				
CSK0880	75	5/16 *[8]*	3-1/8	*[80]*	2-1/2	*[61]*	0.583 *[15]*	0.197 *[5]*	0.354 *[9]*	0.736 *[18.7]*	RW 40
CSK08120	75		4-3/4	*[120]*	4	*[103]*					
CSK08140	75		5-1/2	*[140]*	4-7/8	*[123]*					
CSK08160	75		6-1/4	*[160]*	5-5/8	*[143]*					
CSK08180	75		7-1/8	*[180]*	6-3/8	*[163]*					
CSK08200	75		7-7/8	*[200]*	7-1/4	*[183]*					
CSK08220	75		8-5/8	*[220]*	8	*[203]*					
CSK08240	75		9-1/2	*[240]*	8-3/4	*[223]*					
CSK08260	75		10-1/4	*[260]*	9-5/8	*[243]*					
CSK08280	75		11	*[280]*	10-3/8	*[263]*					
CSK08300	75		11-7/8	*[300]*	11-1/8	*[283]*					

ASSY VG CSK - 3/8" [10 mm] DIAMETER

Specification	Packaging Qty.	D	L		L_{Thread}		D_{Head}	D_m	D_a	D_p	Drive Bit
Item #		in. *[mm]*	in.	*[mm]*	in.	*[mm]*	in. *[mm]*				
CSK10100	50	3/8 *[10]*	4	*[100]*	3	*[77]*	0.774 *[20]*	0.244 *[6.2]*	0.433 *[11]*	0.984 *[25]*	RW 50
CSK10120	50		4-3/4	*[120]*	4-1/8	*[102]*					
CSK10140	50		5-1/2	*[140]*	4-7/8	*[125]*					
CSK10160	50		6-1/4	*[160]*	5-3/4	*[145]*					
CSK10180	50		7-1/8	*[180]*	6-1/2	*[165]*					
CSK10200	50		7-7/8	*[200]*	7-1/4	*[185]*					
CSK10220	50		8-5/8	*[220]*	8-1/8	*[205]*					
CSK10240	50		9-1/2	*[240]*	8-7/8	*[225]*					
CSK10260	50		10-1/4	*[260]*	9-5/8	*[245]*					
CSK10280	50		11	*[280]*	10-3/8	*[265]*					
CSK10300	50		11-7/8	*[300]*	11-1/4	*[285]*					
CSK10320	50		12-5/8	*[320]*	12	*[305]*					
CSK10340	50		13-3/8	*[340]*	12-3/4	*[325]*					
CSK10360	50		14-1/4	*[360]*	13-5/8	*[345]*					
CSK10380	50		15	*[380]*	14-3/8	*[365]*					
CSK10400	50		15-3/4	*[400]*	15-1/8	*[385]*					
CSK10430	25		16-7/8	*[430]*	16-3/8	*[415]*					
CSK10480	25		19	*[480]*	18-1/4	*[465]*					
CSK10530	25		20-7/8	*[530]*	20-1/8	*[512]*					
CSK10580	25		22-7/8	*[580]*	22-1/8	*[562]*					
CSK10650	25		25-5/8	*[650]*	24-7/8	*[632]*					
CSK10700	25		27-5/8	*[700]*	26-7/8	*[682]*					
CSK10750	25		29-1/2	*[750]*	28-7/8	*[732]*					
CSK10800	25		31-1/2	*[800]*	30-3/4	*[782]*					

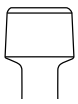
ASSY VG CSK - 1/2" [12 mm] DIAMETER

Specification	Packaging Qty.	D	L		L_{Thread}		D_{Head}	D_m	D_a	D_p	Drive Bit
Item #		in. *[mm]*	in.	*[mm]*	in.	*[mm]*	in. *[mm]*				
CSK12120	50	1/2 *[12]*	4-3/4	*[120]*	4-1/8	*[105]*	0.868 *[22]*	0.280 *[7.1]*	0.512 *[13]*	1.063 *[27]*	RW 50
CSK12140	50		5-1/2	*[140]*	4-7/8	*[125]*					
CSK12160	50		6-1/4	*[160]*	5-3/4	*[145]*					
CSK12180	50		7-1/8	*[180]*	6-1/2	*[165]*					
CSK12200	50		7-7/8	*[200]*	7-1/4	*[185]*					
CSK12220	50		8-5/8	*[220]*	8-1/8	*[205]*					
CSK12240	50		9-1/2	*[240]*	8-7/8	*[225]*					
CSK12260	50		10-1/4	*[260]*	9-5/8	*[245]*					
CSK12280	50		11	*[280]*	10-3/8	*[265]*					
CSK12300	50		11-7/8	*[300]*	11-1/4	*[285]*					
CSK12380	50		15	*[380]*	14-3/8	*[365]*					
CSK12480	25		19	*[480]*	18-1/4	*[465]*					
CSK12600	25		23-5/8	*[600]*	23	*[585]*					

ASSY VG CYL

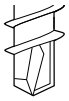
Cylinder Head Self-Tapping Wood Screw

The ASSY VG CYL, with its small and easily concealed head, is ideal for wood reinforcement and concealed connections.



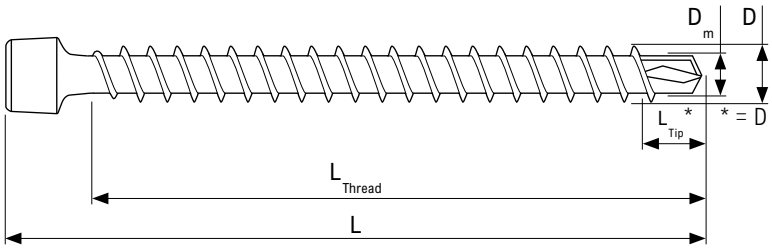
Cylinder Head

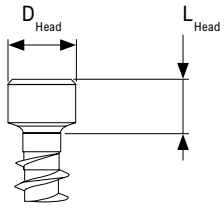
Fully Threaded



Drilling Tip

Code Approval	ICC, CCMC, ETA
Connection Types	Wood / Wood Concrete / Wood





ASSY VG CYL - 1/4" [6 mm] DIAMETER

Specification	Packaging Qty.	D	L		L_{Thread}		D_{Head}	D_m	L_{Head}	Drive Bit
Item #		in. *[mm]*	in.	*[mm]*	in.	*[mm]*	in. *[mm]*			
CYL0680	100	**1/4** *[6]*	**3-1/8**	*[80]*	**2-7/8**	*[73]*	**0.317** *[8.1]*	**0.150** *[3.8]*	**0.185** *[4.7]*	**RW 30**
CYL06100	100		**4**	*[100]*	**3-5/8**	*[93]*				
CYL06120	100		**4-3/4**	*[120]*	**4-1/2**	*[113]*				
CYL06140	100		**5-1/2**	*[140]*	**5-1/4**	*[133]*				
CYL06160	100		**6-1/4**	*[160]*	**6**	*[153]*				
CYL06180	100		**7-1/8**	*[180]*	**6-3/4**	*[173]*				
CYL06200	100		**7-7/8**	*[200]*	**7-5/8**	*[193]*				

ASSY VG CYL - 5/16" [8 mm] DIAMETER

Specification	Packaging Qty.	D	L		L_{Thread}		D_{Head}	D_m	L_{Head}	Drive Bit
Item #		in. *[mm]*	in.	*[mm]*	in.	*[mm]*	in. *[mm]*			
CYL08120	50	**5/16** *[8]*	**4-3/4**	*[120]*	**4**	*[104]*	**0.390** *[10]*	**0.197** *[5]*	**0.295** *[7.5]*	**RW 40**
CYL08140	50		**5-1/2**	*[140]*	**4-7/8**	*[124]*				
CYL08160	50		**6-1/4**	*[160]*	**5-5/8**	*[144]*				
CYL08180	50		**7-1/8**	*[180]*	**6-1/2**	*[164]*				
CYL08200	75		**7-7/8**	*[200]*	**7-1/4**	*[184]*				
CYL08220	75		**8-5/8**	*[220]*	**8**	*[204]*				
CYL08240	75		**9-1/2**	*[240]*	**8-7/8**	*[224]*				
CYL08260	75		**10-1/4**	*[260]*	**9-5/8**	*[244]*				
CYL08280	75		**11**	*[280]*	**10-3/8**	*[264]*				
CYL08300	75		**11-7/8**	*[300]*	**11-1/8**	*[284]*				
CYL08330	50		**13**	*[330]*	**12-3/8**	*[314]*				
CYL08360	50		**14-1/4**	*[360]*	**13-1/2**	*[344]*				
CYL08380	50		**15**	*[380]*	**14-3/8**	*[364]*				
CYL08430	25		**17**	*[430]*	**16-1/4**	*[414]*				
CYL08480	25		**19**	*[480]*	**18-1/4**	*[464]*				
CYL08530	25		**20-7/8**	*[530]*	**20-1/4**	*[514]*				
CYL08580	25		**22-7/8**	*[580]*	**22-1/4**	*[564]*				

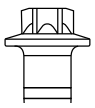
ASSY VG CYL - 3/8" [10 mm] DIAMETER

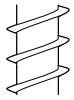
Specification	Packaging Qty.	D	L		L_{Thread}		D_{Head}	D_m	L_{Head}	Drive Bit
Item #		in. *[mm]*	in.	*[mm]*	in.	*[mm]*	in. *[mm]*			
CYL10180	50	**3/8** *[10]*	**7-1/8**	*[180]*	**6-1/2**	*[165]*	**0.528** *[13.4]*	**0.244** *[6.2]*	**0.315** *[8]*	**RW 50**
CYL10200	50		**7-7/8**	*[200]*	**7-1/4**	*[185]*				
CYL10220	50		**8-5/8**	*[220]*	**8-1/8**	*[205]*				
CYL10240	50		**9-1/2**	*[240]*	**8-7/8**	*[225]*				
CYL10260	50		**10-1/4**	*[260]*	**9-5/8**	*[245]*				
CYL10280	50		**11**	*[280]*	**10-3/8**	*[265]*				
CYL10300	50		**11- 7/8**	*[300]*	**11-1/4**	*[285]*				
CYL10320	50		**12-5/8**	*[320]*	**12**	*[305]*				
CYL10340	50		**13-3/8**	*[340]*	**12-3/4**	*[325]*				
CYL10360	50		**14-1/4**	*[360]*	**13-5/8**	*[345]*				
CYL10380	50		**15**	*[380]*	**14-3/8**	*[365]*				
CYL10400	50		**15-3/4**	*[400]*	**15-1/8**	*[385]*				
CYL10430	25		**17**	*[430]*	**16-3/8**	*[415]*				
CYL10480	25		**19**	*[480]*	**18-**	*[456]*				
CYL10530	25		**20-7/8**	*[530]*	**19-7/8**	*[506]*				
CYL10580	25		**22-7/8**	*[580]*	**21-7/8**	*[556]*				
CYL10650	25		**25-5/8**	*[650]*	**24-5/8**	*[626]*				
CYL10700	25		**27-5/8**	*[700]*	**26-5/8**	*[676]*				
CYL10750	25		**29-1/2**	*[750]*	**28-5/8**	*[726]*				
CYL10800	25		**31-1/2**	*[800]*	**30-1/2**	*[776]*				

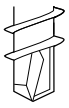
ASSY VG RH

Reverse Head Self-Tapping Wood Screw

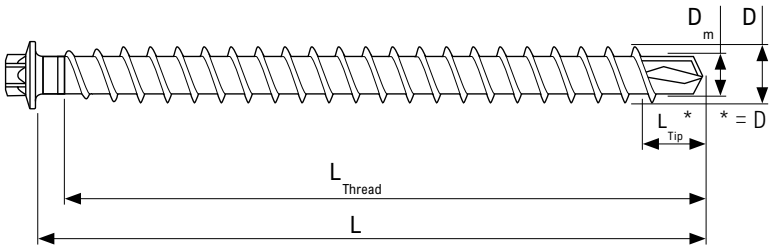
The ASSY VG RH is the longest fully threaded fastener of its kind in the world. Performing a similar function to rebar in concrete, the ASSY VG RH provides strong and reliable reinforcing solutions for large mass timber projects.

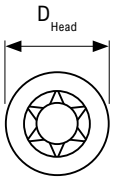

Reverse Head


Fully Threaded


Drilling Tip

Code Approval	ETA
Connection Types	Large Scale Wood Reinforcement





ASSY VG RH - 9/16" [14 mm] DIAMETER

Specification	Packaging Qty.	D	L		L_{Thread}		D_{Head}	D_m	Drive Bit
Item #		in. *[mm]*	in.	*[mm]*	in.	*[mm]*	in. *[mm]*		
RH14800	15	9/16 *[14]*	**31-1/2**	*[800]*	**30-3/4**	*[780]*	0.709 *[18]*	0.335 *[8.5]*	Reverse Head Socket
RH14850	15		**33-1/2**	*[850]*	**32-5/8**	*[830]*			
RH14900	15		**35-3/8**	*[900]*	**34-5/8**	*[880]*			
RH14950	15		**37-3/8**	*[950]*	**36-5/8**	*[930]*			
RH141000	15		**39-3/8**	*[1000]*	**38-5/8**	*[980]*			
RH141050	15		**41-3/8**	*[1050]*	**40-1/2**	*[1030]*			
RH141100	15		**43-1/4**	*[1100]*	**42-1/2**	*[1080]*			
RH141200	15		**47-1/4**	*[1200]*	**46-1/2**	*[1180]*			
RH141300	15		**51-1/8**	*[1300]*	**50-3/8**	*[1280]*			
RH141400	15		**55-1/8**	*[1400]*	**54-3/8**	*[1380]*			
RH141500	15		**59**	*[1500]*	**58-1/4**	*[1480]*			

Note:

1. ASSY VG RH is installed using the reverse head socket. Details about the Reverse Head Socket are provided in the Accessories section.

Reference Design Values

4.1 - Reference Withdrawal Design Values (W_{90}) For Fully Threaded Fasteners Series

Diameter [in.]	W_{90} [lb./in.]				
	Specific Gravity [G]				
	Lumber & Glulam				PSL
	G = 0.35	G = 0.42	G = 0.49	G = 0.55	ESG ≥ 0.50
1/4	137	169	202	230	156
5/16	176	212	248	279	179
3/8	188	237	280	317	211
1/2	209	251	297	331	223
9/16	—	300	347	430	—

Notes:

1. Reference design values presented in this table are based on the ICC-ESR 3178-2023
2. Tabulated Reference Withdrawal Design Values (W_{90}) apply to screws installed perpendicular to the grain of the wood member. For screws installed at an angle to the wood grain, W_{90} shall be reduced by the appropriate angle to grain reduction factor (R_α) to obtain the applicable angle to grain Withdrawal Design Value [see eq.1].
3. G refers to the specific gravity assigned to the wood species. ESG must be the equivalent specific gravity given in the ICC-ESR evaluation report of PSL.
4. Connection design must meet all relevant requirements of the General Notes to the Designer section.

4.2 - Reference Head Pull-Through Design Values (W_H) For Fully Threaded Fasteners Series

Diameter [in.]	Fastener Type	W_H [lb.]				
		Specific Gravity [G]				
		Lumber & Glulam				PSL
		G = 0.35	G = 0.42	G = 0.49	G = 0.55	ESG ≥ 0.50
5/16	**VG CSK**	216	281	350	414	398
3/8		266	334	408	474	491
1/2		266	334	408	474	491

Notes:

1. Reference design values presented in this table are based on the ICC-ESR 3178-2023
2. Design values are applicable to connections with wood side member thickness of 1 3/8".
3. Connection design must meet all relevant requirements of the Notes to the Designer section
4. G refers to the specific gravity assigned to the wood species. ESG must be the equivalent specific gravity given in the ICC-ESR evaluation report of PSL.
5. Tabulated head pull-through design values, W_H, are applicable to screws installed perpendicular to the faces of the wood members and must be multiplied by all adjustment factors included in the NDS 2024 for dowel-type fasteners to determine allowable loads for use with ASD and/or design loads for use with LRFD [see eq.2].

4.3 - Reference Buckling Resistance Values (W_C) for Fully Threaded Fasteners Series

Diameter [in.]	W_c [lb.]	
	ASD	LRFD
5/16	1,420	4,290
3/8	2,220	6,760

Notes:

1. ASD design values were derived with a factor of safety of 5 applied to the average ultimate capacity of the screws tested for buckling.
2. LRFD values are obtained using the 5th Percentile Weibull 2-parameter analysis as per ASTM D5457 which includes the φ = 0.65 for screws embedded in wood.
3. Testing was conducted in glulam specimens of Douglas Fir (D. Fir), Black Spruce and Southern Yellow Pine (SYP).
4. The values in the table above are applicable for all lengths of 5/16" [8 mm] and 3/8" [10 mm] fully threaded ASSY VG screws.

4.4 - Fastener Strength Values For Fully Threaded Fasteners Series

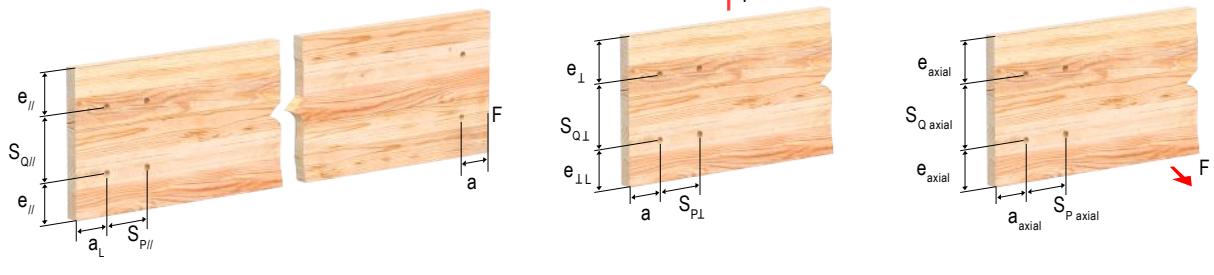
Diameter [in.]	Bending Yield Strength, F_{yb} [psi]	Tensile Strength, T_s [lb.]		Shear Strength, V [lb.]		Allowable Insertion Torque [lb.·ft]
		ASD	LRFD	ASD	LRFD	
1/4	129,200	1,165	1,750	590	885	5.7
5/16	150,000	1,775	2,665	1,105	1,660	12.3
3/8	160,000	2,550	3,825	1,835	2,755	22.1
1/2	166,300	3,470	5,205	2,095	3,145	36.9
9/16	181,300	5,135	7,700	3,200	4,800	56.5

Notes:

1. Connection design must meet all relevant requirements of the General Notes to the Designer section.
2. Bending Yield Strength is determined in accordance with ASTM F1575 using minor diameter of the fastener.
3. The allowable insertion torque is determined in accordance with EAD 130118-01-0603, where the ratio of torsional strength to insertion torque should be at least 1.5.
4. Specified Bending Yield Strength, Tensile resistance and Shear Strength values presented in this table are based on ICC-ESR 3178-2023.

Geometry Requirements

Glulam & Timber



Lateral Loading Parallel-to-Grain

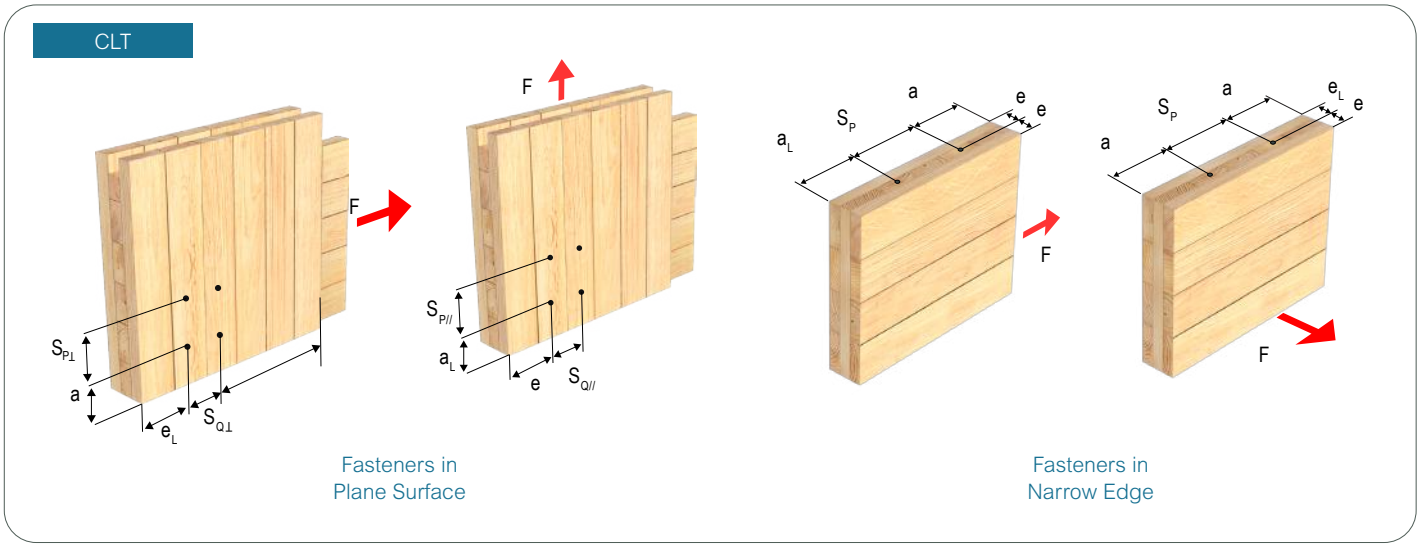
Lateral Loading Perpendicular-to-Grain

Axial Loading

4.5 - Geometry Requirements for Fully Threaded Self Tapping Screws for All Wood Species

Loading Configuration			Installation Configuration Glulam & Timber	
			D ≤ 3/8"	D > 3/8"
End Distance	Lateral loading parallel to grain in tension	a_L	12D	7D
	Lateral loading parallel to grain in compression	a	7D	4D
	Lateral loading perpendicular to grain	a	7D	4D
	Axial loading	a_{axial}	7D	4D
Edge Distance	Lateral loading parallel to grain	$e_{//}$	3D	3D
	Lateral loading perpendicular to grain, towards edge	$e_{\perp L}$	7D	4D
	Lateral loading perpendicular to grain, away from edge	$e_{\perp}$	3D	3D
	Axial loading	e_{axial}	3D	3D
Spacing Between Fasteners in a Row [parallel to grain]	Lateral loading parallel to grain	$S_{P//}$	10D	5D
	Lateral loading perpendicular to grain	$S_{P\perp}$	5D	4D
	Axial loading	$S_{P\ axial}$	7D	5D
Spacing Between Rows [perpendicular to grain]	Lateral loading parallel to grain	$S_{Q//}$	4D	5D
	Lateral loading perpendicular to grain	$S_{Q\perp}$	4D	5D
	Axial loading	$S_{Q\ axial}$	2.5D	5D

1. All connection design must meet all the relevant requirements of the Notes to the Designer section.
2. End distance must also be sufficient to ensure that the screw is fully embedded in the wood member.
3. Within a row, fasteners may be staggered up to 2D to further reduce the potential for splitting.
4. Geometry requirements are in accordance with ICC-ESR 3178-2023.
5. Minimum geometry requirements provided in this section are meant to provide sufficient end & edge distance as well as spacing between rows and fasteners in a row to prevent splitting.
6. Applying the minimum requirements does not prevent wood failure such as row tear-out, group tear-out, block tear-out, net tension failure or splitting perpendicular-to-grain.
7. For the purpose of determining connection geometry requirements, fully threaded fasteners are considered to have the capabilities to drill their own "predrilled" hole.
8. For species prone to splitting (e.g. D fir, Hem-Fir, or Western Red Cedar), it is recommended that the parallel-to-grain spacing requirements be increased by 50%.



4.6 - Geometry Requirements for Fully Threaded Self Tapping Screws

Loading Configuration			Installation Configuration CLT *[G = 0.42]*			
			Self-Tapping Screws		Predrilling	
			Surface	Edge	Surface	Edge
End Distance	Lateral loading parallel to grain in tension	a_L	6D	12D	6D	7D
	Lateral loading parallel to grain in compression	a	6D	7D	4D	4D
	Lateral loading perpendicular to grain	a	6D	7D	4D	4D
	Axial loading	a_{axial}	6D	7D	4D	4D
Edge Distance	Lateral loading parallel to grain	$e_{//}$	2.5D	3D	3D	3D
	Lateral loading perpendicular to grain, towards edge	$e_{\perp L}$	6D	6D	4D	3D
	Lateral loading perpendicular to grain, away from edge	$e_{\perp}$	2.5D	3D	3D	3D
	Axial loading	e_{axial}	2.5D	3D	3D	3D
Spacing Between Fasteners in a Row [parallel to grain]	Lateral loading parallel to grain	$S_{P//}$	4D	10D	4D	4D
	Lateral loading perpendicular to grain	$S_{P\perp}$	4D	10D	4D	4D
	Axial loading	$S_{P\ axial}$	4D	10D	4D	4D
Spacing Between Rows [perpendicular to grain]	Lateral loading parallel to grain	$S_{Q\ //}$	2.5D	4D	4D	4D
	Lateral loading perpendicular to grain	$S_{Q\perp}$	2.5D	4D	4D	4D
	Axial loading (D ≤ 5/16")	$S_{Q\ axial}$	2.5D	4D	4D	4D
	Axial loading (D > 5/16")	$S_{Q\ axial}$	2.5D	4D	4D	4D

Notes:

1. All connection design must meet all the relevant requirements of the Notes to the Designer section.
2. End distance must also be sufficient to ensure that the screw is fully embedded in the wood member.
3. Within a row, fasteners may be staggered up to 2D to further reduce the potential for splitting.
4. The listed values are applicable when the CLT panel thickness is at least 10D.
5. The minimum penetration depth of the screw into the narrow face of the panel is at least 10D.
6. Tabulated requirements for STS installed in CLT panels were derived according to the methods described in the ETA-11/0190 for self tapping wood screws.
7. For the purpose of determining connection geometry requirements, fasteners are considered to drill their own "predrilled" hole.
8. Minimum geometry requirements provided in this section are meant to provide sufficient end and edge distance as well as spacing between rows and fasteners in a row to prevent splitting.
9. Applying the minimum requirements does not prevent wood failure such as row tear-out, group tear-out, block tear-out, net tension failure or splitting perpendicular-to-grain.
10. For species prone to splitting (e.g. D fir, Hem-Fir), it is recommended that the parallel-to-grain spacing requirements be increased by 50%,

Bow River Pedestrian Bridge

Banff, Alberta

Credit StructureCraft & Paul Zizka

Ritchie Market

Edmonton, Alberta

Courtesy of Western Archrib

Stainless Steel Fasteners Series

MTC Solutions stainless steel self-tapping Partially Threaded fasteners are versatile screws used for connections in wet service conditions. For more information, read the Service Condition & Corrosion section.

AVAILABLE IN MULTIPLE SIZES

- **1/4"** *[6 mm]*
- **5/16"** *[8 mm]*

- **2 3/8" to 11 7/8"** *[60 mm to 300 mm]*

Engineered Heads

Countersunk Head | Washer Head

Ring Threaded Tip

Reduces the need for predrilling and provides the quickest fastener wood bite

Stainless Steel

Stainless steel fasteners for use in wet service conditions

Large Threads

Provides high withdrawal resistance

CERTIFICATIONS

ICC EVALUATION SERVICE — ICC-ESR-3179

ISO 50001
Energy Management System

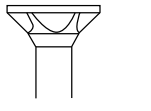
ETA

Product Overview

ASSY A2 Ecofast

Countersunk Head Self-Tapping Wood Screw

The ASSY A2 ECOFAST stainless steel fasteners are ideal for exterior projects, and achieve a clean and flush architectural finish. Applications include outdoor fencing, rails, solar panels, cladding, fascia board, strapping, and decking.

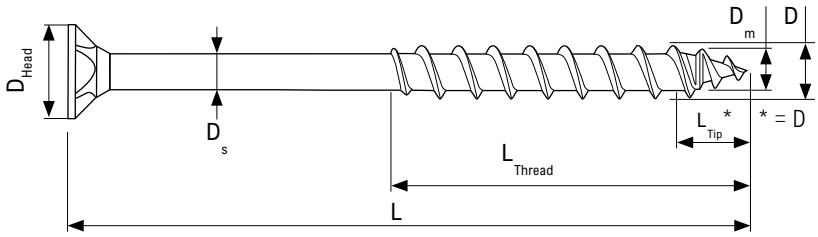


Countersunk Head with Milling Pockets

Ring Thread Tip

Suitable in Wet Service Conditions

Code Approval	ICC, ETA
Connection Types	Wood / Wood Steel / Wood



ASSY A2 Ecofast - 1/4" [6 mm] & 5/16" [8 mm] DIAMETER

Specification	Packaging Qty.	D	L		L_{Thread}		D_{Head}	D_m	D_s	Drive Bit
Item #		in. *[mm]*	in.	*[mm]*	in.	*[mm]*	in. *[mm]*			
A2ECO0660	200	1/4 *[6]*	2-3/8	*[60]*	1-1/2	*[37]*	0.472 *[12]*	0.154 *[3.9]*	0.173 *[4.4]*	RW 30
A2ECO0680	100		3-1/8	*[80]*	2	*[50]*				
A2ECO06100	100		4	*[100]*	2-3/8	*[60]*				
A2ECO06120	100		4-3/4	*[120]*	2-3/4	*[70]*				
A2ECO06140	100		5-1/2	*[140]*	2-3/4	*[70]*				
A2ECO0880	75	5/16 *[8]*	3-1/8	*[80]*	2	*[50]*	0.591 *[15]*	0.197 *[5]*	0.234 *[5.95]*	RW 40
A2ECO08100	75		4	*[100]*	2-3/8	*[60]*				
A2ECO08120	75		4-3/4	*[120]*	3-1/8	*[80]*				
A2ECO08140	75		5-1/2	*[140]*	3-1/8	*[80]*				
A2ECO08160	75		6-1/4	*[160]*	3-1/8	*[80]*				
A2ECO08180	75		7-1/8	*[180]*	3-1/8	*[80]*				
A2ECO08200	75		7-7/8	*[200]*	3-1/8	*[80]*				
A2ECO08220	75		8-5/8	*[220]*	4	*[100]*				
A2ECO08240	75		9-1/2	*[240]*	4	*[100]*				
A2ECO08260	75		10-1/4	*[260]*	4	*[100]*				
A2ECO08280	75		11	*[280]*	4	*[100]*				
A2ECO08300	75		11-7/8	*[300]*	4	*[100]*				

ASSY A2 SK

Washer Head Self-Tapping Wood Screw

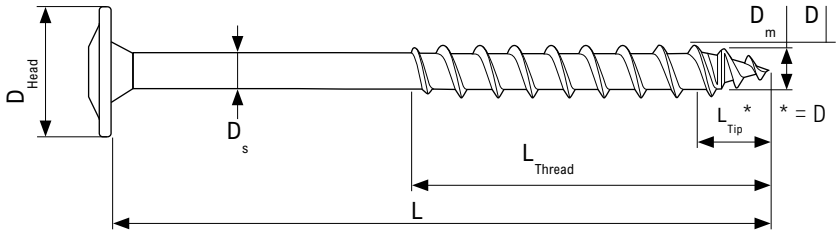
The ASSY A2 SK stainless steel fasteners are ideal for exterior wood-to-wood applications where high head pull-through capacity is required. Applications include exposed timber frame structures, carpentry, and boardwalks.

Washer Head

Ring Thread Tip

Suitable in Wet Service Conditions

Code Approval	ICC, ETA
Connection Types	Wood / Wood



ASSY A2 SK - 1/4" [6 mm] & 5/16" [8 mm] DIAMETER

Specification	Packaging Qty.	D	L		L_{Thread}		D_{Head}	D_m	D_s	Drive Bit
Item #		in. *[mm]*	in.	*[mm]*	in.	*[mm]*	in. *[mm]*			
A2SK0680	100	1/4 *[6]*	3-1/8	*[80]*	2	*[50]*	0.551 *[14]*	0.154 *[3.9]*	0.173 *[4.4]*	RW 30
A2SK06100	100		4	*[100]*	2-3/8	*[60]*				
A2SK06120	100		4-3/4	*[120]*	2-3/4	*[70]*				
A2SK06140	100		5-1/2	*[140]*	2-3/4	*[70]*				
A2SK08100	50	5/16 *[8]*	4	*[100]*	2-3/8	*[60]*	0.739 *[18.9]*	0.197 *[5]*	0.234 *[5.95]*	RW 40
A2SK08120	50		4-3/4	*[120]*	3-1/8	*[80]*				
A2SK08140	50		5-1/2	*[140]*	3-1/8	*[80]*				
A2SK08160	50		6-1/4	*[160]*	3-1/8	*[80]*				
A2SK08180	50		7-1/8	*[180]*	3-1/8	*[80]*				
A2SK08260	50		10-1/4	*[260]*	4	*[100]*				
A2SK08300	50		11-7/8	*[300]*	4	*[100]*				

Reference Design Values

5.1 - Reference Withdrawal Design Values (W_{90}) For Stainless Steel Fasteners Series

Diameter [in.]	W_{90} [lb./in.]	
	Specific Gravity [G]	
	G = 0.42	G = 0.49
1/4	143	162
5/16	169	211

Notes:

1. Reference design values presented in this table are based on the ICC-ESR 3179-2021
2. Tabulated Reference Withdrawal Design Values (W_{90}) apply to screws installed perpendicular to the grain of the wood member. For screws installed at an angle to the wood grain, W_{90} shall be reduced by the appropriate angle to grain reduction factor (R_α) to obtain the applicable angle to grain Withdrawal Design Value [see eq.1].
3. G refers to the specific gravity assigned to the wood species.
4. Connection design must meet all relevant requirements of the General Notes to the Designer section.

5.2 - Reference Head Pull-Through Design Values (W_H) For Stainless Steel Fasteners Series

Diameter [in.]	Fastener Type	W_H [lb.]				
		Specific Gravity [G]				
		Lumber & Glulam				PSL
		G = 0.35	G = 0.42	G = 0.49	G = 0.55	ESG ≥ 0.50
1/4	**A2 Ecofast**	133	163	194	221	262
	A2 SK	244	299	356	407	440
5/16	**A2 Ecofast**	—	445	524	—	—
	A2 SK	410	510	604	685	732

Notes:

1. Reference design values presented in this table are based on the ICC-ESR 3179-2021.
2. Design Values are applicable to connections with wood side member thickness of 1 3/8".
3. Connection design must meet all relevant requirements of the Notes to the Designer section.
4. Tabulated head pull-through design values, W_H, are applicable to screws installed perpendicular to the faces of the wood members and must be multiplied by all adjustment factors included in the NDS 2024 for dowel-type fasteners to determine allowable loads for use with ASD and/or design loads for use with LRFD [see eq.2].

5.3 - Fastener Strength Values For Stainless Steel Fasteners Series

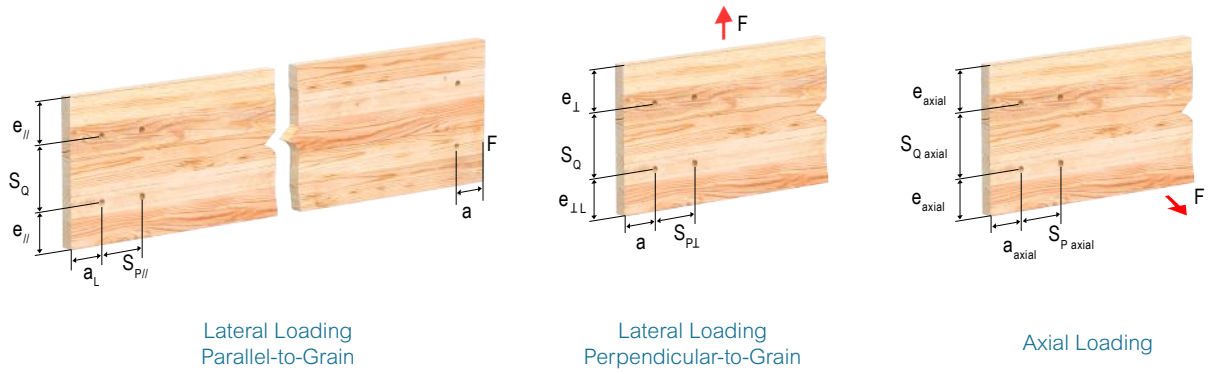
Diameter [in.]	Bending Yield Strength, F_{yb} [psi]	Tensile Strength, T_s [lb.]		Shear Strength, V [lb.]		Allowable Insertion Torque [lb.·ft]
		ASD	LRFD	ASD	LRFD	
1/4	99,900	600	900	450	675	3.1
5/16	99,500	1,170	1,755	915	1,375	7.9

Notes:

1. Connection design must meet all relevant requirements of the General Notes to the Designer section.
2. Bending Yield Strength is determined in accordance with ASTM F1575 using minor diameter of the fastener.
3. The allowable insertion torque is determined in accordance with EAD 130118-01-0603, where the ratio of torsional strength to insertion torque should be at least 1.5.
4. Specified Bending Yield Strength, Tensile resistance and Shear Strength values presented in this table are based on ICC-ESR 3179-2021.

Geometry Requirements

Glulam & Timber



Lateral Loading Parallel-to-Grain

Lateral Loading Perpendicular-to-Grain

Axial Loading

5.4 - Geometry Requirements for Stainless Steel Self Tapping Screws

Loading Configuration			Installation Configuration Glulam & Timber			
			Self-Tapping Screws			Predrilling
			G < 0.5	G ≥ 0.5	Douglas Fir	Any G
End Distance	Lateral loading parallel to grain in tension	a_L	15D	20D	22.5D	7D
	Lateral loading parallel to grain in compression	a	10D	15D	22.5D	4D
	Lateral loading perpendicular to grain	a	10D	15D	22.5D	4D
	Axial loading	a_{axial}	10D	10D	15D	4D
Edge Distance	Lateral loading parallel to grain	$e_{//}$	5D	7D	7D	3D
	Lateral loading perpendicular to grain, towards edge	$e_{\perp L}$	10D	12D	12D	4D
	Lateral loading perpendicular to grain, away from edge	$e_{\perp}$	5D	7D	7D	4D
	Axial loading	e_{axial}	4D	4D	7D	3D
Spacing between Fasteners in a Row [parallel to grain]	Lateral loading parallel to grain	$S_{P//}$	15D	15D	15D	4D
	Lateral loading perpendicular to grain	$S_{P\perp}$	10D	10D	10.5D	4D
	Axial loading	$S_{P\,axial}$	7D	7D	10.5D	4D
Spacing between Rows [perpendicular to grain]	Lateral loading parallel to grain	S_Q	5D	7D	7D	5D
	Lateral loading; staggered rows	$S_{Q\,S}$	2.5D	3D	3D	—
	Axial loading (D ≤ 5/16")	$S_{Q\,axial}$	4D	4D	7D	4D
	Axial loading (D > 5/16")	$S_{Q\,axial}$	5D	5D	7D	4D

Notes:

1. All connection design must meet all the relevant requirements of the Notes to the Designer section.
2. In wood species sensitive to splitting, minimum geometry requirements may be required to be increased.
3. Values for spacing between staggered rows apply where fasteners in adjacent rows are offset by half of the spacing between fasteners in a row.
4. Within a row, fasteners may be staggered up to 2D to further reduce the potential for splitting.
5. The predrilled geometry requirements are as per NDS 2024, Table 12.5.1.G
6. Minimum geometry requirements provided in this section are meant to provide sufficient end & edge distance as well as spacing between rows and fasteners in a row to prevent splitting.
7. Applying the minimum requirements does not prevent wood failure such as row tear-out, group tear-out, block tear-out, net tension failure or splitting perpendicular-to-grain.

North Surrey Sport & Ice Complex

Surrey, British Columbia

Courtesy of StructureCraft

Self-Drilling Dowels

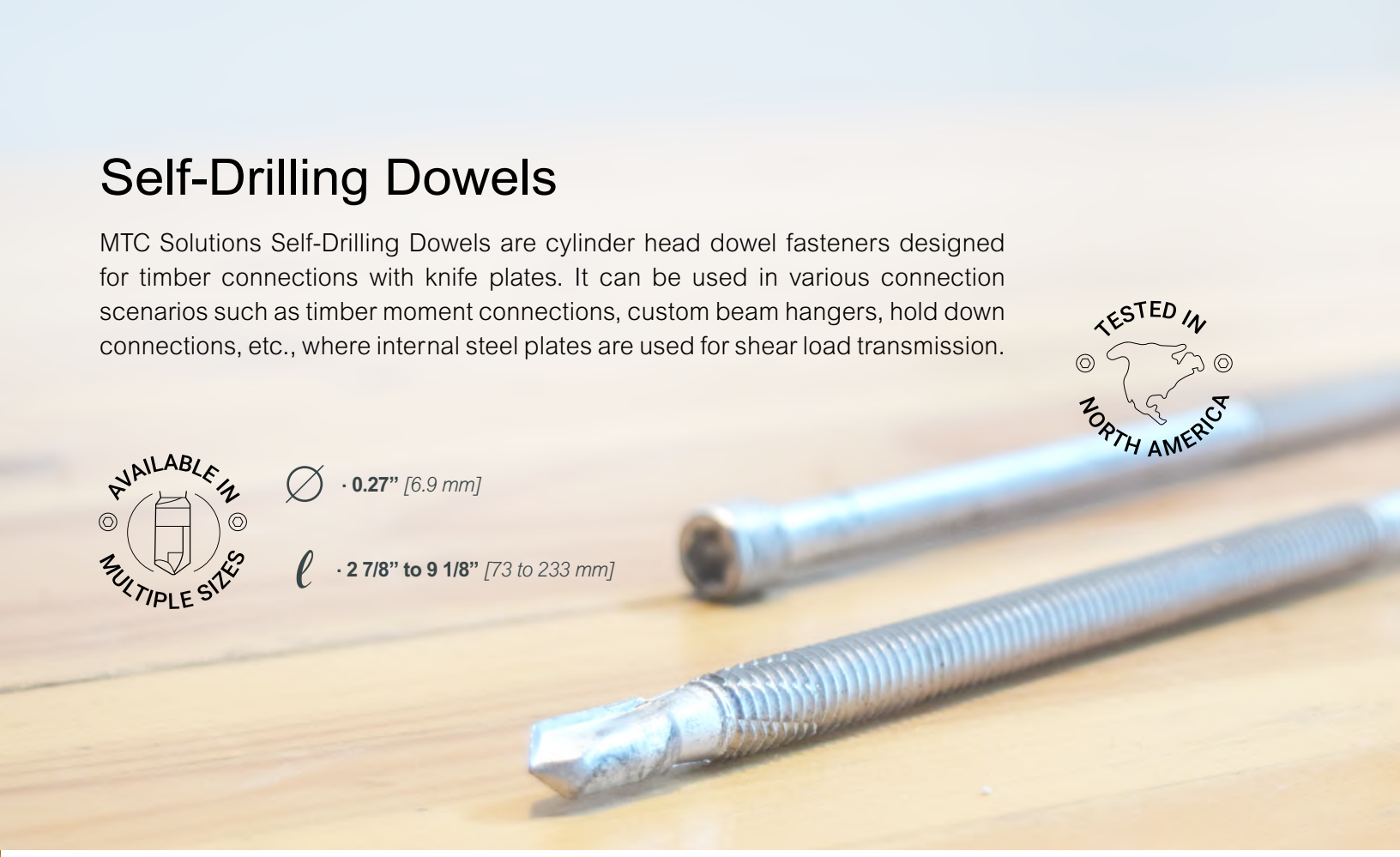
MTC Solutions Self-Drilling Dowels are cylinder head dowel fasteners designed for timber connections with knife plates. It can be used in various connection scenarios such as timber moment connections, custom beam hangers, hold down connections, etc., where internal steel plates are used for shear load transmission.

TESTED IN NORTH AMERICA

AVAILABLE IN MULTIPLE SIZES

∅ · **0.27”** *[6.9 mm]*

ℓ · **2 7/8” to 9 1/8”** *[73 to 233 mm]*



Engineered Head

Cylinder Head

Case-Hardened Steel

A ductile core with increased outer surface hardness, providing high bending yield strength & ductility

Coated Steel

Fasteners with a high-grade zinc–aluminum flake coating for use in dry service conditions

Continuous Thread

Helps prevent the dowel from slipping out of the knife plate, especially when loaded cyclically

Drilling Tip

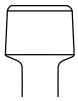
Drilling tip reduces the need for predrilling in wood and thin metal plates. Predrilling is recommended for thicker (> 1/8") knife plates and connections with multiple knife plates

Product Overview

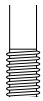
Self-Drilling Dowel

Cylinder Head Fastener for Internal Knife Plate Connections

The Self-Drilling Dowel (SDD) is engineered to be used in multiple connection scenarios where internal steel plates are used for load transmission. The dowel head is perfect for concealed connections and the continuous threads keep the fastener secured in the metal plate. SDDs are suitable for use in dry service conditions only.



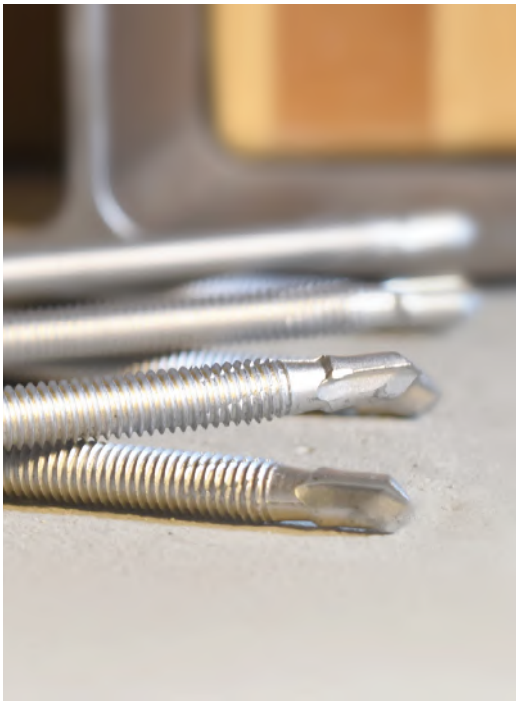
Cylinder Head

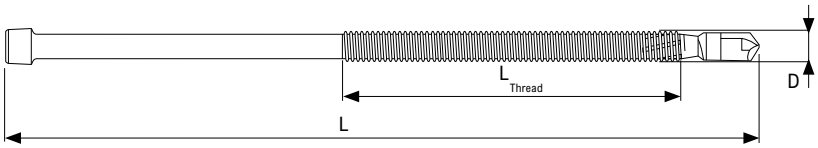


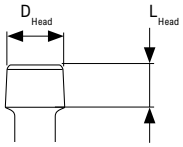
Continuous Thread

Drilling Tip

Connection Type | Internal Steel Plate / Wood







Self-Drilling Dowel - 0.27" [6.9 mm] DIAMETER

Specification	Packaging Qty.	D	L		L_{Thread}		D_{Head}	L_{Head}	Drive Bit
Item #		in. *[mm]*	in.	*[mm]*	in.	*[mm]*	in. *[mm]*	in. *[mm]*	
SDD0673	50	**0.27** *[6.9]*	**2-7/8**	*[73]*	**1-1/4**	*[31]*	**0.394** *[10]*	**0.295** *[7.5]*	**RW 40**
SDD0693	50		**3-5/8**	*[93]*	**1-5/8**	*[40]*			
SDD06113	50		**4-1/2**	*[113]*	**2**	*[50]*			
SDD06133	50		**5-1/4**	*[133]*	**2-3/8**	*[60]*			
SDD06153	50		**6**	*[153]*	**2-3/4**	*[70]*			
SDD06173	50		**6-3/4**	*[173]*	**3-1/8**	*[80]*			
SDD06193	50		**7-5/8**	*[193]*	**3-1/2**	*[90]*			
SDD06213	50		**8-3/8**	*[213]*	**3-7/8**	*[100]*			
SDD06233	50		**9-1/8**	*[233]*	**4-3/8**	*[110]*			

Reference Design Values

6.1 - Fastener Strength Values for Self-Drilling Dowels

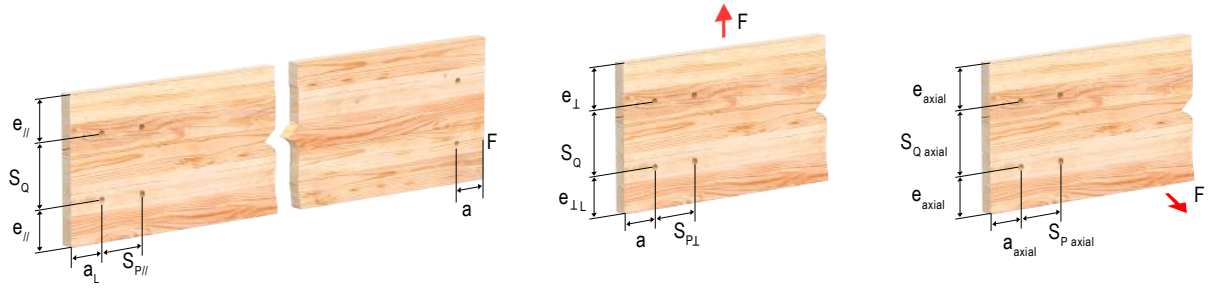
Diameter [in.]	Bending Yield Strength, F_{yb}	Shear Strength, V [lb.]		Adjusted Torsional Strength [lb.·ft]
		ASD	LRFD	
0.27	126,200	1,725	2,590	28.6

Notes:

1. Connection design must meet all relevant requirements of the General Notes to the Designer section.
2. Adjusted Torsional Strengths provided in the table are based on 5th percentile of ultimate resistance values factored down with resistance factor Φ = 0.7 for brittle failures.

Geometry Requirements

Glulam & Timber

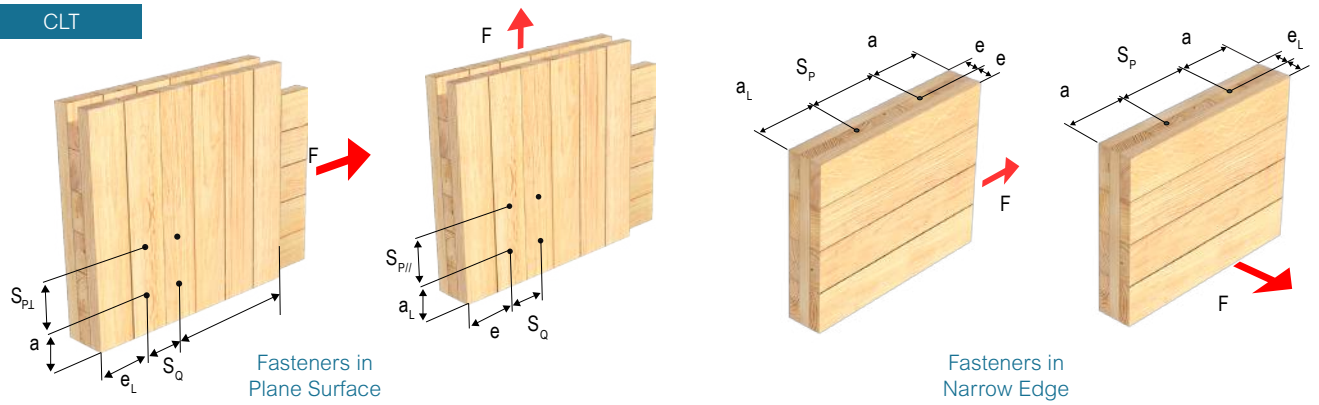


Lateral Loading Parallel-to-Grain

Lateral Loading Perpendicular-to-Grain

Axial Loading

CLT



Fasteners in Plane Surface

Fasteners in Narrow Edge

6.2 - Geometry Requirements for Self-Drilling Dowels

Loading Configuration			Installation Configuration	
			Glulam & Timber *[Any G]*	CLT *[G = 0.42]*
			Predrilling	Predrilling
End Distance	Lateral loading parallel to grain in tension	a_L	7D	6D
	Lateral loading parallel to grain in compression	a	4D	4D
	Lateral loading perpendicular to grain	a	4D	4D
Edge Distance	Lateral loading parallel to grain	$e_{//}$	3D	3D
	Lateral loading perpendicular to grain, towards edge	$e_{\perp L}$	4D	4D
	Lateral loading perpendicular to grain, away from edge	$e_{\perp}$	4D	3D
Spacing Between Fasteners in a Row [parallel to grain]	Lateral loading parallel to grain	$S_{P//}$	4D	4D
	Lateral loading perpendicular to grain	$S_{P\perp}$	4D	4D
Spacing Between Rows [perpendicular to grain]	Lateral loading parallel to grain	S_Q	5D	4D

Notes:

1. All connection design must meet all the relevant requirements of the Notes to the Designer section.
2. In wood species sensitive to splitting, minimum geometry requirements may be required to be increased.
3. The listed values are applicable when the CLT panel thickness is at least 10D.
4. The predrilled geometry requirements are as per NDS 2024, Table 12.5.1.G
5. Minimum geometry requirements provided in this section are meant to provide sufficient end & edge distance as well as spacing between rows and fasteners in a row to prevent splitting.
6. Applying the minimum requirements does not prevent wood failure such as row tear-out, group tear-out, block tear-out, net tension failure or splitting perpendicular-to-grain.

Wood Innovation and Design Centre

Prince George, British Columbia

Courtesy of Structurlam

Accessories

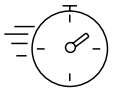
90° Cup Washer

Cost-Reducing Solution for Steel-to-Wood Connections

The 90° Cup Washer is a machined steel part designed for use with countersunk head screws ASSY Ecofast and ASSY VG CSK. The washer provides proper bearing for the screw head in steel-to-wood connections, eliminating the need for reaming out the steel plate.

Designed for	Countersunk Head Fasteners
Connection Type	Steel / Wood

Countersunk Head

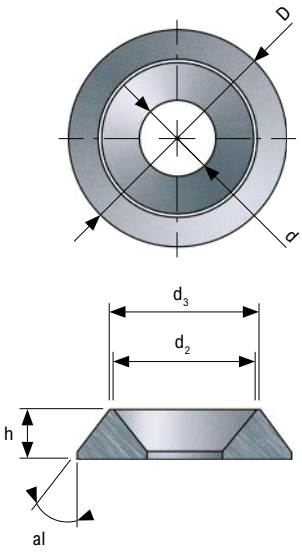


Fast Installation

Stiffer Connections

1/4", 5/16" and 3/8" Cup Washer Dimensions

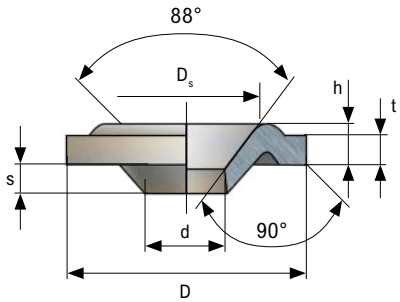
Nominal Fastener Diameter [D]	d	OD	h	al	d_2	d_3
	in. [mm]			°	in. [mm]	
1/4 [6]	**0.252** [6.4]	**0.866** [22]	**0.177** [4.5]	45	**0.551** [14]	**0.591** [15]
5/16 [8]	**0.331** [8.4]	**0.984** [25]	**0.197** [5]	41	**0.669** [17]	**0.709** [18]
3/8 [10]	**0.409** [10.4]	**1.181** [30]	**0.276** [7]	37	**0.787** [20]	**0.827** [21]



Note:
1. The dimension of the steel plate holes is provided in Appendix E: Steel Plate Detailing.

1/2" Cup Washer Dimensions

Nominal Fastener Diameter [D]	d	OD	h	t	D_s	s
	in. [mm]					
1/2 [12]	**0.492** [12.5]	**1.654** [42]	**0.197** [5]	**0.157** [4]	**0.906** [23]	**0.118** [3]



Note:
1. The diameter of the steel plate holes should be equal to D_s.

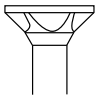
45° Wedge Washer

Cost-Reducing Solution for Steel-to-Wood Connections

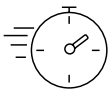
The 45° Wedge Washer combined with a predrilling jig is a cost-reducing solution for steel-to-wood connections using ASSY Ecofast and ASSY VG CSK fasteners. The wedge washer is inserted into a simple punched or machined hole with an elliptical shape. Its use eliminates the need for predrilled inclined countersunk holes in steel plates and only requires standard slotted holes, resulting in cost reductions.

Designed for Countersunk Head Fasteners

Connection Type Steel / Wood



Countersunk Head



Fast Installation

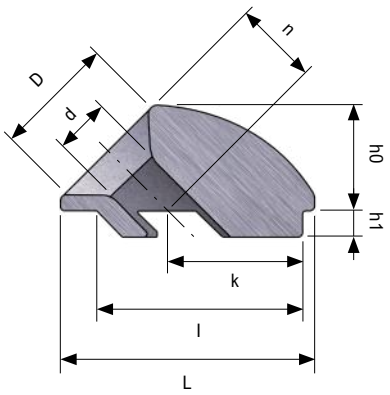
Cost Effective

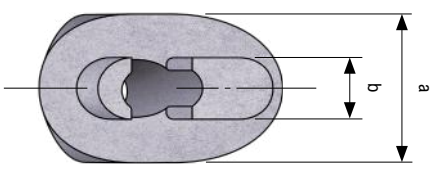
45° Washer Dimensions

Nominal Fastener Diameter [D]	d_1	d_2	L	a	h0	h1	b	l	k	n	Steel Plate Thickness	
											Min.	Max.
					in.							
					[mm]							
5/16	**0.335**	**0.748**	**1.535**	**0.945**	**0.63**	**0.142**	**0.39**	**1.248**	**0.827**	**0.5**	**0.157**	**0.591**
[8]	*[8.5]*	*[19]*	*[39]*	*[24]*	*[16]*	*[3.6]*	*[9.9]*	*[31.7]*	*[21]*	*[12.7]*	*[4]*	*[15]*
3/8	**0.421**	**0.945**	**2.047**	**1.142**	**0.843**	**0.185**	**0.425**	**1.72**	**1.13**	**0.724**	**0.197**	**0.787**
[10]	*[10.7]*	*[24]*	*[52]*	*[29]*	*[21.4]*	*[4.7]*	*[10.8]*	*[43.7]*	*[28.7]*	*[18.4]*	*[5]*	*[20]*
1/2	**0.5**	**1.024**	**2.323**	**1.181**	**0.925**	**0.22**	**0.504**	**1.957**	**1.339**	**0.78**	**0.236**	**0.984**
[12]	*[12.7]*	*[26]*	*[59]*	*[30]*	*[23.5]*	*[5.6]*	*[12.8]*	*[49.7]*	*[34]*	*[19.8]*	*[6]*	*[25]*

Note:

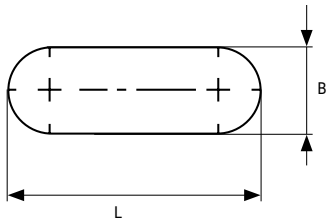
1. For coated steel plates, the hole size needs to be oversized in order to account for the thickness of the coating. Test fitting of wedge washers into steel plate holes is required to ensure that the required tolerances are in place.





45° Washer Steel Plate Hole Dimensions

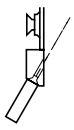
Nominal Fastener Diameter [D]	B		L	
	Min.	Max.	Min.	Max.
in. [mm]				
5/16 [8]	0.394 [10]	0.433 [11]	1.260 [32]	1.299 [33]
3/8 [10]	0.441 [11]	0.472 [12]	1.732 [44]	1.772 [45]
1/2 [12]	0.512 [13]	0.551 [14]	1.969 [50]	2.008 [51]



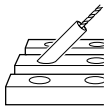
Pre-Drilling Jig

Eases Predrilling for Inclined Fasteners

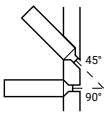
Our Pre-Drilling Jig is a versatile installation accessory designed to improve fastener installation in terms of consistency, precision, and labor and time efficiency, compared to conventional predrilling processes. Available in three sizes to accommodate 5/16” [8 mm], 3/8” [10 mm], and 1/2” [12 mm] VG CSK fasteners, it is compatible with the MEGANT and RICON XL’s inclined fasteners as well as custom steel-to-wood connections (with 45° Wedge Washers, 90° Cup Washers, or appropriately machined holes in steel plates of various thicknesses). The inner diameters (d) accommodate standard imperial and metric drill bit diameters recommended for predrilling (3/16” [5 mm], 1/4” [6 mm], and 9/32” [7 mm]). The outer diameters (D) and shoulder geometries mirror the head of the fastener for rapid positioning and alignment, while a tight tolerance at the tip ensures a snug fit with minimal play in the receiving hole.



RICON XL Compatible



MEGANT Compatible



45° & 90° Steel Plate Compatible

Bits

Patented Bits for ASSY Fasteners

ASSY AW and RW bits are hardened bits designed for quick and efficient installation of ASSY fasteners. The new RW Bits are an upgrade of the AW Bits, requiring fewer bit changes for different fastener diameters. The AW and RW Bits are compatible with both AW and RW drives, but the RW Bits provide better performance. Suitable bits for each fastener are listed in its specifications table.

Snug Fit

Reduce Wobbling

Optimum Torque Transfer

ASSY AW Bits

Designed for	Partially Threaded Fasteners 3.0 Series
	Stainless Steel Fasteners Series
	Self-Drilling Dowels

AW 30 AW 40 AW 50

ASSY RW Bits

Designed for	Partially Threaded Fasteners 4.0 Series
	Fully Threaded Fasteners Series

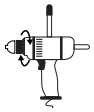
RW 30 RW 40 RW 50

Magnetic Hex Socket

Accessory for Installing ASSY Kombi Screws

The magnetic socket can be used for faster installation of the ASSY Kombi screws. The built-in magnet makes it easy to place and hold the screwhead inside the socket before installation. The magnetic socket is suitable for use with most low-RPM high-torque drills that are used in the installation of ASSY self-tapping screws.

Hex Head



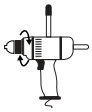
Suitable for Double Handle Drill

Optimum Torque Transfer

Bit Holder Socket

Bit Holder Socket for AW 50 & RW 50 Bits

The Bit Holder Socket is designed to hold the AW 50 Bits and RW 50 Bits on large double handled drills. The socket can be used with the magnetic bit holder case to facilitate the installation of larger-diameter screws which requires higher torque. The Bit Holder Socket is meant to be used with the Magnetic Bit Case Holder SK, VG CSK.



Suitable for Large Drills

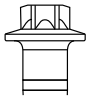
AW 50 & RW 50 Compatible

Optimum Torque Transfer

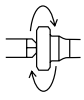
Reverse Head Socket

Accessory for Installing ASSY VG RH Screws

The Reverse Head Socket is a special driver bit for the ASSY VG RH Screws, providing a snug fit for their head type and thus easily transferring the high torque required for installation. This socket is designed for use in conjunction with the associated Magnetic Bit Case Holder.



Reverse Head



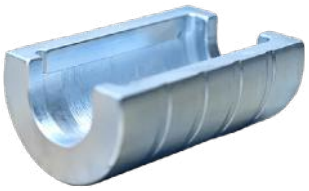
Snug Fit

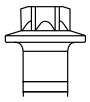
Optimum Torque Transfer

Magnetic Bit Case Holder VG RH

Eases Installation of ASSY VG RH Screw

Using the built-in magnet, the Bit Case Holder holds the screw and bit in place at the start of installation when the threads have not engaged with the wood fiber. This way, the Bit Holder Case can be used for a more efficient overhead installation. This holder is designed for use with the Reverse Head Socket for ASSY VG RH screws, simplifying their installation.





Reverse Head

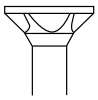
Efficient Overhead Installation

Magnetic

Magnetic Bit Case Holder SK, VG CSK

Eases Installation of ASSY SK and VG CSK Screws

This Magnetic Bit Case Holder is designed for use with the Bit Holder Socket for AW 50 and RW 50 Bits for installation of ASSY SK and VG CSK screws. Using the built-in magnet, the Bit Case Holder secures the screw and the AW or RW bit together to hold the connection in place during installation.



Countersunk Head

Efficient Overhead Installation

Magnetic

Appendix

Appendix A: Installation Guidelines

A proper installation procedure is critical for a connection to perform as intended by the design engineer. Installing high-capacity fasteners into critical connections requires the utmost level of accuracy and craftsmanship. The following sections provide information on why it is important to create and follow an installation procedure, as well as additional tips and best practices. It is important to follow the instructions outlined in these sections to prevent reduced connection capacities, undesired connection performance, and fastener-related issues such as breakage, collision, and deviation.

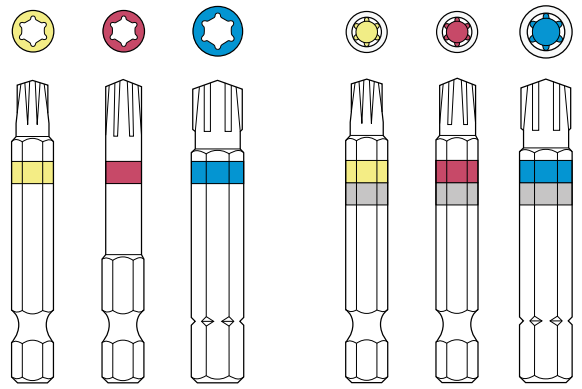
General Installation Instructions

I Use the Correct Bit

MTC Solutions fasteners should only be driven using AW or RW bits, which combine the advantages of both Torx and Phillips bits. This approach ensures good centering and positioning with optimal torque transmission.

Note:

1. For information on bit selection refer to the tables on the Product Overview page for each fastener.

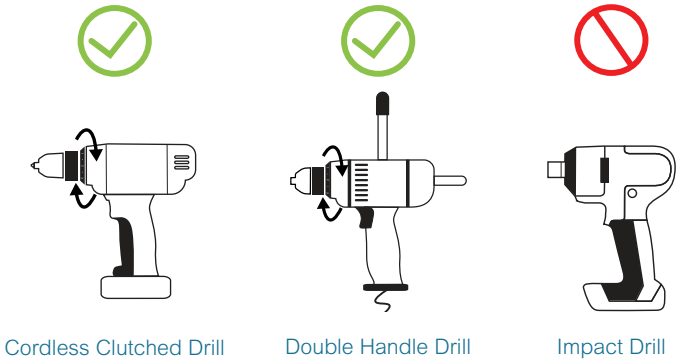


II Use the Correct Drill

Use low RPM, high torque drills to install MTC Solutions fasteners. Avoid excessive acceleration and deceleration during the driving process. RPM should be maintained at 300–400. Do not use impact drills. Do not over-torque fasteners. Use the appropriate drill bit size according to the fastener diameter:

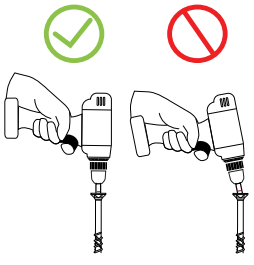
A.1 - Recommended Drill Sizes

Nominal Fastener Diameter [D]		Drill Chuck Size
in.	[mm]	in.
1/4	[6]	1/2
5/16	[8]	
3/8	[10]	3/4
1/2	[12]	



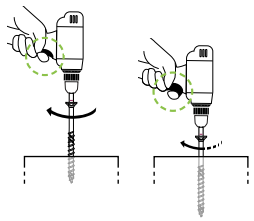
III Align Drill Bit Axis

The drill bit axis must be parallel to the fastener axis during installation to ensure proper torque transmission and to avoid stripping the housing of the bit.



IV Decrease RPM

To avoid over-torquing the screw, especially in steel-to-wood connections, decrease the rotation speed about 1/2" away from the final installed position.



V Do Not Press on the Drill

Do not apply excessive pressure on the drill once the fastener is engaged, as a slight amount of buckling will cause the fastener to deviate from its intended path. Only apply the required force or use the recommended holder case to eliminate cam-out effects.

VI Prevent Fastener Deviation

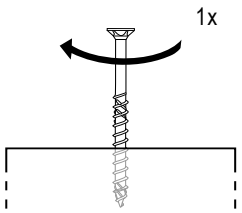
Density variations in the wood, such as knots may cause long and slender fasteners to deviate from the desired installation path. This can lead to reduced connection capacity and risk of screw collision. Predrilling or drilling pilot holes reduces the risk of fastener deviation.

VII Prevent Screw Collision

Fasteners collision in the wood member can occur due to deviation from the installation path. The resulting sudden torque increase can lead to fastener breakage. Predrilling before installation reduces the risk of fastener deviation and helps avoid screw collision.

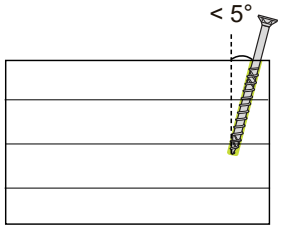
VIII Install in One-Step Process

To avoid increased torque peaks caused by stopping and restarting the drive-in process, install the screw in one run until the head is lightly seated against the side member. If necessary, a torque wrench may be used to complete installation immediately after the fastener has been driven.



IX Installation Near Edges

In near-edge application, the fastener may be slightly inclined inward (< 5°) to prevent the screw from curving outward and protruding out of the wood. Alternatively, predrilling can be performed to ensure a proper penetration path and reduce splitting risks.



X Use Predrilling Jig

Perpendicular bearing of the screw head on a steel plate is required to allow for proper load transfer. An improper bearing can lead to unintended load interactions and breakage. Precise and accurate predrilling with accessories such as predrilling jigs avoids this risk by ensuring the proper alignment of the penetration path.

Predrilling and Pilot Hole

I Predrilling

A predrilled hole, defined as a hole with a depth equivalent to the length of the fastener, serves the purpose of reducing geometry requirements during installation. It is crucial to ensure that the diameter of the predrilled hole follows the recommended values in the table below. Utilizing predrilled holes can optimize the installation process and ensure optimal results in fastener placement in high-capacity connections.

Predrilling is recommended for installing slender fasteners into dense wood, such as SYP.

II Pilot Hole

A pilot hole, defined as a partial length hole, facilitates fastener installation by guiding the fastener and reducing the insertion torque. The installer should use their discretion regarding the length of the pilot hole, ensuring that the diameter does not exceed the minor diameter of the fastener. When working with steel plate connections, especially at angles, utilizing a predrilling jig for accurately locating a precise hole is highly recommended.

A.2 - Recommended Diameters of Predrilled and Pilot Holes

Nominal Fastener Diameter [D]	Predrilled Hole Diameter	Pilot Hole Diameter	Steel Plate Hole Diameter
in. *[mm]*			
1/4 *[6]*	**5/32** *[4]*	**≤ 5/32** *[≤ 4]*	**9/32** *[7]*
5/16 *[8]*	**3/16** *[5]*	**≤ 3/16** *[≤ 5]*	**3/8** *[9]*
3/8 *[10]*	**1/4** *[6]*	**≤ 1/4** *[≤ 6]*	**7/16** *[11]*
1/2 *[12]*	**17/64** *[7]*	**≤ 17/64** *[≤ 7]*	**17/32** *[13]*
9/16 *[14]*	**5/16** *[8]*	**≤ 5/16** *[≤ 8]*	**N/A**

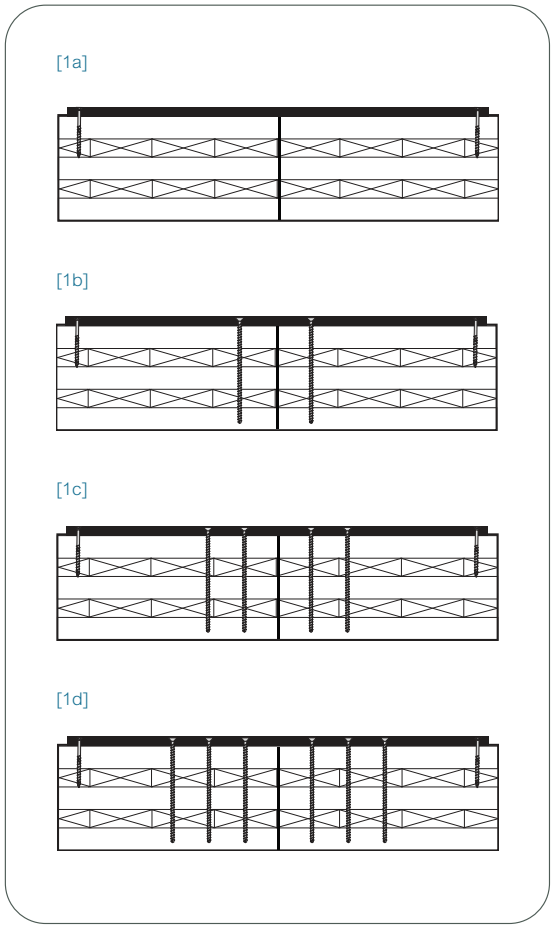
Notes:

1. Full-length predrilling is intended to reduce geometry requirements of the connection according to the lag screw geometry requirements per NDS 2024. Therefore, the predrilling length should be equivalent to the length of the fastener.
2. Pilot holes facilitate fastener installation by reducing splitting risks, ensuring a proper penetration path and faster thread engagement with the wood fiber. A minimum pilot depth of 1" is recommended to obtain the aforementioned benefits.
3. Predrilled holes exceeding the diameters listed above reduce the screw capacity.
4. Recommendations are only applicable to ASSY fasteners supplied by MTC Solutions.
5. Connection design must meet all the relevant requirements outlined in the Notes to the Designer section.

Fastener Installation in Steel Side Plates

This section highlights the recommended installation sequence and instructions for steel-to-wood connections using lateral or inclined screws.

1. Create a list and assemble all tools required according to the type and diameter of the fasteners being installed. Installers should ensure all tools are properly calibrated.
2. Place and secure the steel side plate at the correct position on the wood main member.
3. Plumb and level the steel plate to its intended final position on the wood member via the smaller diameter locator screws as shown in Figure 1a to avoid misalignment. Design professionals should specify holes to accommodate locator screws.
4. Use of pilot holes, while optional, is suggested to ensure precise installation of screws. If desired, drill a pilot hole in every screw location with the appropriate predrilling jig and proper drill bit diameter to a depth of at least 1".
5. Clear off all sawdust inside and around the holes.
6. Start the fastener installation process from the innermost screw row to the outermost screw row as shown in Figures 1b through 1d. In general, start with the innermost screws and move towards the outer edges, where residual stresses can be released.
7. Install the fasteners using the correct drill and bit. During the drive-in process, do not apply excessive pressure on the fasteners. Continue the installation process until the fastener head (lightly) contacts the steel plate. Stop here and remove the drill.
8. (Optional) If the use of a torque wrench is specified by the designer, individual fasteners should be torqued immediately after completion of the previous step. Switch to a torque wrench with a socket bit holder and use the correct bit to slowly drive the fastener to the specified torque. The adjusted torsional value for each fastener is listed in the Reference Design Values Tables.
9. Install the remaining screws consistently from one side of the connection to the other, each time stopping when the fastener head lightly contacts the steel plate.



Notes for the Design Engineer

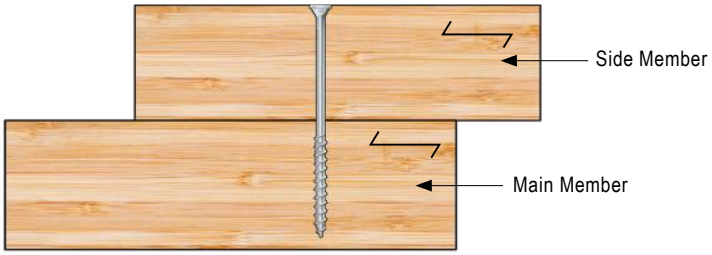
a) Steel plate detailing should accommodate locator screws (i.e., top left and bottom right holes for commonly available screws), especially in end grain connections where the grain orientation can cause fastener deviation during the steel plate installation.

b) Extra holes (~10% of the total required) should be specified for large steel-to-wood tension connections to account for the possibility of installation errors (i.e., accidental damage to screws).

Appendix B: Definitions

Main and Side Members

For connections with multiple closely spaced large-diameter fasteners, the resistance might be limited by wood brittle failure modes. This is due to tension and/or shear failure in parts of the wood members surrounding the fasteners before each fastener reaches its bearing capacity in the group.

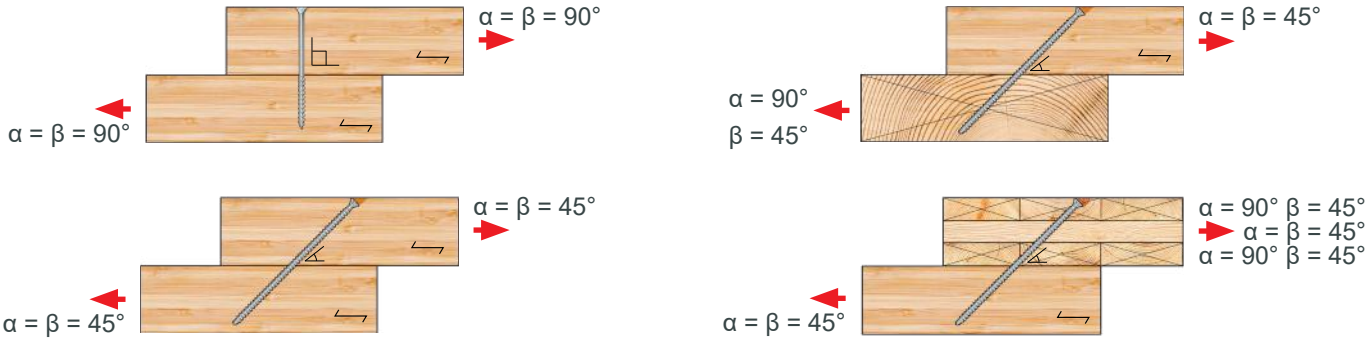


Two-Member Connection

Fastener Angle Notations

Two angle parameters in a connection are defined as follows:

- α represents the relative angle between the fastener axis and the grain orientation
- β represents the smallest angle between the fastener axis and the shear plane

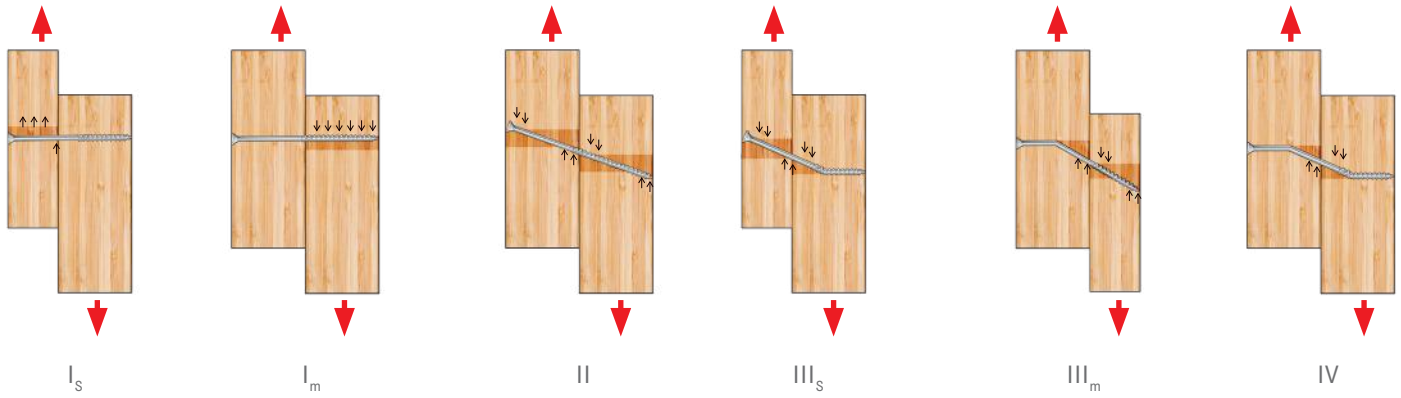


Angle Parameters for Various Configurations

Appendix C: Lateral Connections

Lateral connections can be designed for ductile failure modes. To ensure ductile behavior in a connection, it should be designed in such a way that fastener yielding is the governing failure mode. Additionally, the designer should perform appropriate checks to avoid brittle modes of failure in the wood.

Fastener Yield Modes



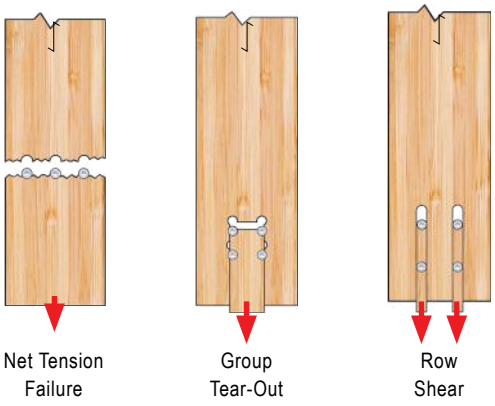
NDS Yield Modes for Two-Member Connections

As illustrated above, fastener yield modes are primarily a function of the embedment failure in the wood member or yielding failure of the fastener, or a combination of both.

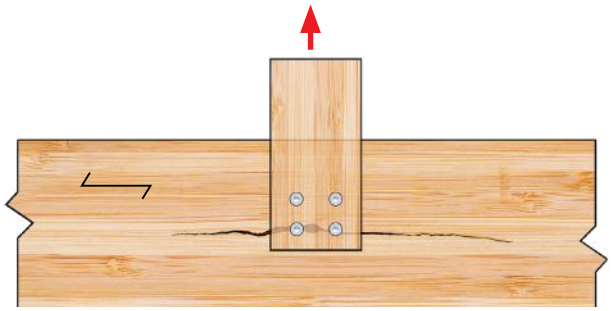
Self-tapping screws have higher bending yield strength (F_{yb}) compared to traditional lag screws. These F_{yb} values are provided in the RDV Tables for different series of MTC Solutions fasteners. With self-tapping screws, yield Modes III_s and IV are the most desirable yielding mechanisms as they offer high ductility. This is especially true for CLT diaphragm design where lateral capacity is required to be governed by Mode III_s or Mode IV according to the 2021 Special Design Provisions for Wind and Seismic (SDPWS). As a rule of thumb, a lateral connection typically reaches yield Mode IV at a minimum penetration length of 8D based on the NDS 2024 yield equations. Increasing the penetration length beyond this point does not result in increased lateral capacity according to these equations as the fastener will have yielded in both members.

Brittle Failure Modes in Wood

For connections with multiple closely spaced large-diameter fasteners, the resistance might be limited by wood brittle failure modes due to tension and/or shear failure in parts of the wood members surrounding the fasteners before each fastener reaches its bearing capacity in the group. These failures can occur in parallel- or perpendicular-to-grain loading directions. Common brittle failure modes that need to be checked for large-dowel type fasteners include, but are not limited to:



Brittle Failures in Parallel-to-Grain Loading



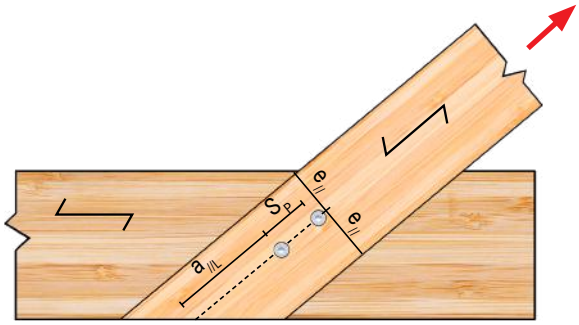
Splitting Failure in Perpendicular-to-Grain Loading

Minimum geometry requirements provided in the ICC-ESR and/or NDS 2024 do not prevent these brittle failure modes, and thus the connections must be checked in accordance with principles of engineering mechanics. Example calculations are provided in Appendix E of NDS 2024.

Appendix D: Geometry Requirements

Wood Members at an Angle

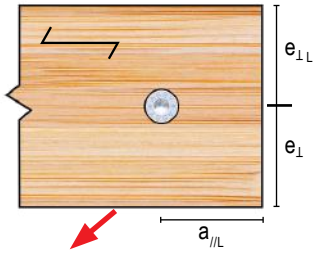
In cases where fasteners are installed in members with miter cuts, the corresponding end and edge distances are measured along and across the grain, respectively.



Wood Member at an Angle

Forces at an Angle to Grain

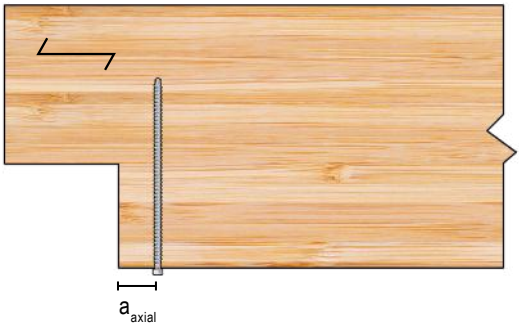
The direction of the force applied to the fastener must be considered when identifying loaded ends and edges.



Wood Member Loaded at an Angle

End and Edge Distance Requirements for Reinforcing Screws

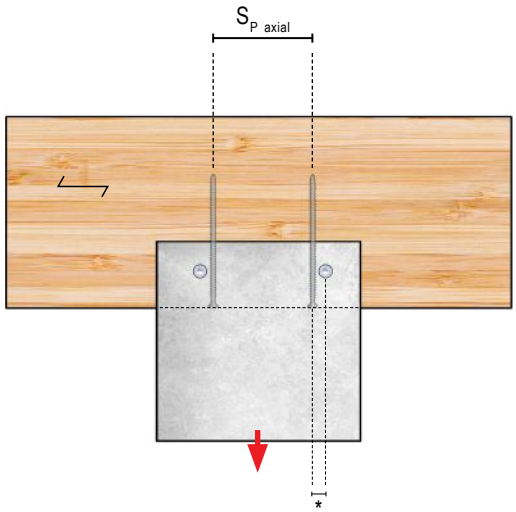
Reinforcing screws should be placed as close to the expected location of peak stress application as possible. Minimum end and edge distances still apply.



End Distance Requirements for Reinforcing Screws

Screws Reinforcing Connections Loaded Perpendicular-to-Grain

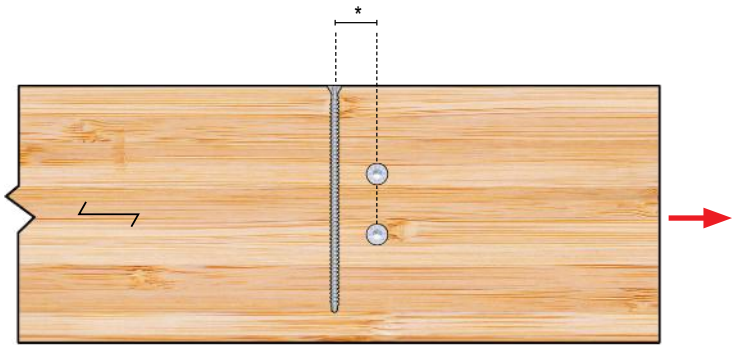
For connection type shown in the figure below, reinforcing screws should be placed as close to the origin of the stress cracking as possible. Maintaining a minimum screw spacing of 0.5D may help to prevent screw collision. The screw spacing follows the usual geometric requirements for axially loaded fasteners. To ensure accurate installation, a pilot hole may be required along the desired fastener path.



Geometry Requirements for Screws Reinforcing Bolted Connections Loaded Perpendicular-to-Grain

Screws Reinforcing Connections Loaded Parallel-to-Grain

Reinforcing screws should be placed as close to the origin of the stress cracking as possible. No minimum distance is required between the reinforcing screws and the other dowel-type fasteners, provided that the respective axes are oriented perpendicular to each other and that there is no screw collision. Reinforcing screws must be placed on the same side of the bolt that bears against the wood member (as shown in the figure below) to resist splitting along the grain.



Geometry Requirements for Screws Reinforcing Bolt Connections Loaded Parallel-to-Grain

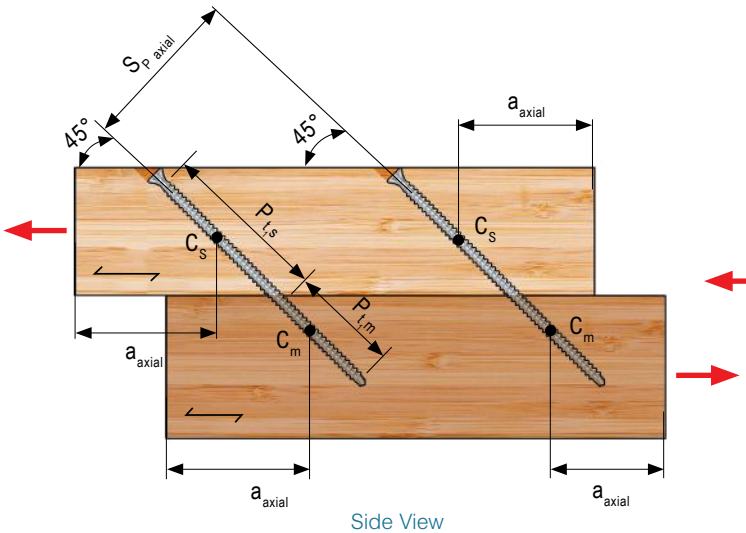
Geometry Requirements for Inclined Screws

For inclined screw connections, the center of gravity of the threaded portion of the screw excluding the tip and unthreaded section in both side (C_s) and main (C_m) members is used when applying end and edge distance requirements.

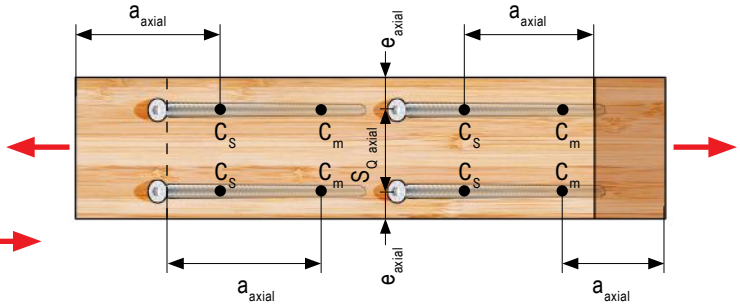
Geometry Requirement		Minimum Dimension
		Any D
Distance between fasteners measured perpendicular to their axes	$S_{P\ axial}$	5D
Distance between rows of screws	$S_{Q\ axial}$	2.5D
End distance	a_{axial}	5D
Edge distance	e_{axial}	3D

Note:

1. Values specified in ICC-ESR 3178-2023.



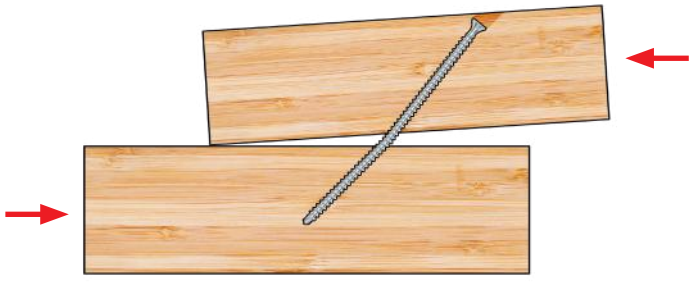
Side View



Top View

Inclined Screws in Reverse Loading

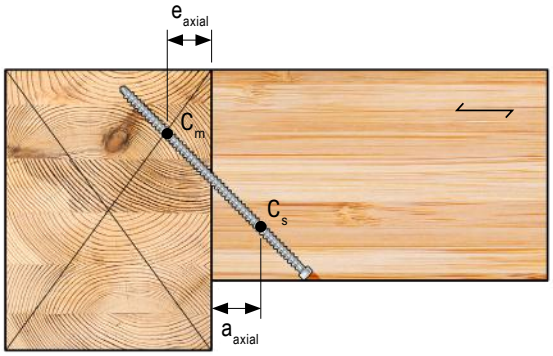
The inclined screw configuration illustrated below is not recommended when the fastener is in shear-compression and may lead to panel separation and screw bending due to uplift forces. For reverse loading or connections subjected to loads oriented in multiple directions, screw crosses are recommended as they offer more stability.



Inclined Screws in Reverse Loading

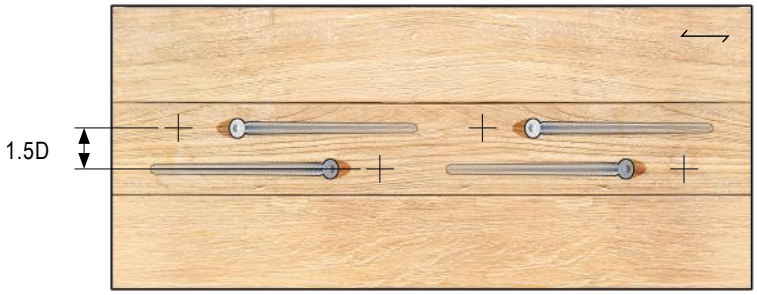
Geometry Requirements for Toe Screws

For toe screw connections, the center of gravity of the portion of the screw in each member is used when applying end and edge distance requirements. It should be noted that swelling and shrinkage of wood members due to changes in moisture content should be considered for toe screw connections. Load eccentricities should be avoided to maintain connection stability. Additionally, toe screw connections should have a tight joint in order to develop compression, essential to effective function.

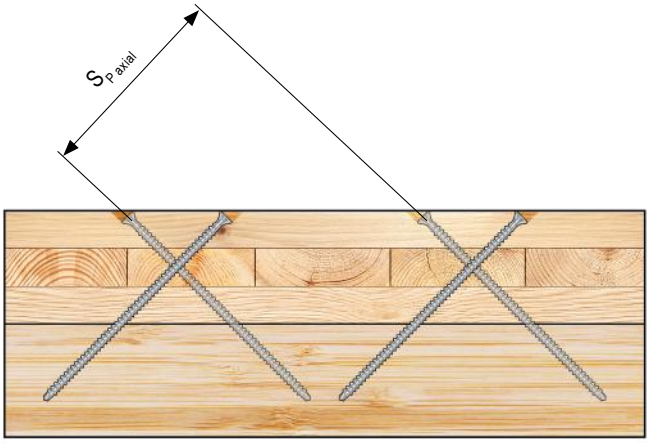


Geometry Requirements in Screw Crosses

Screws in a cross pair need to be offset from one another by at least 1.5D to accommodate installation tolerances and prevent collision.

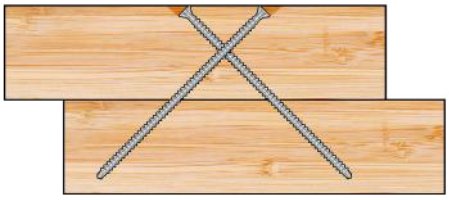


Top View

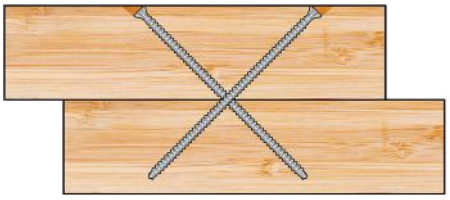


Side View

Fasteners acting as a pair should be installed at the same angle, opposite to each other, with the same thread penetration lengths in either member. Typically, the fasteners cross at either the centroid of the side member or at the shear plane between the two members. Fasteners crossing at the centroid of the side member should be preferred over those crossing at the shear plane, as the former minimizes loading eccentricities that can lead to connection instability.



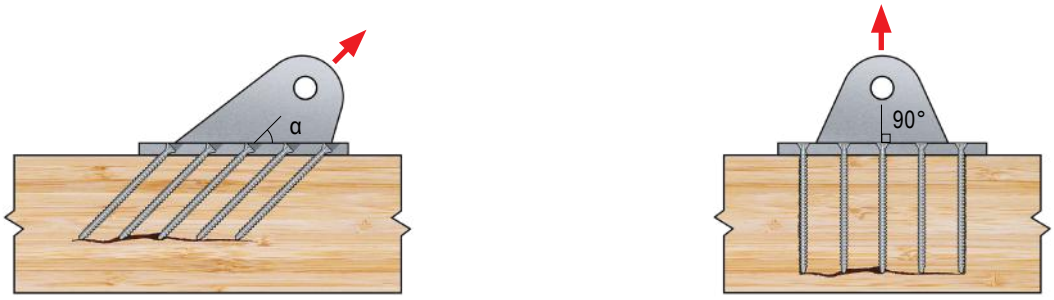
Fasteners Crossing at the Middle of the Side Member



Fasteners Crossing at the Shear Plane

Inclined Screws in Two-Member Connections

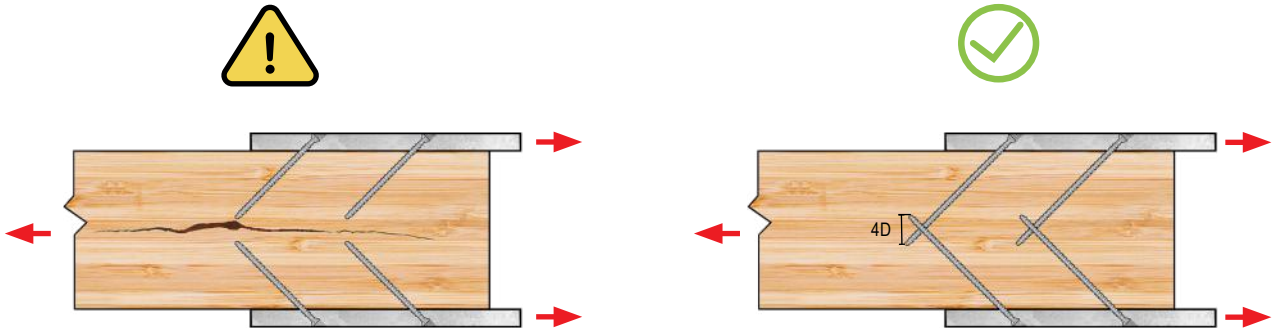
In two-member steel-to-wood connections, there is a possibility of block shear failure, or plug shear failure as shown below, when the screw axis is parallel to the load direction. This failure mechanism depends on the screw spacings, effective thread penetration length, and the angles of the screw axis and loading direction with respect to the wood grain orientation. The worst-case scenario occurs at a 90° angle.



Block Shear Failure in Inclined Steel-to-Wood Connections

Inclined Screws in Three-Member Connections

The loading configuration in the figure below (left) may cause splitting failure in wood. Therefore, such detailing should be avoided for symmetrical, three-member joints. If necessary, the screws in symmetrical joints should overlap by at least 4D (not including the tip).



Inclined Screws in a Three-Member Connection

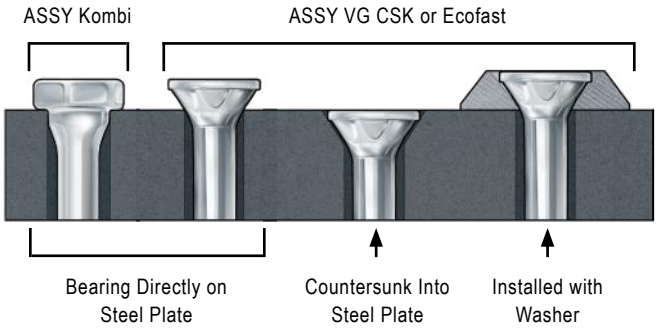
Appendix E: Steel Plate Detailing

Steel-to-Wood Connection Detailing

A steel-to-wood connection can be established with ASSY self-tapping fasteners through the following methods:

1. Bear each fastener directly on the steel plate,
2. Countersink the fastener head into the steel plate, or
3. Install each fastener with a washer

ASSY Kombi and Kombi LT fasteners with hex heads are designed to provide a snug fit with their tapered shoulder in the steel side member. ASSY VG CSK and ASSY Ecofast fasteners with countersunk heads are reliable alternatives for steel-to-wood connections.



The steel side member must be predrilled prior to fastener installation. Steel plate holes are generally kept 1/16" [1 mm] larger than the nominal screw diameter (D). If a coating is present, the steel plate holes must be oversized to account for the coating thickness.

Table E.1 - Fastener Head and Shank Dimensions

Nominal Fastener Diameter [D]	Fastener Type	D_{head}	D_a	D_p	t	Drive Bit
in. [mm]		in. [mm]				
1/4 [6]	Ecofast	0.472 [12]	0.276 [7]	0.622 [15.8]	0.173 [4.4]	RW 40
5/16 [8]	Ecofast	0.591 [15]	0.354 [9]	0.748 [19]	0.197 [5]	RW 40
	VG CSK	0.591 [15]	0.354 [9]	0.748 [19]	0.197 [5]	RW 40
3/8 [10]	Ecofast	0.728 [18.5]	0.433 [11]	0.898 [22.8]	0.232 [5.9]	RW 40
	VG CSK	0.787 [20]	0.433 [11]	0.945 [24]	0.256 [6.5]	RW 50
1/2 [12]	VG CSK	0.866 [22]	0.512 [13]	1.039 [26.4]	0.264 [6.7]	RW 50

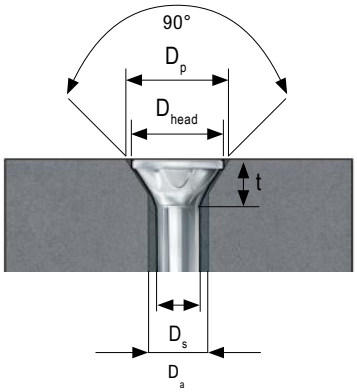
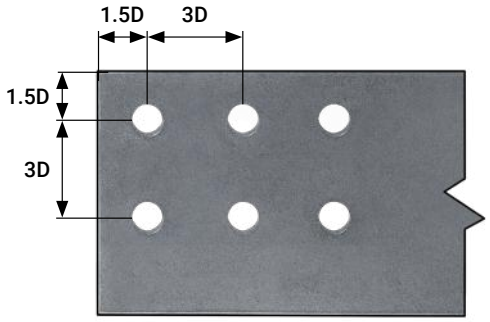


Table E.2 - Steel Plate Geometry Requirements

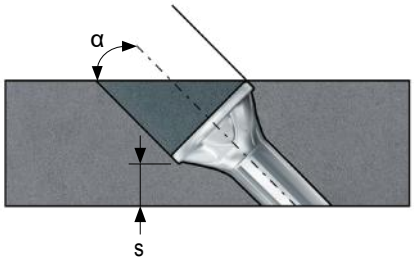
Geometry Requirement	Minimum Dimension
	Any D
Distance between fasteners in a row	3D
Distance between rows of fasteners	3D
End distance	1.5D
Edge distance	1.5D



Note:

1. Values in accordance with ICC-ESR 3178-2023.

For inclined screws in steel side members, their head should be completely countersunk within the milled hole as shown in the figure below. To completely countersink the screw head, the steel plate must be milled at an appropriate angle and to the correct head dimensions. To ensure sufficient stability of an inclined screw with a countersunk head, maintaining a minimum thickness (s) below the head is recommended.



α > 45°	s ≥ 1/8" [3 mm]
30° ≤ α ≤ 45°	s ≥ 5/64" [2 mm]

Appendix F: Service Conditions and Durable Design

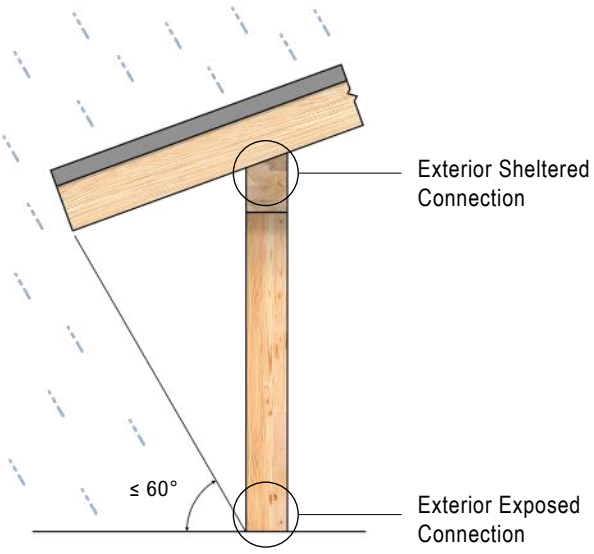
Service conditions and associated demands of corrosion resistance, structural capacity, access for inspection, ease of fastener replacement, and cost all should be considered when selecting fastener materials. Improper material selection can make fasteners more prone to corrosion, which degrades fastener strength.

Corrosion is the reaction that occurs between a metallic material and its environment. Despite being an unavoidable natural phenomenon, proper planning and detailing can mitigate the damaging effects of corrosion. The responsibility is on design professionals to implement appropriate protective measures. The causes of corrosion may vary; however, in timber construction, they are represented by environmental factors, service conditions, galvanic (bimetallic) corrosion, and hydrogen embrittlement.

Service Conditions and Other Factors Impacting Corrosion

Dry Service Conditions

Applications falling within the dry service category are generally confined to indoor environments but may extend to exterior settings, sheltered and unexposed to the elements. It is essential to account for the possibility of prolonged moisture presence during construction, as this might necessitate a reclassification of the service conditions. Regular corrosion-resistant fasteners with an A3K surface coating are intended for use in dry service conditions. For structures exposed to the elements, careful consideration should be given to protection of members when designed using dry service conditions.



Sheltered and Exposed Connections

Wet Service Conditions

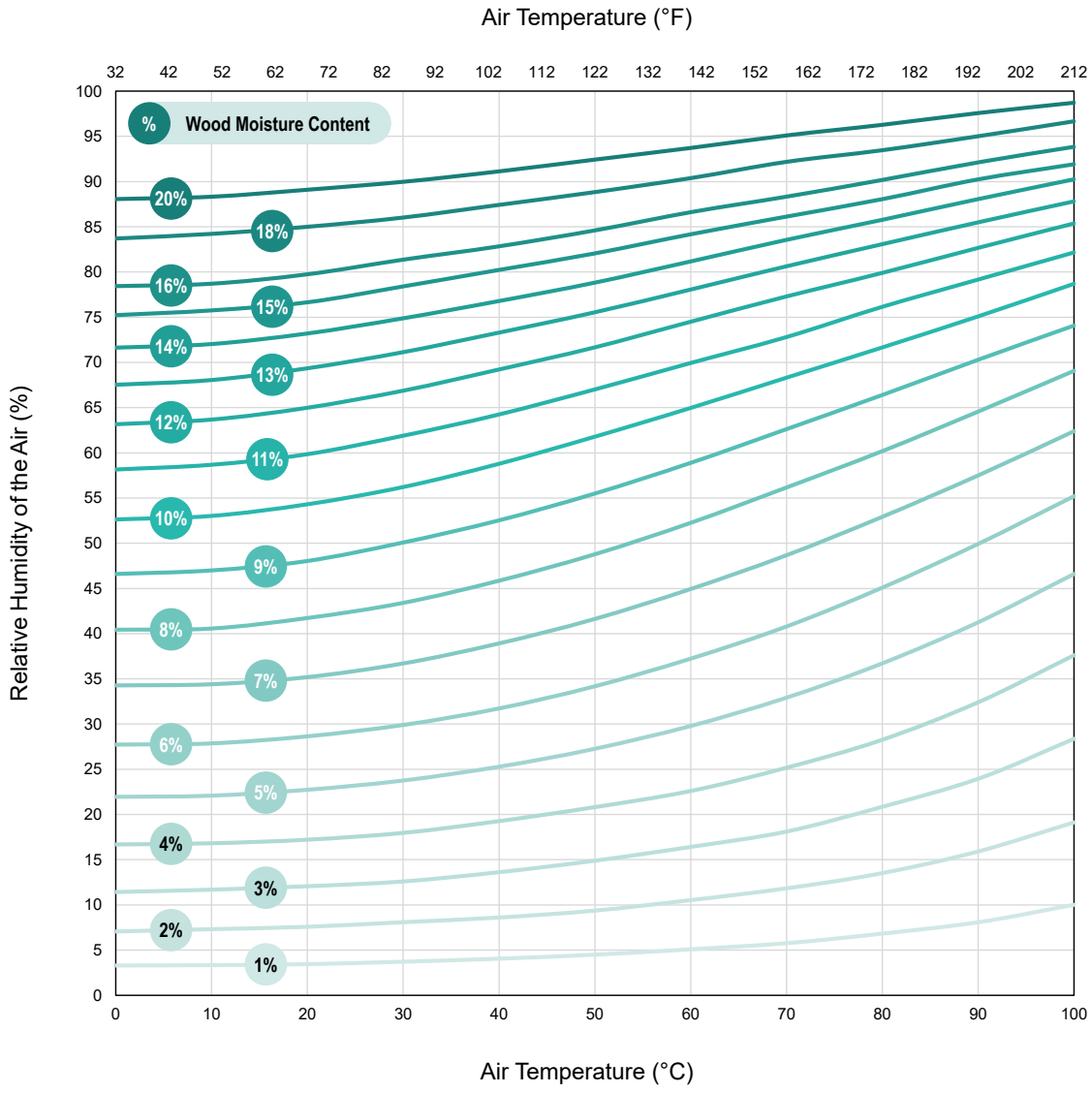
This classification typically applies to outdoor construction projects that do not fall under the Enhanced Corrosion Risk category. It includes scenarios where structures are generally exposed to the outdoors, sheltered but still exposed to the elements, or where members are in direct contact with the ground. Wet service conditions apply to a connection design in the following circumstances:

- The connection is exposed to direct wetting from elements such as rain, snow, splashing, dripping, or condensation, impeding quick and effective drying.
- The wood members are classified as “green” upon installation. In such cases, wet pre-service conditions may apply, at least until the wood dries to below 19% moisture content (MC).
- The equilibrium MC (EMC) exceeds 19% (according to NDS 2024) or 15% averaged over the year and/or 19% at any given time (according to CSA O86 2019).

Designers can estimate EMC from the following wood MC graph. In certain high-humidity indoor or exterior sheltered applications, wood MC can lead to wet service conditions even if the structure is protected from precipitation.

Connections designed for wet service conditions should be detailed to prevent water from accumulating on or under the wood members. An evaluation for wet service conditions is necessary if the annual average MC at a connection surpasses 15%. While direct exposure to the elements is a prerequisite for wet service conditions, sheltered outdoor applications also require careful planning, as corrosion problems can arise from wind-driven rain, splashing, and inadequate air circulation.

Avoiding water traps in weathered members is crucial for the long-term structural health of timber elements. Unprotected end grain can be shielded through the use of covers or strategic positioning in areas protected from direct rainfall. Fasteners installed in members exposed to wet service conditions require a high level of corrosion resistance, such as that offered by A2 stainless steel.



Wood EMC as Related to Environmental Conditions

Enhanced Corrosion Risk

Waterfront Service Conditions

Connections exposed to highly corrosive environments that may contain substances such as chlorine, ocean salt air, and salt water require extreme corrosion-resistant fasteners. Additionally, this classification encompasses areas subject to the application of de-icing salts. Fasteners installed in members for use in these service conditions may require an extreme level of corrosion resistance like that provided by A4 stainless steel.

Exposure to Aggressive Substances

This category encompasses areas exposed to industrial emissions, agricultural chemicals, specific soil types, and certain categories of chemically treated lumber, in accordance with the American Wood Protection Association (AWPA) UC4B and UC4C standards. It also includes environments within industrial regions, zones affected by acid rain, coastal areas with saline air, and exposure to various other corrosive factors. Fasteners installed in members exposed to these service conditions likely require an extreme level of corrosion resistance, such as that offered by A4 stainless steel.

Chemically Treated Lumber

Wood fiber treatment may increase the risk of corrosion, especially in the presence of moisture. Lumber treated with preservatives, followed by copper-containing substances, such as copper azole (CA) and alkaline copper quat (ACQ), exhibits an elevated tendency to induce corrosion in metals within high-moisture environments. This heightened corrosive effect is ascribed to copper's highly galvanic nature, making one of the metals in the couple the anode and accelerating corrosion (see the Bimetallic Contact Corrosion section for more details). Compared to CA, ACQ is more corrosive. Its organic components attract moisture, intensifying fastener corrosion. Therefore, applications involving chemically treated lumber may require fasteners with a high level of corrosion resistance.

Exceptions for Interior, Dry Environments: In accordance with Clause 2304.10.5.1 of the 2018 International Building Code, electroplated carbon-steel fasteners are allowed in interior, dry environments when used in wood treated with SBX/DOT and zinc borate preservatives.

When ambiguity exists surrounding the specifics of treatment chemicals in a particular application or if there are uncertainties about the environmental conditions, MTC Solutions advises opting for stainless-steel hardware with the proper grade. It should be noted that MTC Solutions has not evaluated the formulations of all these chemicals. While manufacturers may offer independent test results or additional product details, MTC Solutions neither endorses nor expresses opinions on such third-party information.

Other Factors that Influence Corrosion

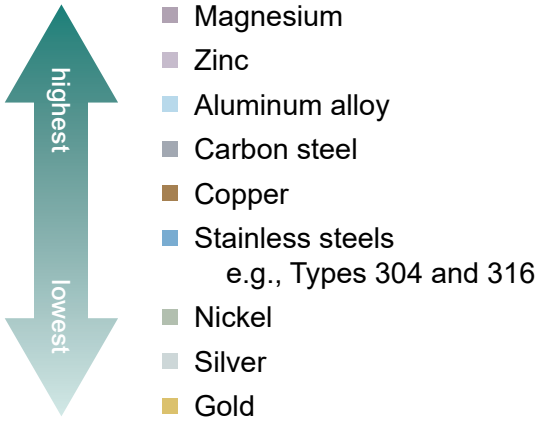
Environmental Hydrogen Embrittlement

Environmental hydrogen embrittlement occurs when there is introduction of hydrogen from the environment, typically from excessive water exposure. Electroplated hardened steel fasteners are susceptible to hydrogen-induced brittle fracture when subjected to tensile stresses in the presence of moisture.

Bimetallic Contact Corrosion

Galvanic (bimetallic) corrosion is an electrochemical process where dissimilar metals are immersed in a conductive solution and are electrically connected, leading to corrosion of the more anodic material.

Effective strategies for mitigating galvanic corrosion include preventing the accumulation of conductive solutions (e.g., water) and eliminating contact between dissimilar metals. Keeping water out of the structure is critical due to its role as an electrolyte that facilitates galvanic corrosion. Additionally, selecting materials with similar corrosion potentials can contribute to prevention of galvanic corrosion. If this is not possible, physical separation of the two metals using a nonconductive material is an alternative preventive approach. In situations where dissimilar metals cannot be avoided, it is considered a best practice to ensure that the fasteners employed are made of a more noble (cathodic) material than the secondary member.



Galvanic Series of Metals and Alloys

Design and Detailing Considerations for Durability

Designers must understand the service life demands of a connection and ensure that the connection is detailed accordingly. Considering MC during both fabrication and service is crucial because the potential reductions from the adjustment factor (C_M) can be substantial.

Table F.1 - Adjustment Factors For Varying Moisture Content Levels

Moisture Content		Adjustment Factor, C_M
At Time of Fabrication	In Service	
≤ 19%	≤ 19%	1
> 19%	≤ 19%	0.4*
Any	> 19%	0.7

Notes:

1. * May be 0.7 or 1.0 in limited conditions.
2. The adjustment factors for varying moisture content levels as per Table 11.3.3 of NDS 2024.

Accommodations for Moisture-Related Movement

In applications where variations in wood MC are expected, special attention should be given to detailing to accommodate the natural shrinkage and swelling of the timber. As sawn lumber primarily undergoes dimensional change in the cross-section (aligning with the tangential and radial directions relative to grain), designers should account for the anticipated movement. Improper connection detailing that does not consider moisture-induced dimensional changes can give rise to the development of restraint forces, resulting in wood splitting and reduced connection performance.

Chapter 13 of the USDA Wood Handbook states the expected change in dimension (ΔD) within the MC range of 6–14% can be estimated using a dimensional change coefficient derived from the dimension at 10% MC:

$$\Delta D = D_I[C_T(M_F - M_I)] \quad \textbf{(eq.9)}$$

$$C_T = \frac{1}{\left(FSP \times {}^{100}/_{S_T}\right) - FSP + M_I} \quad \textbf{(eq.10)}$$

D_I dimension in units of length at start of change;

C_T dimensional change coefficient for the tangential direction;

M_F moisture content (%) at end of change;

M_I moisture content (%) at start of change;

FSP fiber saturation point (assumed at 30% MC unless noted otherwise);

S_T tangential shrinkage

Note:

1. For calculations in the radial direction, C_R (dimensional change coefficient in the radial direction) and S_R (radial shrinkage) replace C_T and S_T, respectively.

Table F.2 - Dimensional Change Coefficients for Common Wood Species in Mass Timber Construction

Species	Dimensional Change Coefficient	
	C_R	C_T
Southern Pine (loblolly)	0.00165	0.00259
Douglas Fir (interior west)	0.00165	0.00263
Spruce-Pine-Fir (black spruce)	0.00141	0.00237

Note:

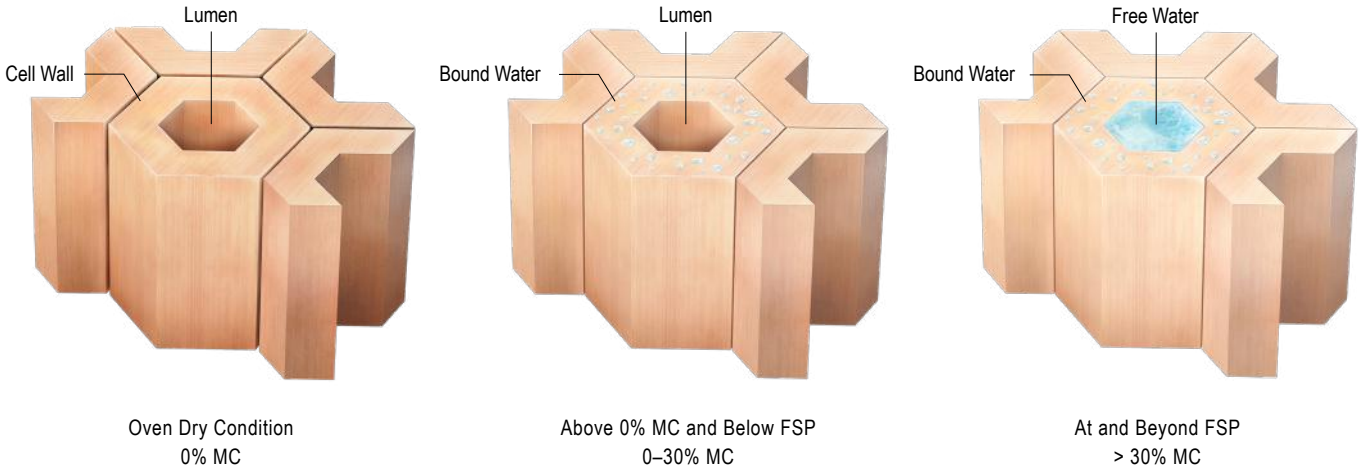
1. Excerpted from Table 13-15 of Wood Handbook, Wood as Engineering Material (2021).

Connections with steel side plates can restrict the natural movement of wood, preventing it from expanding or contracting with changing ambient conditions. It is preferable to allow the wood to shrink or swell with minimal restraint to maintain its structural integrity. In some cases, connectors can be designed with slotted holes to accommodate moisture-related movement. Section 12.5.1.3 of NDS 2024 limits the distance between the outermost fasteners perpendicular to the grain to no more than 5". This limitation helps control restraint forces within a connection, preventing wood splitting and maintaining connection performance.

Maximum Spacing Between Outermost Fasteners

Green Wood

On occasion, fasteners are installed into green wood (with over 30% MC), which undergoes significant drying in the early stages of a building's service life. When wood is below the fiber saturation point (FSP), any water present will be bound in the wood cell walls. As the MC increases, any water will be absorbed by the wood cell walls as "bound water", which causes the cell walls to thicken. Once the MC exceeds the FSP, additional "free water" will be stored in the cell lumen.



Water Movement in Wood Cells

The changes in cell wall thickness correspond with dimensional changes, which are primarily perpendicular-to-grain. It is imperative to implement meticulous detailing to accommodate the considerable shrinkage that will occur as the wood dries out.

End Grain Connections

Connections at the end grain demand careful consideration when subjected to differential drying—a common cause of checking—in heavy timber members. Most building codes include special provisions for screws in withdrawal installed at a 0° angle in the end grain, motivated by the potential development of checks and splits along the grain. In some cases, the fastener axis may run parallel to these voids, resulting in lower capacity, particularly when the fasteners are loaded in withdrawal. As an example, installing fasteners at a 30° angle to the grain offers a solution in end grain applications, enabling the fasteners to pass through checks and splits.

Green Wood

Dry, Checked Wood

Dry, Checked Wood
with Inclined Screws

The following recommendations for fasteners in end grain loaded in withdrawal can help ensure desired connection performance:

- Install the screws at an angle relative to grain greater than approximately 30°
- Use a minimum of 4 screws in each connection
- Ensure a minimum thread penetration length of 20D
- Apply the appropriate angle-to-grain reduction factor (R_α) and end grain factor (C_{eg}) when calculating the design capacity

MTC Solutions provide sustainable, high quality mass timber connection solutions to a rapidly evolving and thriving industry. We drive innovation through certified research and development and contribute our part to the education of young talent and experienced professionals in the technology used in sustainable design.

Credit Stephane Groleau

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