SPAX®

TIMBER CONSTRUCTION

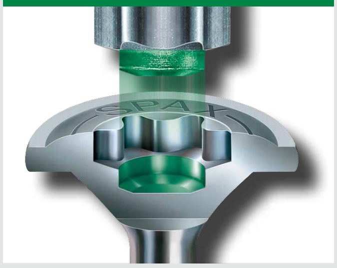
Connection Design according to NZS 3603 using SPAX screws

MADE IN Germany

SPAX Advantages

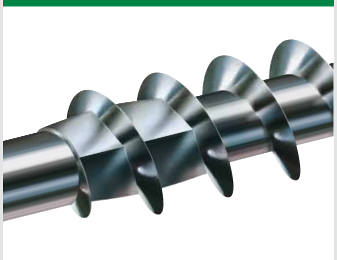
Guaranteed quality and innovation since 1823

T-STAR *plus*



Ensures maximum torque transfer when driving screws.

4CUT



From screw lengths over 160mm. Reduces the screwing-in torque significantly.

Ground Seration / 4CUT

No pre-drilling (wood dependent), reduces splitting. Square end displaces the fibres and reduces screwing in torque.

Certified proof of origin offers a high degree of safety, quality and continuity.

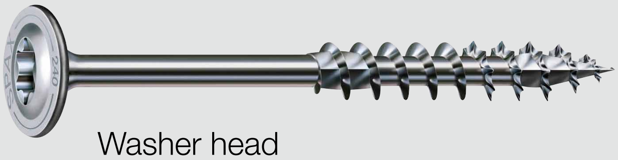
DELTA® - SEAL

Superior corrosion protection, especially in CCA/ACQ treated timber

High corrosion protection from the exclusive DELTA-SEAL coating, providing twice the corrosion protection compared to hot-dipped galvanised products. Ideal for CCA and ACQ treated timbers, all hardwoods and suitable for any external use away from direct exposure to salt water. Large range of stainless steel screws also available.

Screw types & applications

Partial Thread



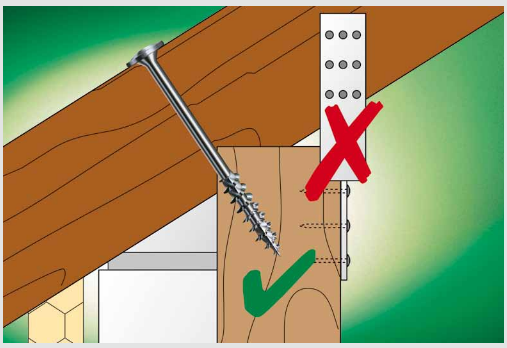
Washer head

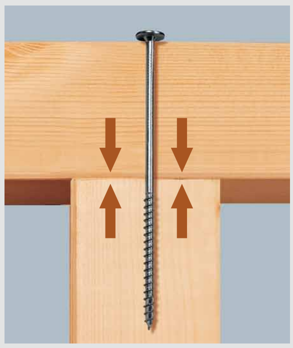
Countersunk head

The partial thread screw works like a clamp, pulling the two timber components together tightly. To achieve this clamping effect, the threadless shank must be equivalent to the thickness of the upper component.

- Washer head - the large bearing area of the head provides a high clamping force
- Countersunk head - used for flush fixings

Ideal for frame and roof structures, pergolas, boardwalks, retaining walls.



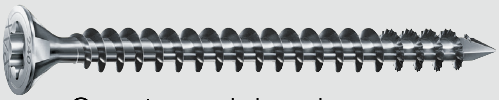


Screw types & applications (cont.)

Screw types & applications (cont.)

Full Thread

Cylinder head

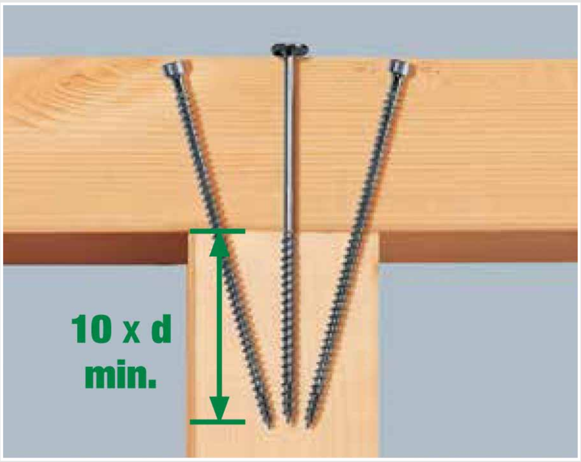


Countersunk head

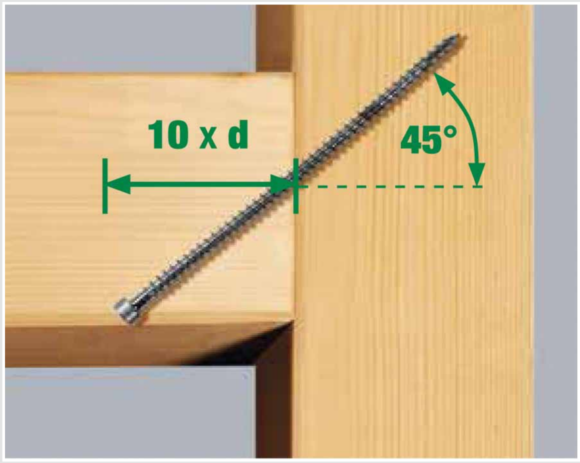
Fully threaded screws are available in countersunk and cylinder head screws up to 600mm long. They are ideal for three main applications:

- Joining two components together for a very high load capacity
- Tensile re-inforcement to prevent cracking of timber
- Compensation re-inforcement to prevent crushing of timber

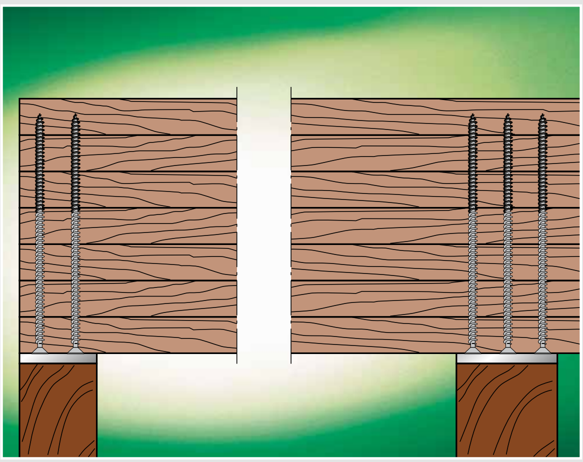
The cylindrical head can sink into the timber below the surface providing a fully concealed fixing.



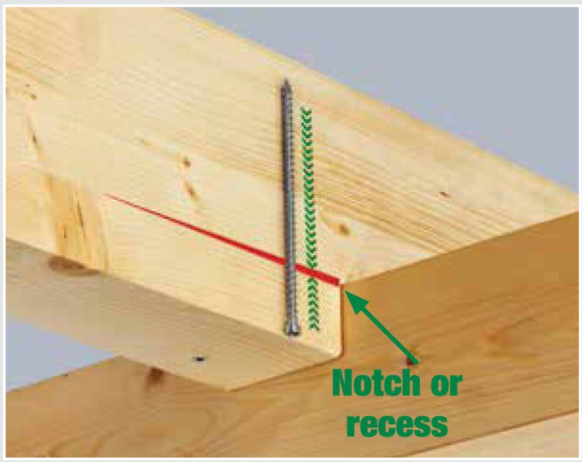
T-joint Beam
Clamp the two pieces together first with a SPAX partial thread washer head screw



Beam to Upright
Insert screw from below at a 45° angle



Compression Reinforcement
Prevents crushing of the timber



Notched Beam
Reinforcement and strengthening of notch or recess

Connection Design According to NZS 3603 Using SPAX Screws

Introduction

This design guide is derived from testing SPAX screws installed in Australian and New Zealand timber species and is designed to be used in conjunction with NZS 3603-1993 for quick predesign of load bearing connections with SPAX screws but is not intended to replace appropriate engineering and design by a design professional.

Testing was conducted according to AS1649-2001 and DIN EN 1382 to determine the limit state design lateral and withdrawal load capacities of SPAX screws in various timber types.

This guide has been established in good faith and to the best of our knowledge. No liability is, therefore, engaged or accepted for any errors.

Characteristic Capacities for SPAX Screws

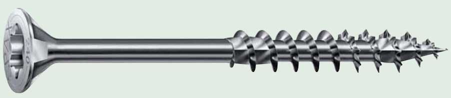
(read in conjunction with Sections 4.3 and 4.5 of NZS 3603 – 1993)

Lateral loads

a) Lateral loads in side grain

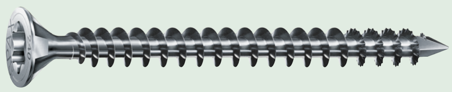
Table 1- Characteristic Capacity for Single Screw in Side Grain Laterally Loaded in Single Shear

Partial Thread Screws



Joint Group	Characteristic Shear Capacity per Screw (Q_k)N*			
	Nominal Diameter d_1 (mm)			
	6.0	**8.0**	**10.0**	**12.0**
	Shank Diameter d_a (mm)			
	4.3	**5.7**	**6.8**	**8.5**
J1	4652	5679	7510	9672
J2	3973	4802	6225	7937
J3	3347	4072	5356	6871
J4	2378	2893	3807	4884
J5	1870	2313	3118	4073

Full Thread Screws



Joint Group	Characteristic Shear Capacity per Screw (Q_k)N*			
	Nominal Diameter d_1 (mm)			
	6.0	**8.0**	**10.0**	**12.0**
	Core Diameter d_2 (mm)			
	3.8	**5.0**	**6.1**	**7.5**
J1	4320	5116	6148	8871
J2	3675	4390	5146	7303
J3	3113	3675	4402	6310
J4	2211	2611	3128	4485
J5	1728	2069	2516	3719

** Capacities for partial thread screws assume the shear plane is in line with the unthreaded screw shank. These capacities are based on interpolation of capacities provided in NZS3603. Actual values from test results may vary slightly.*

Depth of penetration

The depth of penetration as per clause 4.3.2 of NZS 3603.

For the characteristic capacities given in Table 1 to be applicable, the depth of penetration into the member receiving the point should be not less than seven times the shank diameter ($7d_a$). For depths of penetration less than this value the characteristic strength shall be reduced in proportion to the reduction in penetration, but the minimum acceptable penetration depth shall be four times the shank diameter ($4d_a$).

b) Lateral loads in end grain

The characteristic capacities for screws laterally loaded in the end grain shall not exceed 67% of the values provided in Table 1 above determined in accordance with Clause 4.3.2 (c) of NZS 3603.

Withdrawal loads

a) Withdrawal loads from side grain

The characteristic capacities for SPAX screws axially loaded in withdrawal at right angles to the grain of dry timber are provided in Table 2 below.

b) Withdrawal loads from end grain

The characteristic capacities for SPAX screws axially loaded in withdrawal from the end grain of dry timber shall not exceed 67% of the values provided in Table 2 below determined in accordance with Clause 4.3.3(c) of NZS 3603.

Table 2 - Characteristic Capacity for a Single Screw in Side Grain Loaded in Withdrawal

Timber Group	Characteristic Withdrawal Capacity per Screw (Q_k)N per mm Penetration of Thread			
	Normal Diameter d_1 (mm)			
	6.0	**8.0**	**10.0**	**12.0**
J1	293	417	549	686
J2	177	240	303	376
J3	120	162	203	245
J4	76	101	126	152
J5	76	101	126	152

Maximum Tensile Capacity

The maximum tensile capacity for a SPAX screw subject to direct axial loading shall not exceed the value appropriate to the diameter as per Table 3 below:

Table 3 - Maximum Tensile Capacity for Screws

	Design Steel Tensile Resistance $N_{d,tc}$			
	Nominal Diameter d_1 (mm)			
	6.0	**8.0**	**10.0**	**12.0**
High-carbon steel	8800	13600	22400	30400
Stainless steel	5700	10400	16000	22400

Head Pull-Through

NZS 3603 does not consider head pull-through as a failure mode for screws but this should be considered, particularly in radiata pine and other softwoods. We can calculate crushing under the head of the screw by applying the equation $Q_b = f_{pj} \times A_w$, where f_{pj} is the stress factor from table 4.11 of NZS 3603 and A_w is the bearing area of the head, and provide theoretical values for head pull-through in Table 4 below (actual values may be higher).

Table 4 – Characteristic Capacity for Head Pull-Through

Joint Group	Head Type	Characteristic Capacity per Screw for Head Pull-through (Q_b)N			
		Nominal Diameter d_1 (mm)			
		6.0	**8.0**	**10.0**	**12.0**
J1	Countersunk	2635	4438	6804	9955
	Washer Head	3779	6618	13138	NA
J2	Countersunk	2070	3486	5344	7819
	Washer Head	2968	5198	10320	NA
J3	Countersunk	1322	2227	3414	4995
	Washer Head	1896	3328	6592	NA
J4	Countersunk	1240	2089	3202	4685
	Washer Head	1778	3114	6183	NA
J5	Countersunk	1176	1981	3037	4443
	Washer Head	1687	2954	5865	NA

Joint Groups

The corresponding joint design for timber species is provided in Table 5 below.

Table 5 – Joint Groups

Timber Species	Screws in Lateral loading	Screws with withdrawal
Radiata pine	J5	J4
Rimu	J4	J4
Douglas fir	J5	J5
Silver beech	J4	J4
LVL 13	J4	J4
Spotted Gum	J2	J2

Design Capacity of SPAX Screwed Joints (as per NZS 3603 section 4.3.3)

Lateral loads

Laterally loaded screwed joints should be so proportioned to satisfy:

$S^* \leq \varphi Q_n$

where

S^* = *design action effect in shear*

φ = strength reduction factor

$Q_n = n_k Q_k$ = nominal strength of joint

where

n = number of fasteners

Q_k = characteristic strength as given in Table 1

k = product of modification factors listed below:

(a)	Green timber (see table 2.1 of NZS 3603)	0.80
(b)	Duration of loading	Factor k_1 as given by clause 2.7 of NZS 3603
(c)	Screws in end grain	0.67
(d)	Steel side plates where screws are driven through close-fitting holes in steel side plates that are of adequate strength to transfer the load.	1.25
(e)	The depth of penetration as per clause 4.3.2 of NZS 3603 and on page 1 of this document.	

Withdrawal loads

Screwed joints subjected to withdrawal loads shall be proportioned to satisfy:

$N^* \leq \varphi Q_n$

where

N^* = design action effect in withdrawal

φ = strength reduction factor

$Q_n = n\, k\, p\, Q_k$ = nominal strength of joint

where

n = number of fasteners

Q_k = characteristic strength as given in Table 2

p = penetration length of screw

k = product of modification factors listed below:

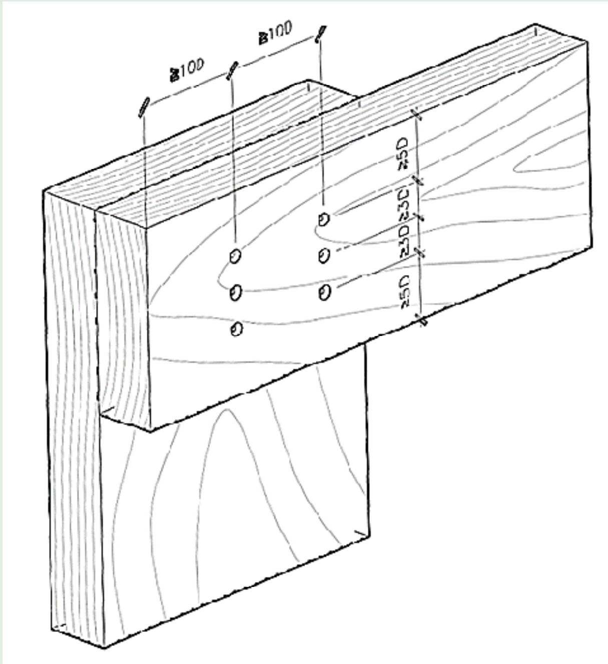
(a)	Green timber (see table 2.1 of NZS 3603)	0.80
(b)	Duration of loading	Factor k_1 as given by clause 2.7 of NZS 3603
(c)	Screws in end grain	0.67

Spacing, Edge and End Distance (refer to clause 4.3.1.2 of NZS 3603)

Table 6

Spacing	Minimum distance
End distance	$10d_a$
Edge distance	$5d_a$
Between screws	
- along grain	$10d_a$
- cross grain	$3d_a$

d_a= shank diameter of screws



Pre-drilling

SPAX screws can be driven into radiata pine and other softwoods with or without pre-drilling. We recommend pre-drilling in hardwood and LVL according to the below diameters:

Outer Thread Diameter	Drill Hole Diameter (mm)	
	Softwood	Hardwood
4.0	2.5	3.0
4.5	3.0	3.0
5.0	3.0	3.5
6.0	4.0	4.0
8.0	5.0	6.0
10.0	6.0	7.0
12.0	7.0	8.0

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How to Specify SPAX

When specifying SPAX screws, the following items should be included:

- Screw diameter and length
- Head type
- Thread type i.e. full thread or partial thread
- Material / corrosion protection
- Edge distances and spacings on drawing

e.g. SPAX 8 x 240 DELTA-SEAL cylinder head full thread.

Contacts

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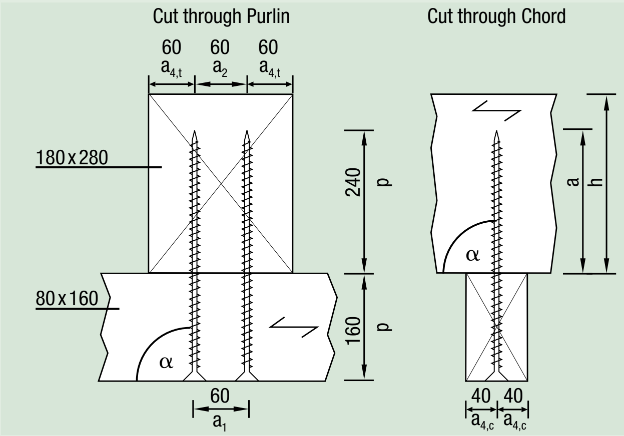
Example 1



Selected fastener: SPAX 8.0x400 countersunk head, full thread with CUT point, w/o predrilling subject to shear and withdrawal. Timber is dry radiata pine.

Minimum dimensions

Minimum penetration = 7 x d_a = 7 x 5.7 = 40< 280mm	OK
Edge distance = 5 x d_a = 5 x 5.7 = 28.5	OK
No end distance	
Spacing (along grain) = 10 x d_a = 10 x 5.7 = 57	OK

Shear resistance

1. Characteristic resistance Q_k = 1734 N	Table 1 (J5)

$\varphi Q_n = \varphi n k Q_k$

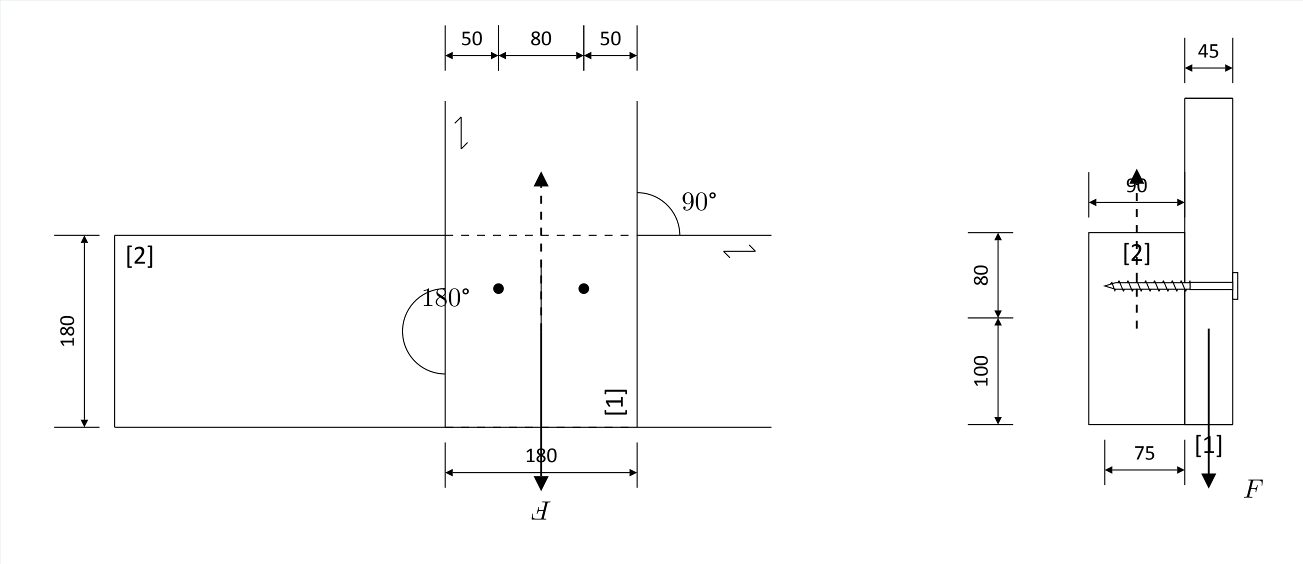
= 0.8 x 2x 0.8x 1734 = 2219 N

Withdrawal resistance

1. Withdrawal of thread point side	
$\phi Q_n = \phi n k p Q_k$ = 0.8 x 2 x 0.8 x 240 x 108 = 33177 N	Table 2 (J4)
Withdrawal of thread headside	
$\phi Q_n = \phi n k p Q_k$ = 0.8 x 2 x 0.8 x 160 x 108 = 22118 N	Table 2 (J4)
2. Tensile steel resistance	
$N_{d,tc}$= 2 x 13600 = 27200	Table 3

Governing resistance is withdrawal of thread head side = **22118N**

Example 2



Selected fastener: SPAX 8x120 washer head, partial thread, w/o predrilling subject to shear.

Minimum dimensions

Min. thickness	t_1 = 3 x *D* = 3 x 5.7 = 17.1 > 45mm	OK
	t_p = 7 x *D* = 7 x 5.7 = 40 < 90mm	OK
Edge distance	= 5 x *D* = 5 x 5.7 = 28.5	OK
End distance	= 10 x *D* = 10 x 5.7 = 57	OK
Spacing (along grain)	= 10 x *D* = 10 x 5.7 = 57	OK
Spacing (across grain)	= 3 x *D*= 3 x 5.7 = 15	OK

Shear resistance

Dry timber, radiata pine =J5 timber group in shear

Characteristic resistance Q_k per screw = 2313 N Table 1

For medium duration, K1 = 0.8

$\varphi Q_n = \varphi nkQ_k$

= 0.8 x 2 x 0.8 x 2313 = 2960 N

**SPAX IS NOT ONLY CALLED
“INTERNATIONAL” – IT ACTUALLY IS!**

Production is carried out at our site in Ennepetal and we export SPAX products to more than 40 countries across all continents.

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