

National Technical Approval

Approval body for construction products and construction types

Construction testing institute

A public institution jointly supported
by the federal and state governments

Member of EOTA, UEAtc and WFTAO

Date:

Reference number:

11/03/2011

I 52-1.9.1-519//08-1

Translation of the original German document; translation not examined
by Deutsches Institut für Bautechnik

Approval No.:

Z-9.1-519

Period of validity:

from: **11th March 2011**

to: **30th April 2012**

Applicant:

SPAX International GmbH & Co.KG

Kölner Straße 71-77

58256 Ennepetal

Approved Product:

**SPAX®-S full-thread screws
for fastening timber**

National Technical Approval has herewith been granted for the above named product.

This National Technical Approval comprises 14 pages and 12 appendices.

This National Technical Approval replaces National Technical Approval No. Z-9.1-519 dated
7th May 2007.

The product was first granted National Technical Approval on 17th April 2002.

DIBt

I GENERAL PROVISIONS

- 1 The National Technical Approval certifies the suitability and applicability of the product pursuant to the building regulations of the Federal States of Germany.
- 2 Wherever demands are placed upon the particular expertise and experience of the persons assigned to undertake the manufacture of construction products and construction types according to Section 17, Paragraph 5 of the Model Building Regulation respective state rules in the National Technical Approvals, it must be taken into account that this expertise and experience can also be proved by means of equivalent evidence from other member states of the European Union. This may also apply for equivalent evidence presented within the context of the Agreement on the European Economic Area (EEA) or other bilateral agreements.
- 3 The National Technical Approval shall not exempt the holder from acquiring all approvals, permissions and certificates legally required for the completion of the relevant building project.
- 4 The National Technical Approval is granted without prejudice to the rights of third parties, in particular private property rights.
- 5 Irrespective of other regulations laid down in the “Special Regulations”, the manufacturer and distributor of the approved product must forward copies of the National Technical Approval to the user of the approved product and inform him that a copy of the National Technical Approval must be kept available at the location at which the product is used. On request, all authorities involved in the realisation of the construction project must be handed a copy of the National Technical Approval.
- 6 The National Technical Approval may only be reproduced in its entirety. The publication of this document is only permitted with the explicit consent of Deutsches Institut für Bautechnik. Texts and graphics in printed promotional material shall not contradict the National Technical Approval. Translations of the National Technical Approval must bear the following notice: “Translation of the original German document; translation not examined by Deutsches Institut für Bautechnik”.
- 7 The National Technical Approval can be revoked at any time. The terms and regulations governing National Technical Approvals may be amended, and extended at any time, especially if this is warranted as a result of technological development.

II SPECIAL PROVISIONS

1 Approved Product and Area of Application

1.1 Approved Product

The SPAX®-S screws covered by this National Technical Approval are full-thread screws with an outer thread diameter of $d_t \geq 6$ mm made of carbon steel. The screws are either galvanised or coated with non-electrolytic zinc laminates; for specific applications they are provided with an additional organic top coating. They are used to fasten construction components of solid timber (soft wood) or glue-laminated timber, laminated veneer lumber according to the relevant national approval, or wood based panels or steel components to solid timber (soft wood) and glue-laminated timber or laminated veneer lumber according to the relevant national approval. They serve to further increase the load capacity of timber construction components when applied at right angles to the grain.

1.2 Area of Application

SPAX®-S screws may be used as fasteners for timber components in load-bearing timber structures to be designed and constructed in accordance with the standards DIN1052¹, unless provided otherwise in this National Technical Approval.

The dimensioning may take place according to DIN V ENV 1995-1-1:1994-06-Eurocode 5: Design, calculation and dimensioning of timber structures; part 1-1: General dimensioning rules and dimensioning rules for building construction in connection with the national application document "Guidelines for the application of V ENV 1995-1-1", February 1995 edition, unless otherwise stipulated below.

The screws can be used for joining timber construction components in accordance with National Technical Approval if the National Technical Approval granted for the timber component permits the use of screws according to the National Technical Approval for joining same.

The SPAX® screws may not be used for connections to timber products.

However, the timber product boards named below may be connected to timber parts according to Section 1.1 using the SPAX® screws:

- Plywood according DIN EN 13986² (DIN EN 636³) and DIN V 20000-1⁴ or in accordance with National Technical Approval
- Synthetic-bonded chipboard according to DIN EN 13986 (DIN EN 312⁵) and DIN V 20000-1 or according to National Technical Approval
- Type OSB/3 and OSB/4 OSB boards (Oriented Strand Boards) according to DIN EN 13986 (DIN EN 300⁶) and DIN V 20000-1 or OSB boards according to National Technical Approval

1	DIN1052:2008-12	Design, calculation and dimensioning of timber structures, general dimensioning rules and dimensioning rules for building construction
2	DIN EN 13986:2005-03	Timber materials for use in construction – properties, conformity assessment and identification
3	DIN EN 636:2003-11	Plywood specifications
4	DIN V 20000-1:2005-12	Use of building products in structures – Part 1: timber materials
5	DIN EN 312:2003-11	Particle board specifications
6	DIN EN 300:2006-09	Boards of long, slender, oriented strand board (OSB) – definitions – classification and specifications

- Fibreboards according to DIN EN 13986 (DIN EN 622-2⁷ and 622-3⁸) and DIN V 20000-1 or according to National Technical Approval, minimum gross density 650 kg/m³
- Cement-bonded chipboard according to DIN EN 13986 (DIN EN 634-2⁹) and DIN V 20000-1 or according to National Technical Approval
- Plaster-bonded chipboard according to National Technical Approval.

Screws with an outer thread diameter of $d_1 \geq 8$ mm that are screwed in without pre-drilling may only be screwed into timber parts made from solid timber, glue-laminated timber and from laminated veneer lumber, composite laminated board or composite laminated beam provided that spruce, pine or fir wood is used. This analogously also applies for screwing into timber parts according to National Technical Approval.

These screws can be driven into the cover surfaces, narrow edge faces, and end edge faces (grain cut timber) of “KERTO” veneer timber “KERTO-S” and “KERTO-Q” in accordance with the National Technical Approval No. Z-9.1-100, hereinafter called “KERTO-S” and “KERTO-Q”. Screws applied to end edge faces must be subjected to pull-out loads only.

The screws may only be used for mainly static loads (see DIN 1055-3: 2006-03).

The screws may be screwed into grain cut timber made from solid timber, glue-laminated timber or composite laminated board or composite laminated beam made from pine wood at an angle of $15^\circ \leq \alpha \leq 90^\circ$ (α = angle between the screw axis and grain direction).

For the area of application for screws, depending upon the environmental conditions, DIN 1052 standard applies. The screws may not be used in the area of application specified in DIN 1052-2:1988-04, Table 1, last column, and DIN 1052:2008-12, Table 2, Column 3, respectively.

2 Provisions specific to SPAX®-S Screws

2.1 Properties and composition

- 2.1.1 The shape, dimensions and dimensional deviations of the screw must conform to the specifications in appendices 1 to 6.
- 2.1.2 The screws according to appendices 1 to 6 must be manufactured from high-carbon steel according to the works standards¹¹ D20, D21 or D22.
- 2.1.3 The characteristic values of the axial load-bearing capacity $R_{t,u,k}$ of the screws must not be less than those specified in Table 1.

Table 1: Characteristic Values of Axial Load-Bearing Capacity $R_{t,u,k}$

Outer Thread Diameter d_1 mm	Characteristic Values of Axial Load-Bearing Capacity $R_{t,u,k}$ N
6.0	11,000
8.0	17,000
10.0	28,000
12.0	38,000

- ⁷ DIN EN 622-2:2003-10 Fibreboard Specifications Part 2: Specifications for hard boards
- ⁸ DIN EN 622-3:2003-10 Fibreboard Specifications Part 3: Specifications for medium-hard boards
- ⁹ DIN EN 634-2:2007-05 Cement bonded particle board – requirements – Part 2: specifications for particle boards bonded with Portland cement (PZ) for use in dry, moist and outdoor areas.
- ¹⁰ Z-9.1-100 KERTO laminated veneer lumber
- ¹¹ The internal factory standards are on file at the Deutsches Institut für Bautechnik.

- 2.1.4 The characteristic values of the torque at fracture $M_{t,u,k}$ must not be less than those specified in Table 2.

Table 2: Characteristic Values of Torque at Fracture $M_{t,u,k}$

Screws made of carbon steel	
Outer Thread Diameter d_1 mm	Characteristic Values of Torque at Fracture $M_{t,u,k}$ Nmm
6.0	10,000
8.0	21,000
10.0	40,000
12.0	70,000

- 2.1.5 The screws must be capable of being bent to an angle of 45° without breaking.
- 2.1.6 The shape, dimensions and sizes of the washers must conform to Appendix 7. The washers must be manufactured from high-carbon steel.

2.2 Identification

The packaging of the screws or the manufacturer's delivery note must bear the mark of conformity (Ü mark) in accordance with relevant acts issued by the Federal States. The use of this mark is only permitted if the requirements specified in Section 2.3 are met.

The packages and delivery note must also contain the following information:

- The name of the approved product
- Screw type and screw size
- Screw corrosion protection

2.3 Proof of conformity

2.3.1 General

Proof of conformity of the screws with this National Technical Approval must be provided individually for each manufacturing plant and by means of a certificate of conformity based on internal production inspection and regular external production inspection, including an original inspection of the screw in accordance with the provisions below.

For granting the certificate of conformity and the external product inspection, including all necessary products inspections, the manufacturer of the screw must commission an authorised certification body as well as an approved inspection body.

The declaration that a certificate of conformity has been issued shall be provided by the manufacturer by labelling the construction product with the mark of conformity whilst stating the intended use.

The certification body must file a copy of the certificate of conformity with Deutsches Institut für Bautechnik.

2.3.2 Internal Production Inspection

An internal production inspection system must be established and operated at each manufacturing plant. In this context, the internal inspection must provide for the continuous monitoring of production by the manufacturer. The inspection system must ensure that the building products manufactured at the relevant plant conform to the specifications laid down in this National Technical Approval.

The internal production inspection system must comprise the following procedures as a minimum requirement:

- The raw wire must meet the requirements of the works certificate “2.2” according to DIN EN 10204¹²; compliance with the requirements specified in Section 2.1.2 and 2.1.3 must be checked on the basis of the test certificate
- Testing of the tensile strength and the breaking torque of the screw: One of these tests may be foregone if, in consultation with the inspecting body, the implemented test also allows conclusions to be drawn as regards the adherence of the requirements concerning the untested characteristic.
- 45° bending test
- Inspection of the screw dimensions

All further provisions associated with the internal production inspection system must be set forth in the supervision contract.

The results of the internal production inspection shall be recorded and evaluated. As a minimum requirement the records must contain the following details:

- Name of the building product or the raw material and the parts
- Nature of the inspection or testing
- Date of manufacture and inspection of the product or the raw material and the parts
- Results of the tests and inspection and, as far as applicable, a comparison with the specifications
- Signature of person responsible for the internal production inspection

The records must be kept for at least five years, and must be made available to the external inspection body responsible for the external production control. On request, these records must be made available to Deutsches Institut für Bautechnik an the relevant building supervisory board.

In the event of inadequate test results, the manufacturer is required to take the necessary corrective measures immediately. Non-conforming building products must be identified as such and handled in a way to fully exclude confusion with conforming products. After the situation has been rectified, the relevant test must be repeated without delay to the extent technically feasible and actually required to verify that the non-conformity has been eliminated.

2.3.3 External Production Inspection

The in-house production control is to be checked regularly by a third party monitoring at every manufacturer's works, at least however once per year.

Within the context of third party monitoring, an initial testing is to be carried out on the screws and samples for random sample testing are to be taken. The sample taking and the testing are the responsibility of the recognised inspecting body respectively. At least the breaking torque, bending angle and the dimensions of the screws are to be tested.

The results of the certification and external production inspection must be kept for at least five years. On request, these records must be made available by the certification body or the authorised inspection body to Deutsches Institut für Bautechnik and the relevant building supervisory board.

3 Stipulations for the dimensioning

3.1 General

DIN 1052 applies for the dimensioning of wood structures when using SPAX® screws unless otherwise stipulated below. Where necessary, the National Technical Approvals are to be observed for the timber parts.

Provided the following provisions are adhered to, the dimensions may also be determined in accordance with DIN V ENV 1995-1-1:1994-06 (in conjunction with the National Application Document).

Penetration depths of $< 4 \cdot d_1$ (d_1 = outer thread diameter) shall not be considered for dimensioning.

The calculation value of the slip modulus K_{ser} for the evidence concerning fitness for use of the SPAX® screw with total thread stressed in the axial direction amounts to the following per cutting edge:

$$K_{ser} = 780 \cdot d_1^{0.2} \cdot l_{ef}^{0.4} \text{ (in N/mm)} \quad (1)$$

Wherein:

l_{ef} = the respective thread length in both of the individual cross sections in mm (see l_1 and l_2 in Appendices 10 and 11)

d_1 = outer thread diameter of the screw in mm

The calculation value of the slip modulus for the evidence of load bearing capacity is to be assumed to be 2/3 of the calculation value of the slip modulus for the evidence concerning fitness for use.

3.2 Dimensioning according to DIN 1052:2008-12 or DIN V ENV 1995-1-1 (in combination with the national application document)

3.2.1 Perpendicular load to the screw axis (shearing)

When dimensioning according to DIN 1052 or according to DIN V ENV 1995-1-1, the outer thread diameter d_1 according to appendices 1 to 6 may be taken into account as screw diameter d .

For the characteristic value of yield moment the given values of Table 3 are valid.

Table 3: Characteristic Values of Yield Moment $M_{y,k}$

Outer Thread Diameter d_1 mm	Characteristic Values of Yield Moment $M_{y,k}$ Nmm
6.0	10,900
8.0	20,000
10.0	30,000
12.0	48,000

Shear loading of screws in the end edge faces of “KERTO-S” and “KERTO-Q” is not to be taken into account.

For screws subject to shear loads driven into the narrow edge faces of “KERTO-Q”, an actual embedding strength of 1/3 of that of the cover surface must be assumed.

With regard to the pre-drilling of the timber parts for the SPAX® screws, the embedment strength $f_{h,k}$ of the timber materials can be assumed as when dealing with nails in pre-drilled timber parts.

3.2.2 Load in the direction of the screw axis

3.2.2.1 Extracting load

The characteristic value of the extraction resistance for screws screwed in at an angle of $15^\circ \leq \alpha \leq 90^\circ$ may:

$$R_{ax,k} = k_{ax} \cdot f_{1,k} \cdot l_{ef} \cdot d_1 \quad (\text{in N}) \quad (2)$$

be taken into account with

$$k_{ax} = 0.3 + \frac{0.7 \cdot \alpha}{45^\circ} \quad \text{for } 15^\circ \leq \alpha \leq 45^\circ \quad (3)$$

$$k_{ax} = 1.0 \quad \text{for } \alpha \geq 45^\circ$$

$$k_{ax} = 1.25 \quad \text{for } \alpha = 90^\circ \text{ and } d_1 < 8.0 \text{ for solid timber, glue-laminated timber and composite laminated board or composite laminated beam}$$

α = angle between the screw axis and the grain direction,

$15^\circ \leq \alpha \leq 90^\circ$ for solid timber (pine wood), glue-laminated timber (pine wood) and composite laminated board or composite laminated beam (pine wood)

$30^\circ \leq \alpha \leq 90^\circ$ for laminated veneer lumber with National Technical Approval

$$f_{1,k} = 80 \cdot 10^{-6} \cdot \rho_k^2 \quad (\text{in N/mm}^2) \text{ for solid timber (pine wood), glue-laminated timber (pinewood) and composite laminated board or composite laminated beam (pine wood)} \quad (4)$$

If screws are screwed into the upper surfaces of "KERTO-S" and "KERTO-Q" at an angle of $30^\circ \leq \alpha \leq 90^\circ$, then $f_{1,k}$ with

$$f_{1,k} = 70 \cdot 10^{-6} \cdot \rho_k^2 \quad (\text{in N/mm}^2) \text{ for } d_1 \leq 8 \text{ mm and} \quad (5)$$

$$f_{1,k} = 60 \cdot 10^{-6} \cdot \rho_k^2 \quad (\text{in N/mm}^2) \text{ for } d_1 > 8 \text{ mm} \quad (6)$$

is to be assumed. These values are to be reduced by 20% where screws are screwed into the edges and front surfaces.

Wherein:

l_{ef} = thread length in wood section with the screw tip in mm. Screw-in depths l_{ef} smaller than $4 \cdot d_1$ may not be taken into account.

d_1 = outer thread diameter of the screw in mm

ρ_k = characteristic gross density of the timber material in kg/m^3

Due to the risk of head pull-through and the risk of screw thread pull-through through screwed-on timber parts, the characteristic value of the extraction resistance when extracting screws may be taken into account with a maximum of

$$R_{ax,k} = \max \left\{ \frac{f_{2,k} \cdot d_k^2}{k_{ax} \cdot f_{1,k} \cdot l_{ef,k} \cdot d_1} \right\} \quad \text{in N} \quad (7)$$

Wherein:

$f_{2,k}$ = characteristic value of the head pull-through parameters in N/mm^2

$$f_{2,k} = 80 \cdot 10^{-6} \cdot \rho_k^2 \quad (8)$$

For flange head, washer head and pan head screws:

$$f_{2,k} = 100 \cdot 10^{-6} \cdot \rho_k^2 \quad (9)$$

ρ_k = characteristic gross density in kg/m^3 , maximum 500 kg/m^3 , maximum 380 kg/m^3 for timber boards

d_k = head diameter of the screw according to appendices 1 to 6 in mm, $d_k = 0$ is to be assumed when dealing with hexagonal head screws with a small head, cylindrical head screws and hexagonal screws without flange.

$l_{ef,k}$ = thread length in timber part to be connected (head-side screw area) in mm

d_1 = outer thread diameter of the screw according to appendices 1 to 6 in mm

When connecting timber parts with thicknesses of ≥ 12 to ≤ 20 mm, only

$f_{2,k} = 8 \text{ N/mm}^2$

may be used for calculation.

Extraction parameters $f_{1,k}$ are to be calculated according to equations (4) to (6). Equation (7) applies for screws with an outer thread diameter of $d_1 = 12$ mm when using timber products only when washer head screws are used.

When connecting timber product boards, a maximum of 400 N may be taken into account when dealing with board thicknesses of under 12 mm, wherein the minimum thicknesses according to Section 4.4 are to be observed.

Equation (7) is not authoritative with regard to steel plate-wood connections.

The dimensioning value $R_{t,u,d}$ determined from the characteristic value of the load capability of the screw for tensile load $R_{t,u,k}$ according to Table 1 may not be exceeded.

3.2.2.2 Pressure Loads

The dimensioning value of the load bearing capacity for screws screwed in at an angle of $15^\circ \leq \alpha \leq 90^\circ$ (α = angle between screw axis and grain direction) with a pressure load may be taken into account with

$$R_{c,\alpha,d} = \min \{ R_{ax,d}; R_{ki,d} \} \quad (\text{in N}) \quad (10)$$

Wherein:

$R_{ax,d}$ = dimensioning value of the extraction resistance with $R_{ax,k}$ according to equation (2) in N

$R_{ki,d}$ = dimensioning value of the load bearing capacity against buckling according to Table 4 in N. Intermediate values may be interpolated linearly

Table 4: Dimensioning Value of the Load Bearing Capacity against Buckling $R_{ki,d}$

Characteristic Raw Density ρ_k kg/m ³	Screw-in angle α °	Outer Thread Diameter d_1 mm			
		6	8	10	12
		N			
310	15	5,520	8,530	13,600	20,000
	30	5,720	8,850	14,100	20,700
	45	5,890	9,130	14,600	21,400
	60	6,040	9,380	15,000	21,900
	75	6,180	9,600	15,300	22,400
	90	6,300	9,800	15,600	22,800
350	15	5,700	8,820	14,100	20,700
	30	5,890	9,140	14,600	21,400
	45	6,060	9,420	15,000	22,000
	60	6,220	9,660	15,400	22,500
	75	6,350	9,880	15,700	23,000
	90	6,470	10,100	16,000	23,400

Continuation Table 4:

380	15	5,820	9,020	14,400	21,100
	30	6,010	9,340	14,900	21,800
	45	6,180	9,610	15,300	22,400
	60	6,330	9,850	15,700	23,000
	75	6,460	10,100	16,000	23,400
	90	6,580	10,300	16,300	23,800
410	15	5,930	9,200	14,700	21,500
	30	6,120	9,510	15,200	22,200
	45	6,290	9,780	15,600	22,800
	60	6,440	10,000	15,900	23,300
	75	6,570	10,200	16,300	23,800
	90	6,680	10,400	16,600	24,200
450	15	6,060	9,420	15,000	22,000
	30	6,250	9,730	15,500	22,700
	45	6,420	10,000	15,900	23,300
	60	6,560	10,200	16,300	23,800
	75	6,690	10,400	16,600	24,200
	90	6,800	10,600	16,900	24,600

3.2.2.3 Reinforcement of timber parts under transverse loads

To the extent timber components compressed at an angle of $45^\circ \leq \alpha \leq 90^\circ$ to the grain (α = angle between screw axis and grain direction) are reinforced by means of screws, care must be exercised as to ensure that the pressure on all reinforcement screws is evenly distributed and the pressure emanating from the screw heads can be absorbed by the supporting members.

The rated value of the load-bearing capacity of a pressure surface with screws driven at an angle of $45^\circ \leq \alpha \leq 90^\circ$ (= angle between screw axis and grain direction) may be calculated at

$$R_{90,d} = \min \left\{ \begin{array}{l} k_{c,90} \cdot B \cdot l_{ef,1} \cdot f_{c,90,d} + n \cdot \min \{ R_{ax,d}; R_{ki,d} \} \\ B \cdot l_{ef,2} \cdot f_{c,90,d} \end{array} \right. \quad (\text{in N}) \quad (11)$$

The following definitions apply:

$k_{c,90}$ lateral pressure coefficient in accordance with DIN 1052:2008-12, Section 10.2.4

B width of support area in mm

$l_{ef,1}$ effective length of support area in accordance with DIN 1052:2008-12, Section 10.2.4 in mm

$f_{c,90,d}$ dimensioning value of the transverse pressure strength in N/mm²

n number of reinforcing screws, $n = n_0 \cdot n_{90}$

n_0 number of reinforcing screws arranged in a row in grain direction

n_{90} number of reinforcing screws arranged in a row at right angles to the grain

$R_{ax,d}$ design value of pull-out resistance with $R_{ax,k}$ according to Equation (2) in N

$R_{ki,d}$ design value of load-bearing capacity to buckling according to Table 4 in N

- $l_{ef,2}$ effective length of support area in the plane of the screw points in mm
 $= l_{ef} + (n_0 - 1) \cdot a_1 + \min(l_{ef}; a_{3,c})$ for end supports (see app. 12)
 $= 2 \cdot l_{ef} + (n_0 - 1) \cdot a_1$ for intermediate supports (see app.12)
- l_{ef} depth of the reinforcing screws in the timber in mm
- a_1 distance between screw axes in a plane parallel to grain direction (see app.12)
- $a_{3,c}$ distance between the centre of gravity of the portion of the screw in the timber and the end grain surface (see app.12)

The fastening of wood based panels using screws which are subject to pressure loads is not considered in this National Technical Approval.

3.2.3 Combined Load

For connections subject to both axial (F_{ax}) and right angle (F_{la}) loads, the following must hold true:

$$\left(\frac{F_{ax,d}}{R_{ax,d}} \right)^2 + \left(\frac{F_{la,d}}{R_{la,d}} \right)^2 \leq 1 \quad (12)$$

Here $F_{ax,d}$ and $F_{la,d}$ represent the design values of the forces parallel and at a right angle to the screw axis respectively. $R_{ax,d}$ and $R_{la,d}$ represent the design values of the load-bearing capacity of the fastenings in the case of single-force-component loading parallel and at a right-angle to the screw axis respectively.

4 Provisions for production

4.1 For production DIN 1052 applies, unless provided otherwise below. The National Technical Approvals for timber building components are to be observed.

4.2 The screws may only be used for the fastening solid timber parts (soft wood) and elements made of glue-laminated timber, laminated veneer according to the National Technical Approval and wood based panels in accordance with section 1.2, or for the fastening steel parts to solid timber parts (soft wood), and elements made of glue-laminated timber or laminated veneer according to the National Technical Approval.

The screws may be used for joining timber construction components in accordance with National Technical Approval if the National Technical Approval granted for the timber component permits the use to this end of screws according to the National Technical Approval.

Screws with an outer thread diameter of $d_1 \geq 8$ mm that are screwed in without pre-drilling may only be screwed into timber parts made from solid timber, glue-laminated timber and from laminated veneer lumber, composite laminated board or composite laminated beam provided that spruce, pine or fir wood is used. This analogously also applies for screwing into timber parts according to the National Technical Approval.

The screws also enhance the load-bearing capacity of timber construction components at a right angle to the grain direction.

If pressed timber parts perpendicular or diagonally to the grain have to be reinforced by screws, it must be guaranteed that the compressive force is evenly distributed across all reinforcement screws and that the screw heads under pressure can cope with the pressure from the supporting material.

- 4.3** The screws may only be driven in with the tools recommended for that purpose by the manufacturer.

When pre-drilling the timber part for the SPAX® screws, the diameter of the drill hole is to be selected in such a manner that it conforms to the core diameter $d_2 \begin{smallmatrix} +0.0 \text{ mm} \\ -0.5 \text{ mm} \end{smallmatrix}$ of the SPAX® screws.

The holes in steel components are to be pre-drilled with a suitable diameter. In cement-bonded particle boards, the screw holes must be predrilled with a diameter of $0.7 \cdot d_1$. In timber building components (with the exception of cement-bonded particle boards) the screws must be driven without pre-drilling.

The screws must be countersunk such that the head is flush with the surface of the fastened part, but for washer head and hex. head part k protruding. Deeper countersinking, with the exception of cylindric head screws, is not permitted.

The countersunk screws may be used together with washers according to appendix 7. The respective washer must completely rest on the wood after the screwing in process.

- 4.4** When dealing with SPAX® screws with an outer thread diameter of $d_1 \leq 8 \text{ mm}$ that will be screwed into timber parts that have not been pre-drilled, the thickness of the timber parts must measure at least 30 mm, when dealing with screws with $d_1 = 10 \text{ mm}$, the thickness must measure at least 40 mm and when dealing with screws with $d_1 = 12 \text{ mm}$, the thickness must at least amount to 80 mm.

When connecting timber boards using SPAX® screws to timber parts according to 1.1, their board thickness must amount to at least $1.2 \cdot d_1$ (d_1 = outer thread diameter of the screw). Furthermore, the board thickness must measure at least 10 mm when dealing with plaster-bonded chipboard.

For minimum distances in timber construction components in accordance with National Technical Approval, the provisions of the National Technical Approvals apply.

- 4.5** For end grain connections solid timber must be at least half-cut and the timber moisture content must not exceed 18% at the time of fastening.

- 4.6** Minimum distances

- 4.6.1** Perpendicular load to the screw axis (shearing)

- 4.6.1.1** Timber parts that have not been pre-drilled

The minimum distances of the screws must correspond to the values laid down in DIN 1052, as is the case for nails with no pre-drilled holes, with the outer thread diameter d_1 according to the Appendices 1 to 6 being calculated as the screw diameter.

For screws the distance from the end grain face in grain direction must not be less than $15 \cdot d_1$.

The values according to DIN 1052 must be adhered to as minimum distances of the SPAX® screws with CUT point or 4CUT point when dealing with timber parts regulated by the standard, as with nails with pre-drilled nail holes. The minimum distance a_1 parallel to the grain direction may not fall below the value $5 \cdot d_1$ and the minimum distance to the end grain $a_{3,c}$ or $a_{3,t}$ must not be lower than $12 \cdot d_1$. The named minimum distances only apply under the prerequisite that there is a minimum wood cross section of $40 \cdot d_1^2$ and the minimum thickness of the timber parts $t_{\min}$ of:

Screws with CUT point

$$t_{\min} = 5 \cdot d_1 \text{ for } d_1 = 6 \text{ mm}$$

$$t_{\min} = 7 \cdot d_1 \text{ for } d_1 \geq 8 \text{ mm}$$

Screws with 4CUT point

$$t_{\min} = 6 \cdot d_1 \text{ for } d_1 = 6 \text{ mm}$$

$$t_{\min} = 7 \cdot d_1 \text{ for } d_1 \geq 8 \text{ mm}$$

If the minimum wood cross section of $40 \cdot d_1^2$ is not reached, the values according to DIN 1052 shall be adhered to as minimum distances for the screws when dealing with timber parts regulated by the standard, as with nails with nail holes that have not been pre-drilled.

When dealing with SPAX® screws without CUT point or 4CUT point that have to be screwed into timber parts that have not been pre-drilled, and if the distance to each other in the grain direction and to the end grain measures at least $25 \cdot d_1$, then the distance to the unstressed edge may be reduced to $3 \cdot d_1$ perpendicular to the grain direction.

When dealing with Douglas-fir, the minimum distances in the grain direction are to be increased by 50%.

4.6.1.2 Pre-drilled timber parts

The values according to DIN 1052 must be adhered to as minimum distances of the SPAX® screws in pre-drilled timber parts when dealing with timber parts regulated by the standard, as with nails with pre-drilled nail holes.

4.6.1.3 For minimum distances in timber construction components in accordance with the National Technical Approval, the provisions of the National Technical Approvals apply.

4.6.2 Load in the direction of the screw axis

When dealing with screws that are planned to be exclusively stressed in the direction of the screw axis with an outer thread diameter of $d_1 \leq 8$ mm or with CUT point, the following minimum distances may be used as a basis when dealing with pre-drilled timber parts if the minimum wood thickness of $t = 12 \cdot d_1$ is observed (see Appendices 8 and 11):

Distance a_1 between the screw axes
in a plane parallel to grain direction:

$$a_1 = 5 \cdot d_1$$

Distance a_2 between the screw axes
at right angles to a plane parallel to grain direction:

$$a_2 = 5 \cdot d_1$$

Distance $a_{3,c}$ between the centre of gravity of the portion of the screw
in the timber and the end grain face:

$$a_{3,c} = 5 \cdot d_1$$

Distance $a_{4,c}$ between the centre of gravity of the portion of the screw
in the timber and the side face:

$$a_{4,c} = 4 \cdot d_1$$

For screws with CUT point or 4CUT point:

$$a_{4,c} = 3 \cdot d_1$$

The distance a_2 between the screw axes may be reduced to $2.5 \cdot d_1$, provided each screw has a connecting face of $a_1 \cdot a_2 = 25 \cdot d_1^2$.

For screws that crossover, the axis distance a_2 can be assumed as shown below:

$$a_2 = \max \left\{ \begin{array}{ll} 1.5 \cdot d_1 & \text{for } 70^\circ < \alpha_k \leq 90^\circ \\ 2.5 \cdot d_1 \left(1 - \frac{\alpha_k}{180^\circ} \right) & \text{for } 0^\circ < \alpha_k \leq 70^\circ \end{array} \right. \quad (13)$$

Wherein:

α_k See Appendices 9 and 11 for crossing angle of the screws

Minimum distances a_1 and a_2 are to be observed between screws arranged in parallel belonging to adjacent screw intersections.

4.7 Minimum distances for connections using “KERTO-S” and “KERTO-Q”

4.7.1 Perpendicular load to the screw axis (shearing)

For connections with “KERTO-Q” (upper surfaces and edges) and “KERTO-S” subject to shear loads, the minimum distances laid down in DIN 1052 must be complied with; the same applies to nails without pre-drilling. The screw diameter d_1 is calculated as the outer thread diameter as specified in the Appendices 1 to 6.

For the distances of screws driven into the cover surfaces of “KERTO-Q” the values in table 5 of the National Technical Approval No. Z-9.1-100 apply.

4.7.2 Load in the direction of the screw axis

When dealing with screws that are planned to be exclusively stressed in the direction of the screw axis and if a minimum thickness of the “KERTO-Q” or “KERTO-S” components of $t = 6 \cdot d_1$ is observed, the following minimum distances may be used as a basis (see appendices 8 and 11):

Distance a_1 between the screw axes
in a plane parallel to grain direction:

$$a_1 = 5 \cdot d_1$$

Distance a_2 between the screw axes
at right angles to a plane parallel to grain direction:

$$a_2 = 5 \cdot d_1$$

Distance $a_{3,c}$ between the centre of gravity of the portion of the screw
in the timber and the end grain face:

$$a_{3,c} = 5 \cdot d_1$$

Distance $a_{4,c}$ between the centre of gravity of the portion of the screw
in the timber and the side face:

$$a_{4,c} = 3 \cdot d_1$$

The distance a_2 between the screw axes may be reduced to $2.5 \cdot d_1$, provided each screw has a connecting face of $a_1 \cdot a_2 = 25 \cdot d_1^2$.

For screws that crossover, the axis distance a_2 according to equation (13) can be assumed.

Minimum distances a_1 and a_2 are to be observed between the screws arranged in parallel belonging to adjacent screw intersections.

Rainer Schäpel
Head of Division

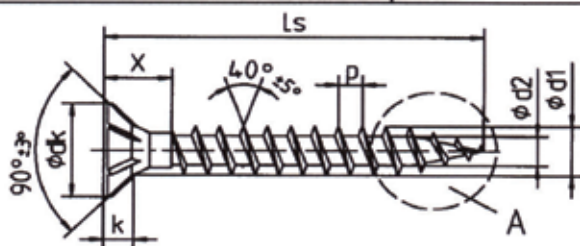


SPAX®-S

Full-thread, self-drilling screw

Material: Cold rolled wire according to SPAX Factory Norm
Screws of high-carbon steel

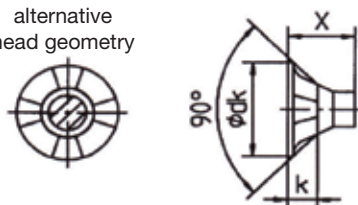
Countersunk head



Trademark
or "SPAX"

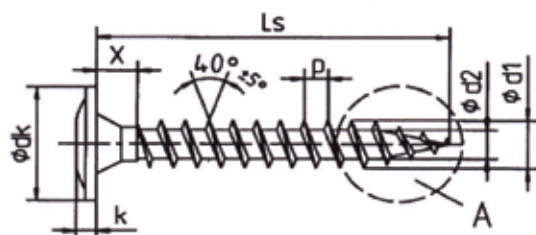


alternative
head geometry



A: alternatively with
CUT point

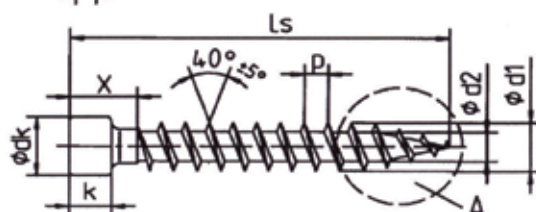
Washer head



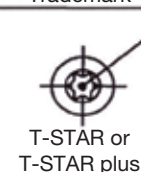
Trademark
or "SPAX"



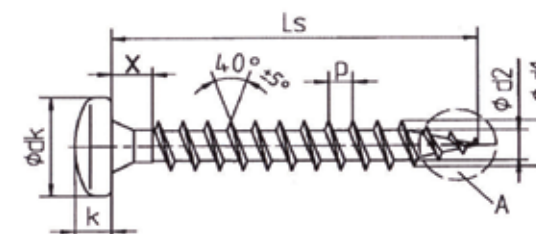
Cylindric head



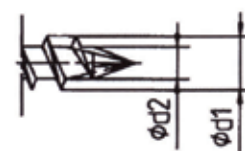
Trademark



Pan head



Trademark
or "SPAX"



Nominal diameter		6.0							
Type of Head		Countersunk head		Washer head		Cylindric head	Pan head		
d1	thread size	6,0							
	permissible tolerance	±0.20							
dk	head diameter	9.7	11.9	13.0	15.0	8.4	11.9	9.9	
	permissible tolerance	-0.60		±1.0		-0.60			
d2	core diameter	4.0							
	permissible tolerance	-0.40							
k	height of head, max.	4.0	5.0	2.2	2.4	6.0	4.0	3.4	
p	thread pitch	3.6							
	permissible tolerance	±0.1 x p							
T-STAR	size	T30							T20
Thread-free length X Ls 60-200		max. 15mm							
Permissible tolerance of screw length	Ls 60-99	Ls ±2mm							
	Ls 100-200	Ls ±5mm							

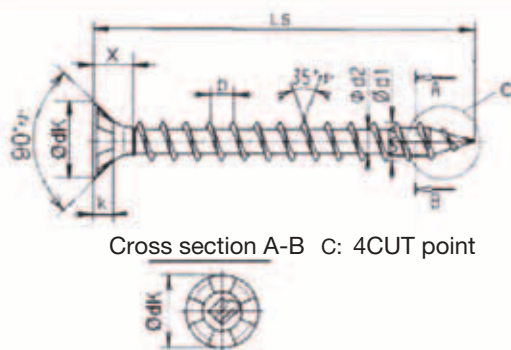
 = Preferred size



SPAX®

Full-thread, self-drilling screw

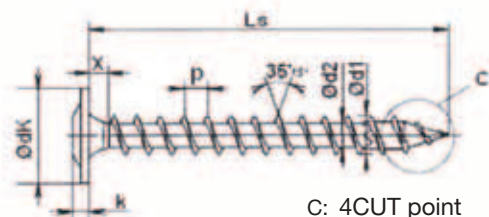
Material: Cold rolled wire according to SPAX Factory Norm
Screws of high-carbon steel



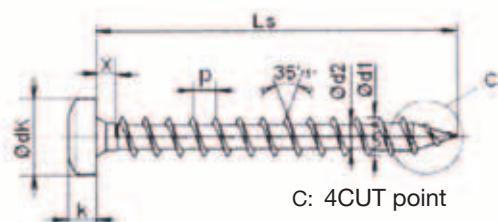
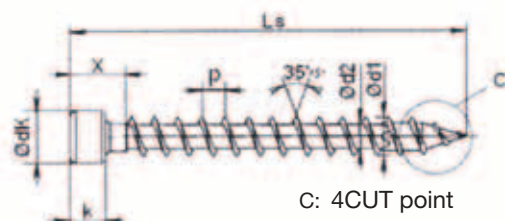
Manufacturer's logo
"SPAX"



4CUT point :
Square point
in core



Manufacturer's logo
"SPAX"



Manufacturer's logo
"SPAX"



Nominal diameter		6.0						
Type of Head		Countersunk head		Washer head		Cylindric head	Pan head	
d1	thread size	6.0						
	permissible tolerance	±0.20						
dk	head diameter	9.7	11.9	13.0	15.0	8.4	11.9	9.9
	permissible tolerance	-0.60		±1.0		-0.60		
d2	core diameter	4.0						
	permissible tolerance	-0.40						
k	height of head, max.	4.0	5.0	2.2	2.4	6.0	4.0	3.4
p	thread pitch	3.0						
	permissible tolerance	±0.1 x p						
T-STAR	size	T30						T20
Thread-free length X Ls 60-200		max. 15mm						
Permissible tolerance of screw length	Ls 60-99	Ls ±2mm						
	Ls 100-200	Ls ±5mm						

= Preferred size

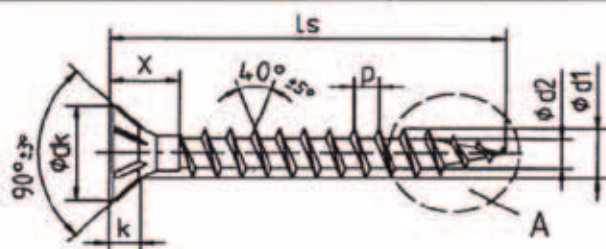


SPAX®-S

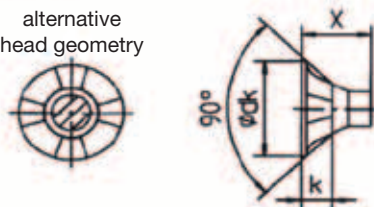
Full-thread, self-drilling screw

Material: Cold rolled wire according to SPAX Factory Norm
Screws of high-carbon steel

Countersunk head



alternative head geometry

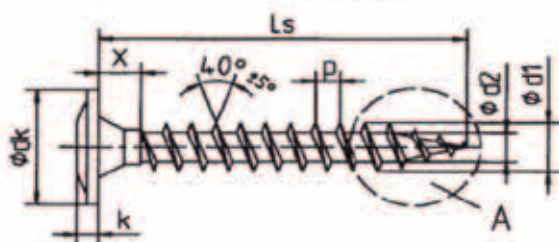


Trademark or "SPAX"



T-STAR or T-STAR plus

Washer head

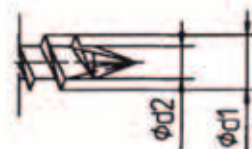


Trademark or "SPAX"

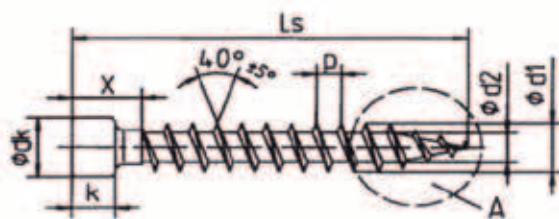


T-STAR or T-STAR plus

A: alternatively with CUT point



Cylindric head

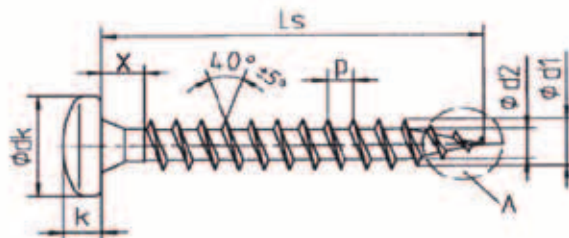


Trademark



T-STAR or T-STAR plus

Pan head



Trademark or "SPAX"



T-STAR or T-STAR plus

Nominal diameter		8.0								
Type of Head		Countersunk head		Washer head				Cylindric head	Pan head	
d1	thread size	8.0								
	permissible tolerance	±0.30								
dk	head diameter	12.0	15.1	18.0	20.0	22.0	24.0	10.0	15.5	11.9
	permissible tolerance	-0.60		±1.0				-0.60		
d2	core diameter	5.0								
	permissible tolerance	-0.30								
k	height of head, max.	4.0	5.0	4.5			8.0	5.8	4.0	
p	thread pitch	4.0								
	permissible tolerance	±0.1 x p								
T-STAR	size	T40								T30
Thread-free length X	Ls 60-200	max. 15mm								
	Ls > 200	max. 25mm								
Permissible tolerance of screw length	Ls 60-99	Ls ±2mm								
	Ls 100-200	Ls ±5mm								
	Ls > 200	Ls ±15mm								

Screw lengths Ls up to 600 mm possible (lengths > 400 mm with CUT point)

15.1 = Preferred size



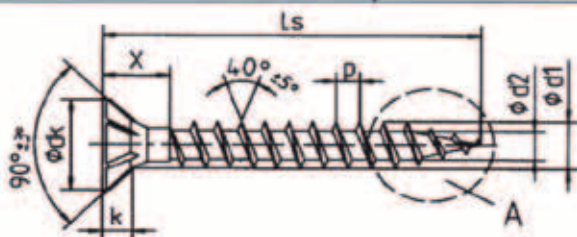
SPAX®-S

Full-thread, self-drilling screw

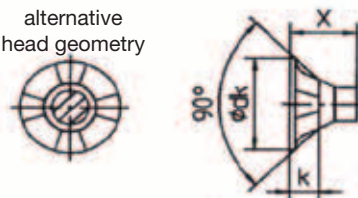
Material: Cold rolled wire according to SPAX Factory Norm

Screws of high-carbon steel

Countersunk head



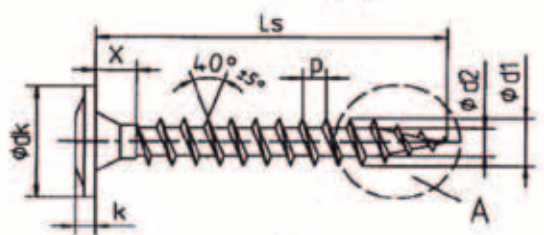
alternative head geometry



Trademark or "SPAX"



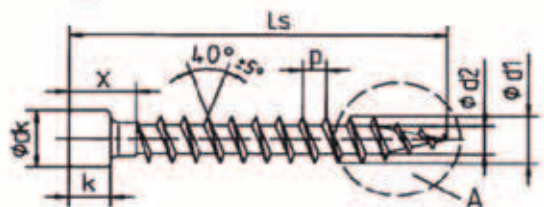
Washer head



Trademark or "SPAX"



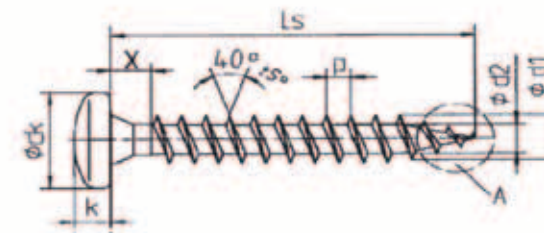
Cylindric head



Trademark



Pan head



Trademark or "SPAX"



A: alternatively with CUT point



Nominal diameter			10.0						
Type of Head			Countersunk head		Washer head		Cylindric head	Pan head	
d1	thread size		10.0						
	permissible tolerance		±0.30						
dk	head diameter		15.1	18.6	20.0	26.0	12.0	19.0	15.5
	permissible tolerance		-0.60		±1.0		-0.60		
d2	core diameter		6.1						
	permissible tolerance		-0.30						
k	height of head, max.		4.0	6.0	5.0	5.0	10.0	7.1	5.8
p	thread pitch		5.0						
	permissible tolerance		±0.1 x p						
T-STAR	size		T50		T40		T50		T40
Thread-free length X	Ls 60-200		max. 15mm						
	Ls > 200		max. 25mm						
Permissible tolerance of screw length	Ls 60-99		Ls ±2mm						
	Ls 100-200		Ls ±5mm						
	Ls > 200		Ls ±15mm						

Screw lengths Ls up to 800 mm possible

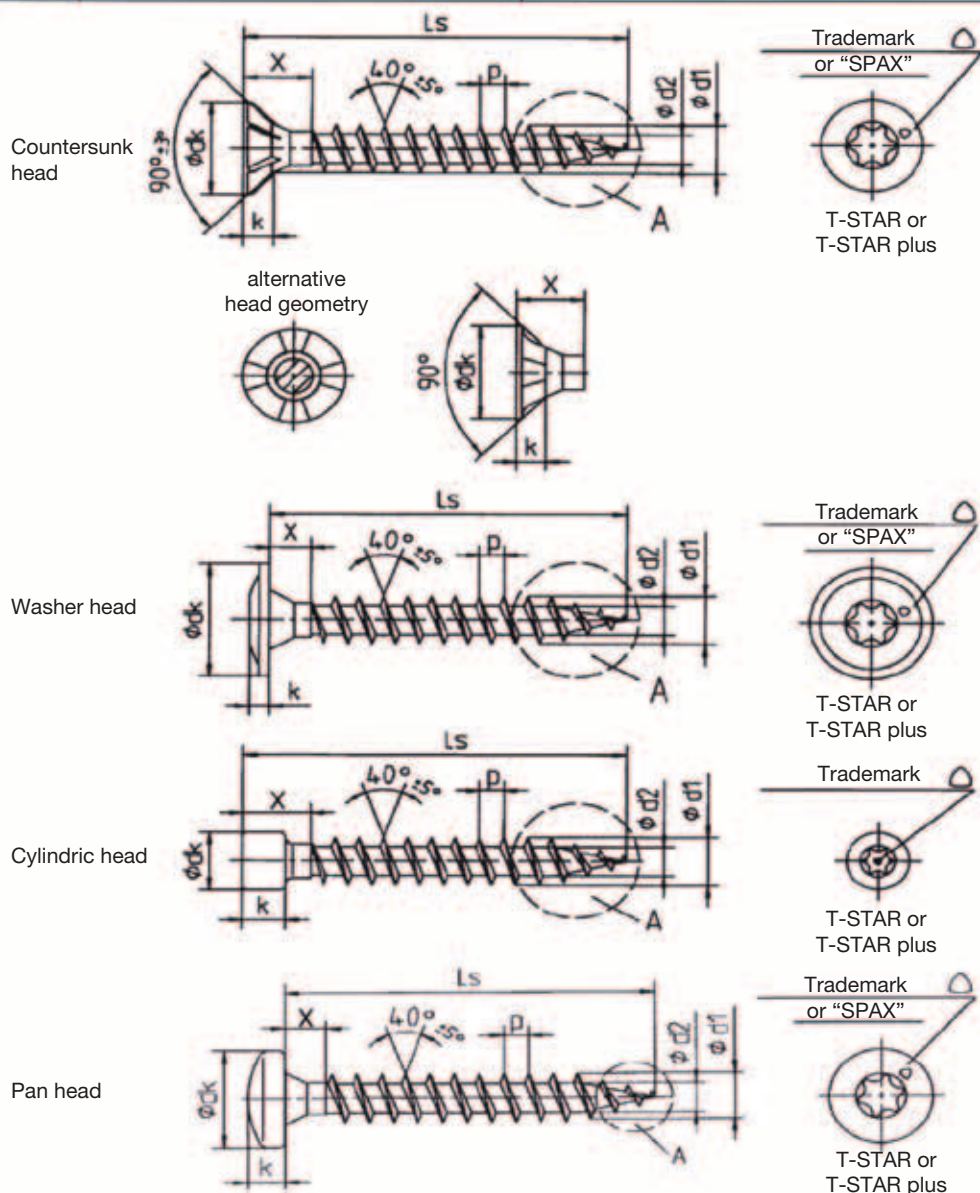
18.6 = Preferred size



SPAX®-S

Full-thread, self-drilling screw

Material: Cold rolled wire according to SPAX Factory Norm
Screws of high-carbon steel



Nominal diameter		12.0						
Type of Head		Countersunk head		Washer head		Cylindric head	Pan head	
d1	thread size	12.0						
	permissible tolerance	±0.30						
dk	head diameter	18.6	22.6	26.0	31.0	14.0	23.0	19.0
	permissible tolerance	-0.60		±1.0		-0.60		
d2	core diameter	7.5						
	permissible tolerance	-0.50						
k	height of head, max.	5.5	7.0	6.0		12.0	8.5	7.1
p	thread pitch	6.0						
	permissible tolerance	±0.1 x p						
T-STAR	size	T50						T50
Thread-free length X	Ls 60-99	max. 15mm						
	Ls 100-200	max. 20mm						
	Ls > 200	max. 25mm						
Permissible tolerance of screw length	Ls 60-99	Ls ±2mm						
	Ls 100-200	Ls ±10mm						
	Ls > 200	Ls ±15mm						

Screw lengths Ls up to 600 mm possible

 = Preferred size



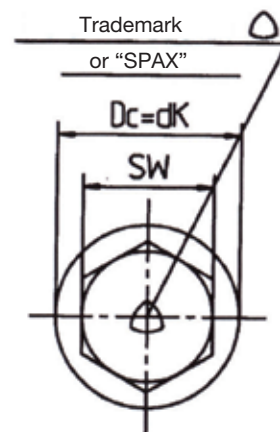
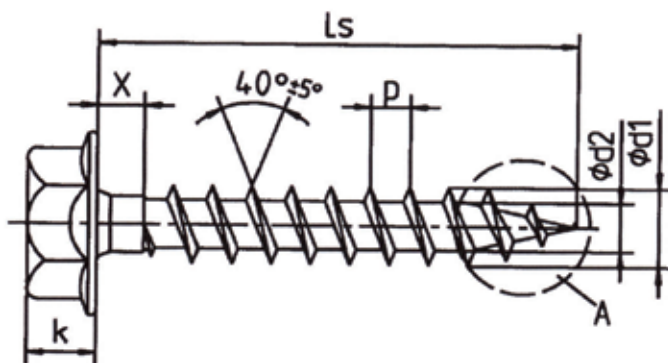
SPAX®-S

Hex. head

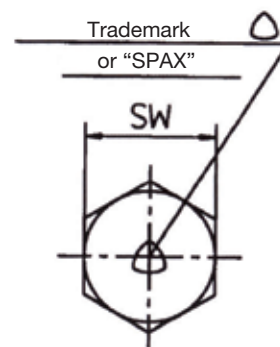
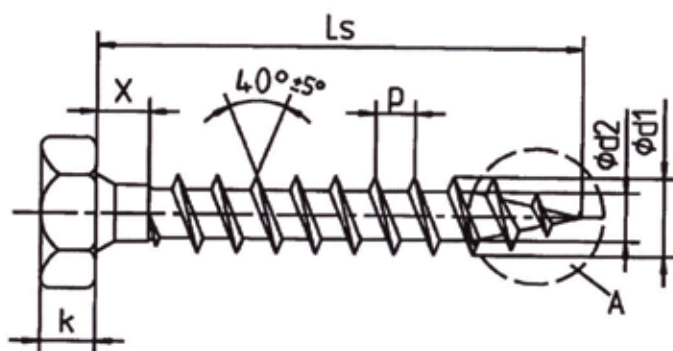
Full-thread, self-drilling screw

Material: Cold rolled wire according to SPAX Factory Norm

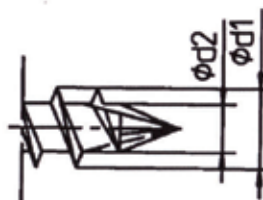
Screws of high-carbon steel



Hex. head with flange



Hex. head



A: alternatively with CUT point

Nominal diameter		8.0		10.0		12.0	
Type of Head		with flange	without flange	with flange	without flange	with flange	without flange
SW	wrench size, max.	10		13		16	
k	height of head, max.	6.00	8.5	7.00	9.70	8.00	12.1
Dc	diameter of flange		15.5		19.5		22.5
	permissible tolerance	±1					
d1	thread outer diameter	8.0		10.0		12.0	
	permissible tolerance	±0.30					
d2	thread inner diameter	5.0		6.1		7.5	
	permissible tolerance	-0.30				-0.50	
p	thread pitch	4.0		5.0		6.0	
	permissible tolerance	±0.1 x p					
Thread-free length X	Ls 60-99	max. 15mm		max. 15mm		max. 15mm	
	Ls 100-200					max. 20mm	
	Ls > 200	max. 25mm		max. 25mm		max. 25mm	
Permissible tolerance of screw length	Ls 60-99	Ls ±2mm				Ls ±2mm	
	Ls 100-200	Ls ±5mm				Ls ±10mm	
	Ls > 200	Ls ±15mm				Ls ±15mm	

Screw lengths Ls up to 600 mm possible (at a nominal diameter of 8.0 mm: lengths > 400mm with CUT-point)

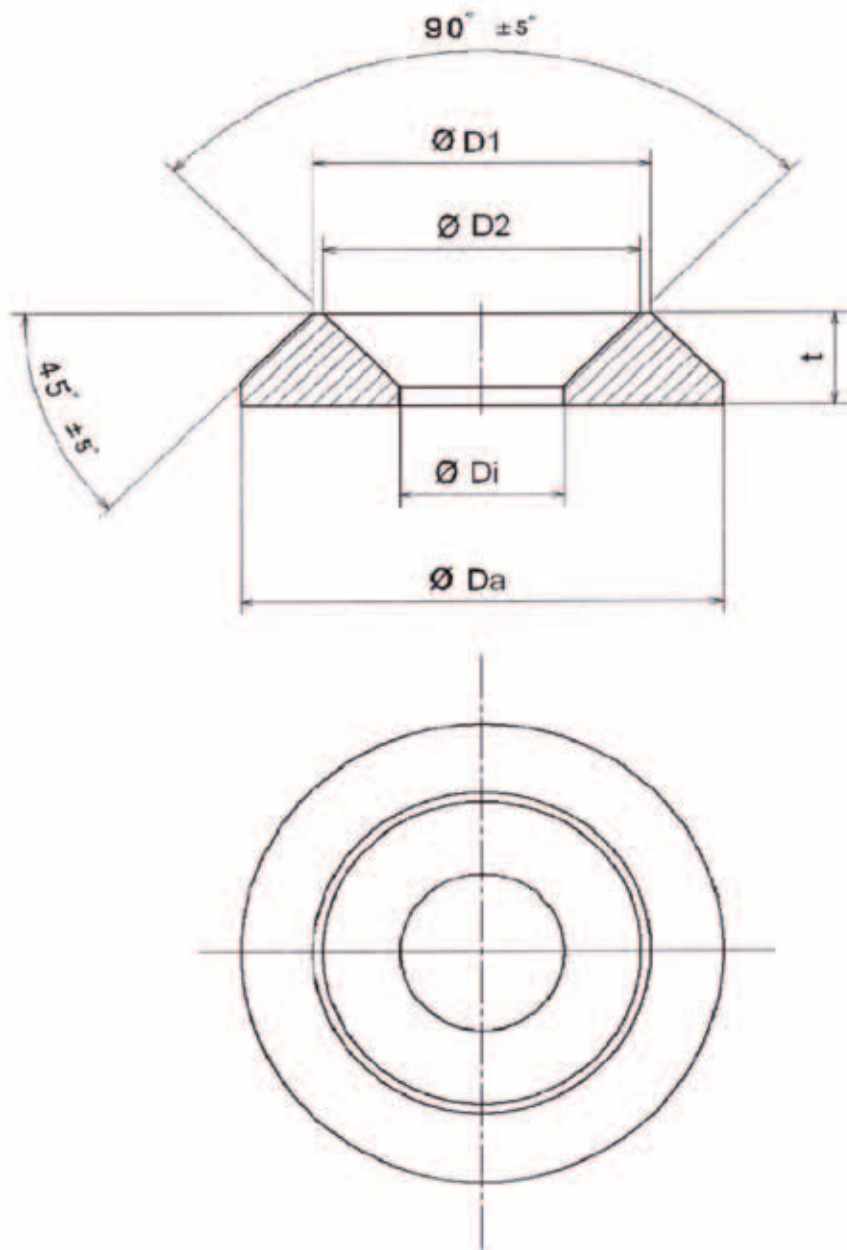
**SPAX**[®]

Washer

Washer for screws with countersunk head

Material: machining steel

Dimensions in mm



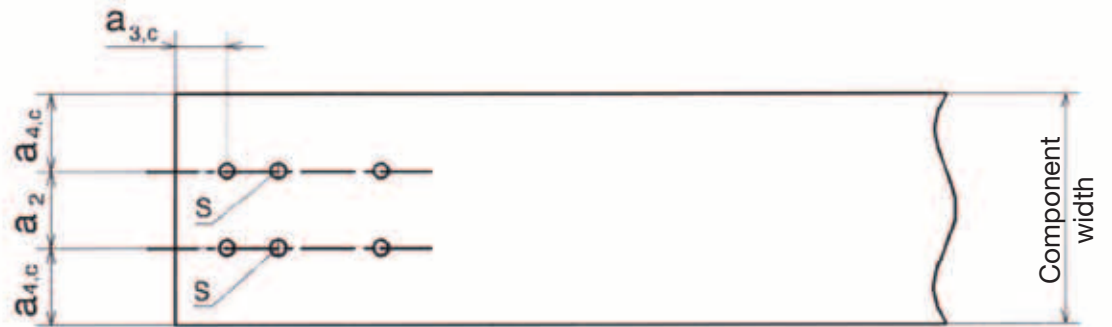
Thread size	6.0	8.0	10.0	12.0	Tolerance
$\varnothing Da$	18.0	25.0	32.0	40.0	± 0.3
$\varnothing Di$	6.5	8.5	11.0	13.0	
$\varnothing D1$	13.5	17.5	22.5	27.0	
$\varnothing D2$	12.5	16.5	21.5	26.0	
t	3.5	5.0	5.6	7.0	



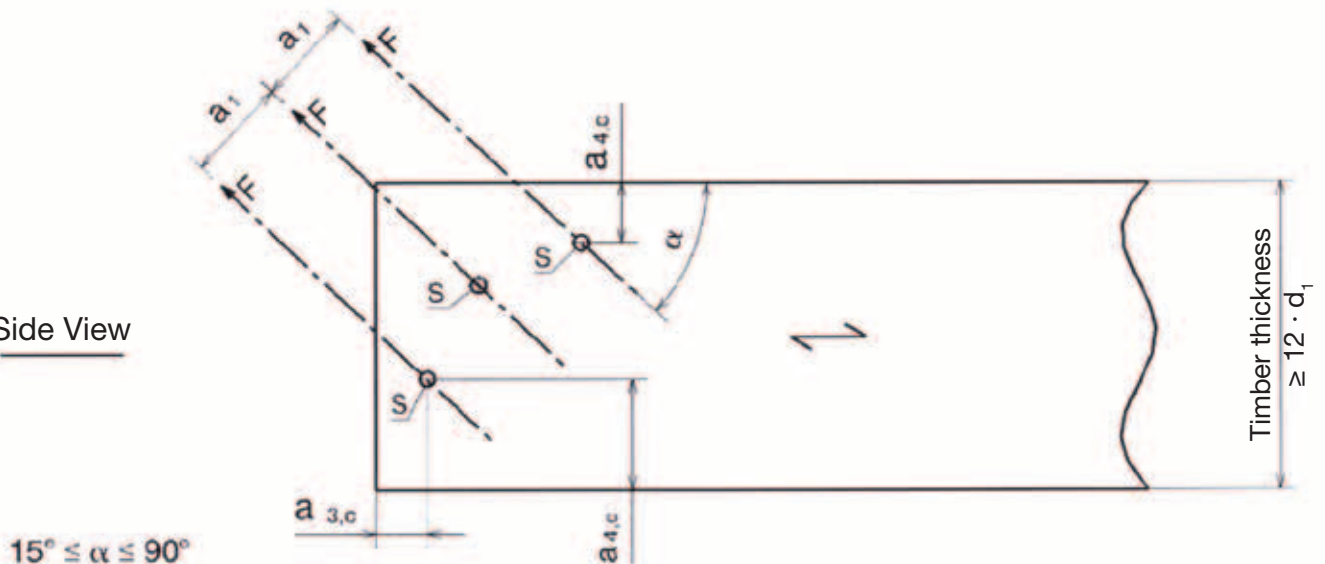
Minimum distances for screws with $d_1 \leq 8$ mm or with CUT or 4CUT point, planned to be exclusively stressed in the shaft direction.

Parallel arrangement (example for 3 pairs of screws)

Top View



Side View



= direction of grain

= screw axis

S = centre of gravity of the embedded portion of the screw

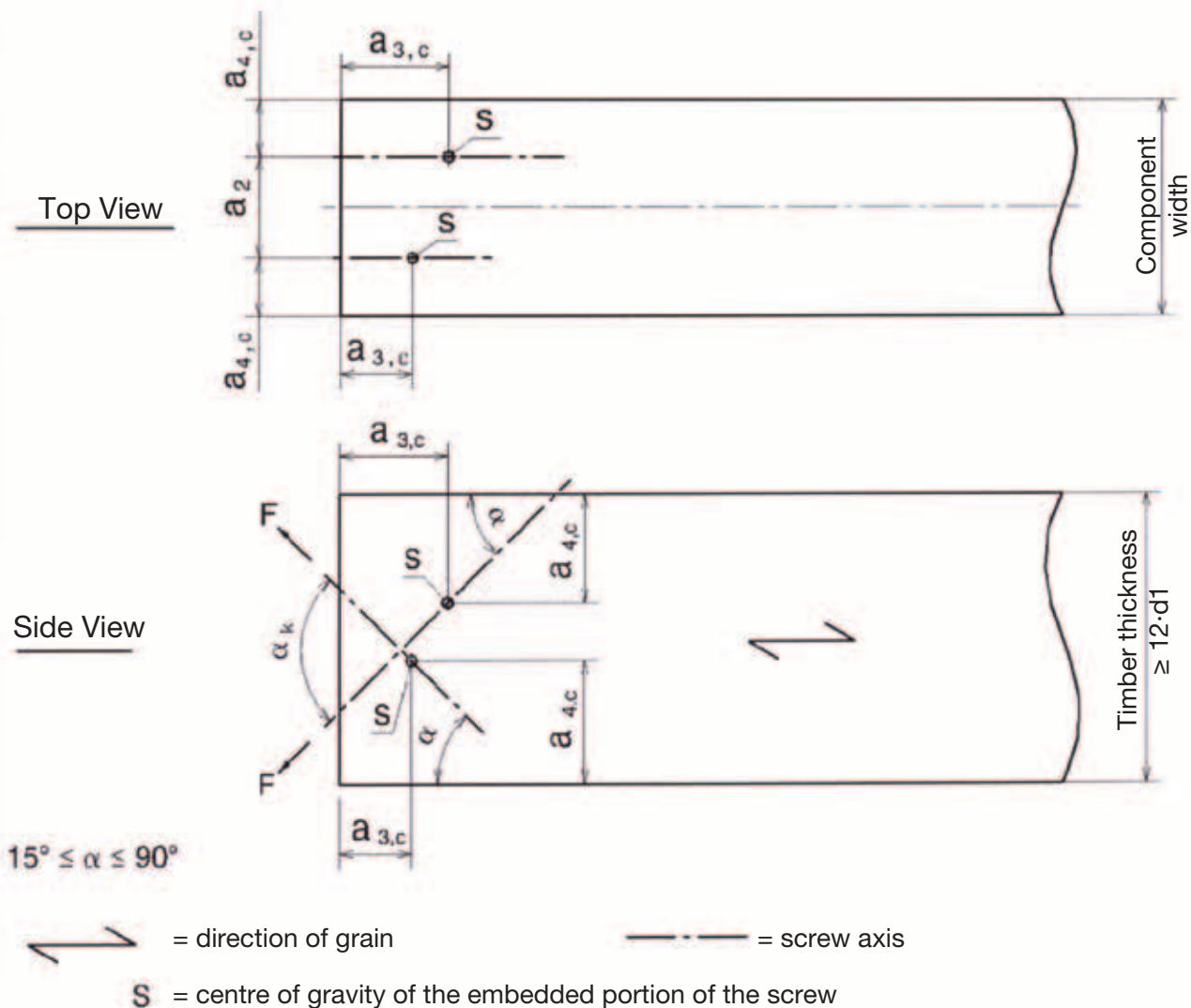
$a_1 = 5 \cdot d_1$	$a_{3,c} = 5 \cdot d_1$
$a_2 = 2.5 \cdot d_1$	$a_{4,c} = 4 \cdot d_1$ $a_{4,c} = 3 \cdot d_1$ for CUT or 4CUT point
$a_1 \cdot a_2 = 25 \cdot d_1^2$	

The stipulations in Section 4.6 of the approval apply for KERTO-S and KERTO-Q.



Minimum distances for screws with $d_1 \leq 8$ mm or with CUT or 4CUT point, planned to be exclusively stressed in the shaft direction.

Crosswise arrangement (example for 1 pair of screws)



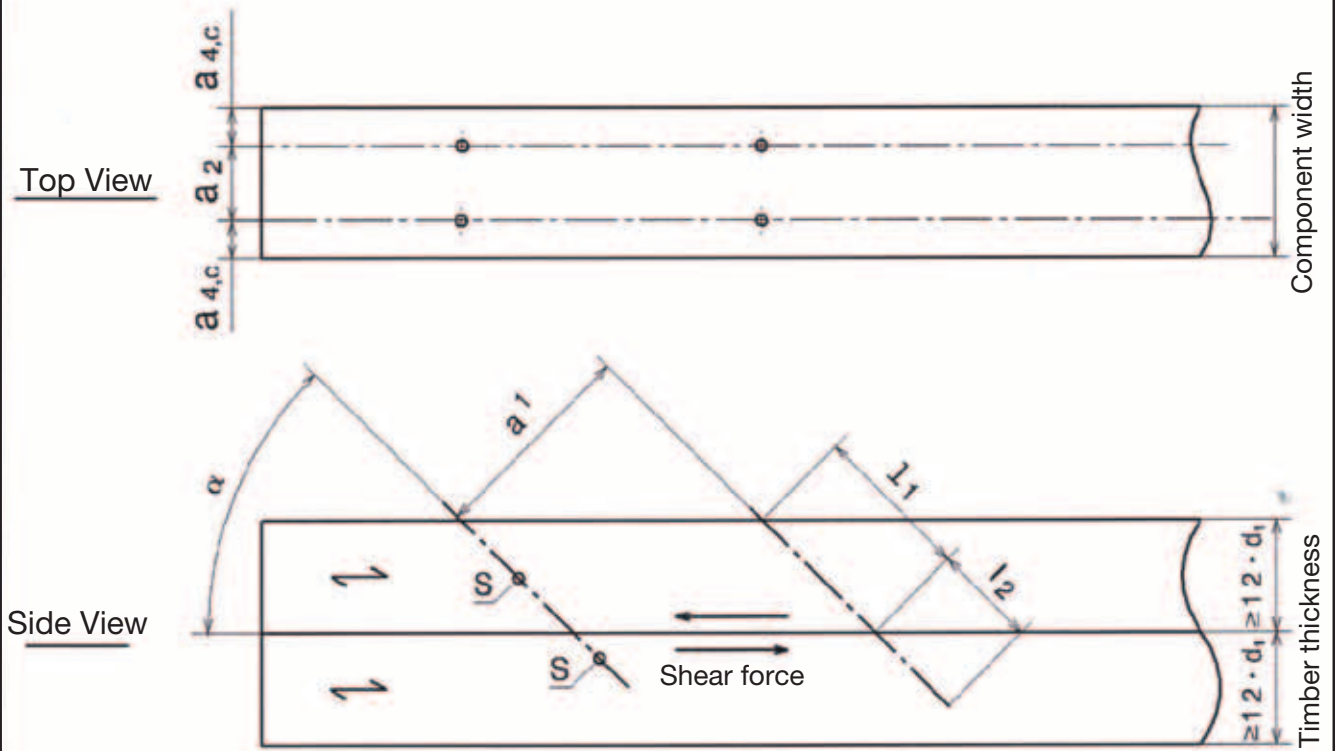
$a_1 = 5 \cdot d_1$	$a_{3,c} = 5 \cdot d_1$
$a_2 = \max \begin{cases} 1.5 \cdot d_1 & 70^\circ < \alpha_k \leq 90^\circ \\ 2.5 \cdot d_1 \left(1 - \frac{\alpha_k}{180}\right) & 30^\circ \leq \alpha_k \leq 70^\circ \end{cases}$	$a_{4,c} = 4 \cdot d_1$ $a_{4,c} = 3 \cdot d_1$ for CUT or 4CUT point
$a_1 \cdot a_2 = 25 \cdot d_1^2$	

The stipulations in Section 4.6 of the approval apply for KERTO-S and KERTO-Q.



Penetration depths for the determination of the modulus of displacement K_{ser} for screws driven at an angle of $15^\circ \leq \alpha \leq 90^\circ$ to the grain and which are used to fasten single cross members in ductile connected flexural beams.

Parallel arrangement (example for 2 pairs of screws)



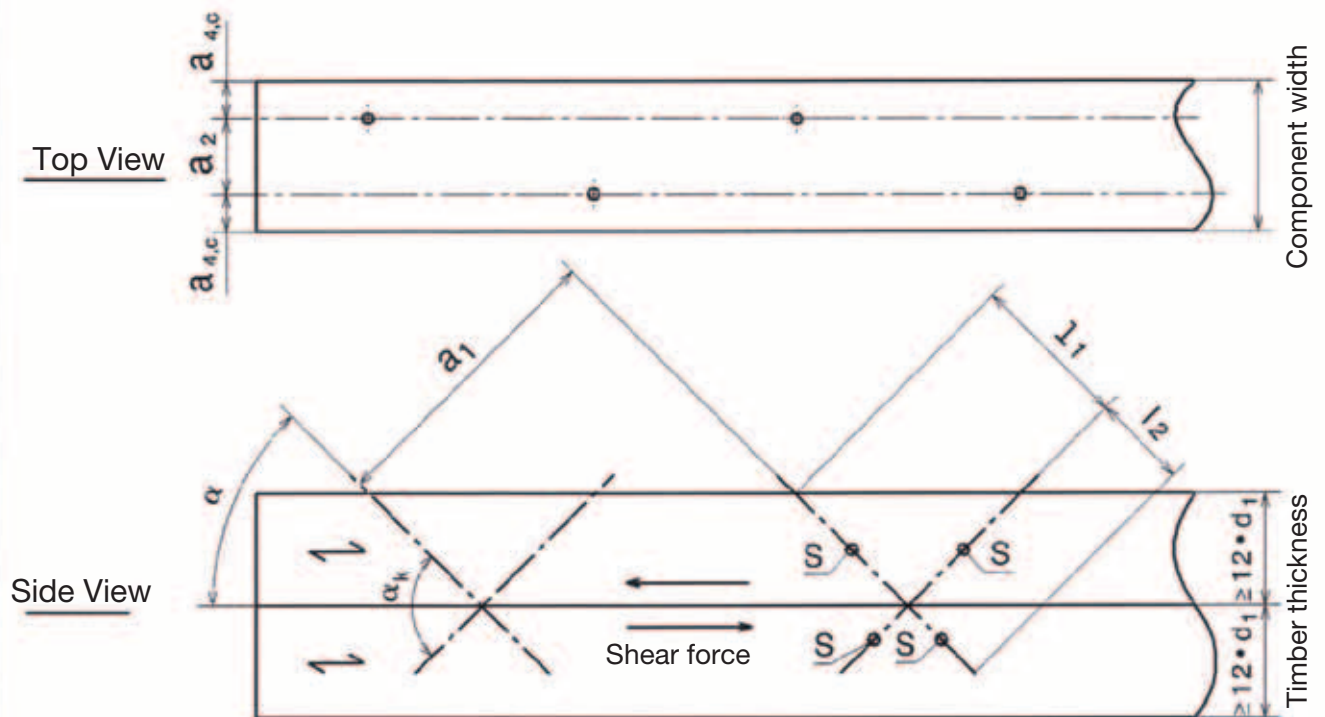
$a_1 = 5 \cdot d_1$	$a_{3,c} = 5 \cdot d_1$
$a_2 = 2.5 \cdot d_1$	$a_{4,c} = 4 \cdot d_1$ $a_{4,c} = 3 \cdot d_1$ for CUT or 4CUT point
$a_1 \cdot a_2 = 25 \cdot d_1^2$	

The stipulations in Section 4.6 of the approval apply for KERTO-S and KERTO-Q.



Penetration depths for the determination of the modulus of displacement K_{ser} for screws driven at an angle of $15^\circ \leq \alpha \leq 90^\circ$ to the grain and which are used to fasten single cross members in ductile connected flexural beams.

Parallel arrangement (example for 2 pairs of screws)



$$15^\circ \leq \alpha \leq 90^\circ$$



= direction of grain

— · — · — = screw axis

S = centre of gravity of the embedded portion of the screw

$a_1 = 5 \cdot d_1$	$a_{3,c} = 5 \cdot d_1$
$a_2 = \max \begin{cases} 1.5 \cdot d_1 & 70^\circ < \alpha_k \leq 90^\circ \\ 2.5 \cdot d_1 \left(1 - \frac{\alpha_k}{180}\right) & 30^\circ \leq \alpha_k \leq 70^\circ \end{cases}$	$a_{4,c} = 4 \cdot d_1$ $a_{4,c} = 3 \cdot d_1$ for CUT or 4CUT point
$a_1 \cdot a_2 = 25 \cdot d_1^2$	

The stipulations in Section 4.6 of the approval apply for KERTO-S and KERTO-Q.

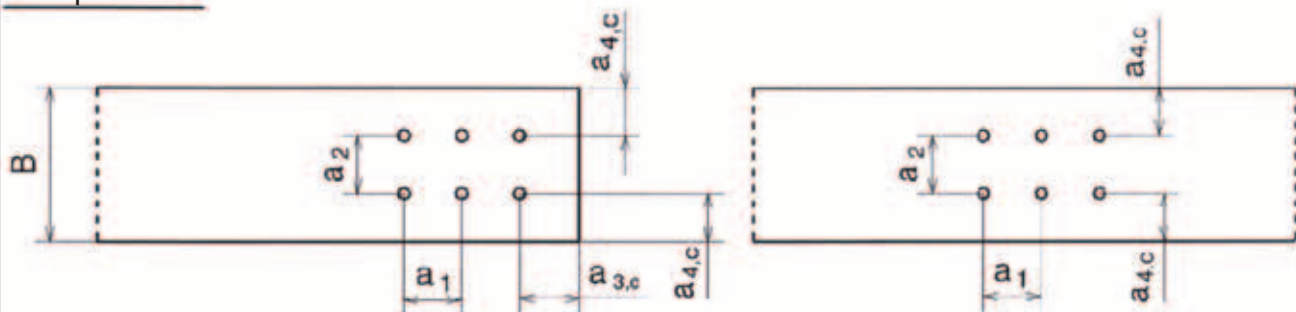


SPAX®

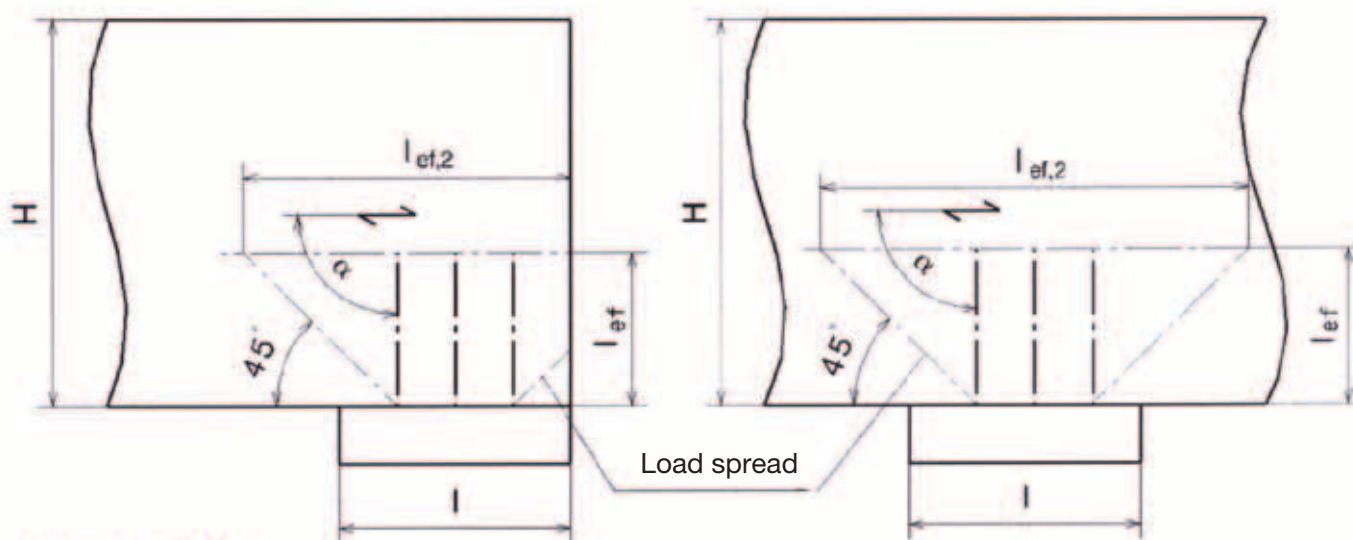
Reinforced end support

Reinforced intermediate support

Top View



Side View



$45^\circ \leq \alpha \leq 90^\circ$

= direction of grain

= screw axis

$a_1 = 5 \cdot d_1$	$a_{3,c} = 5 \cdot d_1$
$a_2 = 2.5 \cdot d_1$	$a_{4,c} = 4 \cdot d_1$ $a_{4,c} = 3 \cdot d_1$ for CUT or 4CUT point
$a_1 \cdot a_2 = 25 \cdot d_1^2$	

The stipulations in Section 4.6 of the approval apply for KERTO-S and KERTO-Q.