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European Technical Assessment ETA-12/0197 of 2019/02/28

I General Part

Technical Assessment Body issuing the ETA and designated according to Article 29 of the Regulation (EU) No 305/2011: ETA-Danmark A/S

Trade name of the construction product:	SWG “Timtec”, “Timtec Isotec” and “Timtec Plus VG” screws
Product family to which the above construction product belongs:	Screws for use in timber constructions
Manufacturer:	SWG Schraubenwerk Gaisbach GmbH Am Bahnhof 50 DE-74638 Waldenburg Tel. +49 79 42 100 454 Fax +49 79 42 100 400 Internet www.swg-produktion.de
Manufacturing plant:	SWG Schraubenwerk Gaisbach GmbH Am Bahnhof 50 DE-74638 Waldenburg
This European Technical Assessment contains:	95 pages including 7 annexes which form an integral part of the document
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of:	European Assessment document (EAD) no. EAD 130118-00-0603 “Screws for timber constructions”
This version replaces:	The previous ETA with the same number issued on 2017-07-12

II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of product and intended use

Technical description of the product
SWG „Timtec 3.0", "Timtec Isotec" and "Timtec plus VG" screws are self-tapping screws to be used in timber structures. SWG „Timtec 3.0" screws shall be threaded over a part or over the full length. SWG "Timtec plus VG" screws shall be threaded over the full length. The screws shall be produced from carbon steel wire for nominal diameters of 3,0 mm to 14,0 mm and from stainless steel wire for nominal diameters of 3,0 mm to 10,0 mm. Where corrosion protection is required, the material or coating shall be declared in accordance with the relevant specification given in Annex A of EN 14592.

Geometry and Material
The nominal diameter (outer thread diameter), d, shall not be less than 3,0 mm and shall not be greater than 14,0 mm. The overall length, L, of screws shall not be less than 13 mm and shall not be greater than 2000 mm. Other dimensions are given in Annex A.

The ratio of inner thread diameter to outer thread diameter d_i/d ranges from 0,58 to 0,73.

The screws are threaded over a minimum length ℓ_g of 4·d (i.e. $\ell_g \geq 4 \cdot d$).

The lead p (distance between two adjacent thread flanks) ranges from 0,44·d to 0,95·d.

No breaking of screws shall be observed at a bend angle, α, of less than $(45/d^{0,7} + 20)$ degrees.

2 Specification of the intended use in accordance with the applicable EAD

The screws are used for connections in load bearing timber structures between members of solid timber (softwood and hardwoods beech and oak), glued laminated timber (softwood and hardwoods beech and oak), cross-laminated timber, laminated veneer lumber, similar glued members, wood-based panels or steel. The nominal diameter, d (outer thread diameter) of screws made of carbon steel driven without pre-drilling in Beech LVL according to EN 14374 or in FST according to ETA-14/0354 shall not be less than 5,0 mm and shall not be greater than 12,0 mm.

SWG "Timtec plus VG" and fully threaded "Timtec 3.0" screws are also used as tensile or compressive reinforcement perpendicular to the grain and SWG "Timtec plus VG" and fully threaded "Timtec 3.0" screws with a diameter of 8 mm as shear reinforcement.

Furthermore, SWG screws with diameters between 6 mm and 14 mm may also be used for the fixing of heat insulation on rafters.

Steel plates and wood-based panels except solid wood panels, laminated veneer lumber and cross laminated timber shall only be located on the side of the screw head.

The following wood-based panels may be used:

- Plywood according to EN 636 or European Technical Assessment or national provisions that apply at the installation site
- Particleboard according to EN 312 or European Technical Assessment or national provisions that apply at the installation site
- Oriented Strand Board according to EN 300 or European Technical Assessment or national provisions that apply at the installation site
- Fibreboard according to EN 622-2 and 622-3 or European Technical Assessment (minimum density 650 kg/m³) or national provisions that apply at the installation site
- Cement bonded particleboard according to EN 634 or European Technical Assessment or national provisions that apply at the installation site
- Solid wood panels according to EN 13353 or European Technical Assessment or national provisions that apply at the installation site
- Cross laminated timber according to European Technical Assessment
- Laminated Veneer Lumber according to EN 14374 or European Technical Assessment
- FST according to ETA-14/0354
- Engineered wood products according to European Technical Assessment if the ETA of the product includes provisions for the use of self-tapping screws, the provisions of the ETA of the engineered wood product apply

The screws or threaded rods are intended to be used in timber connections for which requirements for mechanical resistance and stability and safety in use in the the sense of the Basic Works Requirements 1 and 4 of Regulation 305/2011 (EU) shall be fulfilled.

The design of the connections shall be based on the characteristic load-carrying capacities of the screws. The design capacities shall be derived from the characteristic capacities in accordance with Eurocode 5 or an appropriate national code.

The screws are intended for use for connections subject to static or quasi static loading.

The scope of the screws regarding resistance to corrosion shall be defined according to national provisions that apply at the installation site considering environmental conditions. Section 3.10 of this ETA contains the corrosion protection for Timtec screws made from carbon steel and the material number of the stainless steel.

The provisions made in this European Technical Assessment are based on an assumed intended working life of the hold downs of 50 years.

The indications given on the working life cannot be interpreted as a guarantee given by the producer or Assessment Body, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

3 Performance of the product and references to the methods used for its assessment

Characteristic	Assessment of characteristic
3.1 Mechanical resistance and stability*) (BWR1)	
Tensile strength Screws made of carbon steel	Characteristic value $f_{tens,k}$: d = 3,0 mm: 2,8 kN d = 3,5 mm: 3,0 kN d = 4,0 mm: 5,0 kN d = 4,5 mm: 5,3 kN d = 5,0 mm: 7,9 kN d = 6,0 mm: 12,5 kN d = 7,0 mm: 15 kN d = 8,0 mm: 21,5 kN d = 10,0 mm except "Timtec plus VG": 26 kN d = 10,0 mm "Timtec plus VG": 33 kN d = 12,0 mm except "Timtec plus VG": 41 kN d = 12,0 mm "Timtec plus VG": 45 kN d = 14,0 mm "Timtec plus VG": 62 kN d = 14,0 mm "Timtec plus VG hot-dip galvanised": 47 kN "Timtec Isotec": 11 kN
Screws made of stainless steel	d = 3,0 mm: 1,8 kN d = 3,5 mm: 2,4 kN d = 4,0 mm: 3,1 kN d = 4,5 mm: 3,6 kN d = 5,0 mm: 4,2 kN d = 5,5 mm: 5,9 kN d = 6,0 mm: 7,1 kN d = 6,5 mm: 8,3 kN d = 8,0 mm: 12 kN d = 10,0 mm: 19 kN
Insertion moment	Ratio of the characteristic torsional strength to the mean insertion moment: $f_{tor,k} / R_{tor,mean} \geq 1,5$
Torsional strength Screws made of carbon steel	Characteristic value $f_{tor,k}$: d = 3,0 mm: 1,5 Nm d = 3,5 mm: 2,0 Nm d = 4,0 mm: 3,0 Nm d = 4,5 mm: 4,3 Nm d = 5,0 mm: 6,0 Nm d = 6,0 mm: 10 Nm d = 7,0 mm: 15 Nm d = 8,0 mm: 23 Nm d = 10,0 mm 45 Nm d = 12,0 mm except "Timtec plus VG": 65 Nm d = 12,0 mm "Timtec plus VG": 75 Nm d = 14,0 mm "Timtec plus VG": 115 Nm d = 14,0 mm "Timtec plus VG hot-dip galvanised": 100 Nm "Timtec Isotec" head side: 20 Nm "Timtec Isotec" point side: 12 Nm

Characteristic		Assessment of characteristic	
	Screws made of stainless steel	Screw d = 3,0 mm:	0,85 Nm
		Screw d = 3,5 mm:	1,35 Nm
		Screw d = 4,0 mm:	2,0 Nm
		Screw d = 4,5 mm:	2,6 Nm
		Screw d = 5,0 mm:	3,3 Nm
		Screw d = 5,5 mm:	5,0 Nm
		Screw d = 6,0 mm:	6,4 Nm
		Screw d = 6,5 mm:	7,5 Nm
		Screw d = 8,0 mm:	16 Nm
		Screw d = 10 mm:	30 Nm
3.2	**Safety in case of fire (BWR2)**		
	Reaction to fire	The screws are made from steel classified as performance class A1 of the characteristic reaction to fire, in accordance with the provisions of Commission Delegated Regulation 2016/364 and EC decision 96/603/EC, amended by EC Decision 2000/605/EC.	
3.7	**Sustainable use of natural resources (BWR7)**	No Performance Assessed	

Characteristic		Assessment of characteristic
3.8	**General aspects related to the performance of the product**	The screws have been assessed as having satisfactory durability and serviceability when used in timber structures using the timber species described in Eurocode 5 and subject to the conditions defined by service classes 1, 2 and 3
	Identification	See Annex A

*) See additional information in section 3.9 – 3.12.

3.9 Mechanical resistance and stability

The load-carrying capacities for SWG screws are applicable to the wood-based materials mentioned in paragraph 1 even though the term timber has been used in the following.

The characteristic lateral load-carrying capacities and the characteristic axial withdrawal capacities of SWG screws should be used for designs in accordance with Eurocode 5 or an appropriate national code.

Point side penetration length must be $\ell_{ef} \geq 4 \cdot d$, where d is the outer thread diameter of the screw. For the fixing of thermal insulation material on top of rafters, point side penetration must be at least 40 mm, $\ell_{ef} \geq 40$ mm.

Point or head side penetration thread length for screws made of carbon steel driven without pre-drilling in Beech LVL according to EN 14374 or in FST according to ETA-14/0354 must not exceed the following values:

Timtec plus VG screw d = 6,0 mm:	$\ell_{ef} \leq 30$ mm
Timtec plus VG screw d = 8,0 mm:	$\ell_{ef} \leq 48$ mm
Timtec plus VG screw d = 10,0 mm:	$\ell_{ef} \leq 80$ mm
Timtec plus VG screw d = 12,0 mm:	$\ell_{ef} \leq 96$ mm
Timtec 3.0 screw d = 5,0 mm:	$\ell_{ef} \leq 50$ mm
Timtec 3.0 screw d = 6,0 mm:	$\ell_{ef} \leq 60$ mm
Timtec 3.0 screw d = 7,0 mm:	$\ell_{ef} \leq 70$ mm
Timtec 3.0 screw d = 8,0 mm:	$\ell_{ef} \leq 80$ mm
Timtec 3.0 screw d = 10,0 mm:	$\ell_{ef} \leq 100$ mm

Screws made of stainless steel shall be driven in pre-drilled holes if the characteristic member density exceeds 500 kg/m³.

European Technical Assessments for structural members or wood-based panels must be considered where applicable.

Reductions in the cross-sectional area caused by SWG screws with a diameter of 10 mm or more shall be taken into account in the member strength verification both, in the tensile and compressive area of members.

For screws in pre-drilled holes, the drill hole diameter should be considered in the member strength verification, for screws driven without pre-drilling, the inner thread diameter.

Lateral load-carrying capacity

The characteristic lateral load-carrying capacity of SWG screws shall be calculated according to EN 1995-1-1:2008 (Eurocode 5) using the outer thread diameter d as the nominal diameter of the screw. The contribution from the rope effect may be considered.

For steel-to-timber connections with Timtec screws d = 5 mm with joist hanger screw head, a thick steel plate may be assumed for steel plate thickness t ≥ 1,5 mm.

The characteristic yield moment is:

SWG screws for 3,0 mm ≤ d ≤ 14,0 mm made of carbon steel except “Timtec Isotec”:

Screw d = 3,0 mm:	$M_{y,k}$ = 1,6 Nm
Screw d = 3,5 mm:	$M_{y,k}$ = 1,8 Nm
Screw d = 4,0 mm:	$M_{y,k}$ = 3,3 Nm
Screw d = 4,5 mm:	$M_{y,k}$ = 3,7 Nm
Screw d = 5,0 mm:	$M_{y,k}$ = 5,9 Nm
Screw d = 6,0 mm:	$M_{y,k}$ = 10 Nm
Screw d = 7,0 mm:	$M_{y,k}$ = 14 Nm
Screw d = 8,0 mm:	$M_{y,k}$ = 23 Nm
Screw d = 10,0 mm:	$M_{y,k}$ = 36 Nm
Screw d = 12,0 mm:	$M_{y,k}$ = 58 Nm
Screw d = 14,0 mm:	$M_{y,k}$ = 86 Nm

SWG “Timtec Isotec” screws: $M_{y,k}$ = 11 Nm

SWG screws for 3,0 mm ≤ d ≤ 10,0 mm made of stainless steel:

Screw d = 3,0 mm:	$M_{y,k}$ = 0,9 Nm
Screw d = 3,5 mm:	$M_{y,k}$ = 1,4 Nm
Screw d = 4,0 mm:	$M_{y,k}$ = 1,9 Nm
Screw d = 4,5 mm:	$M_{y,k}$ = 2,3 Nm
Screw d = 5,0 mm:	$M_{y,k}$ = 2,8 Nm
Screw d = 5,5 mm:	$M_{y,k}$ = 4,4 Nm
Screw d = 6,0 mm:	$M_{y,k}$ = 5,5 Nm
Screw d = 6,5 mm:	$M_{y,k}$ = 6,8 Nm
Screw d = 8,0 mm:	$M_{y,k}$ = 11 Nm
Screw d = 10,0 mm:	$M_{y,k}$ = 20 Nm

Where

d outer thread diameter [mm]

The embedding strength for screws in non-pre-drilled holes in softwood arranged at an angle between screw axis and grain direction, 0° ≤ α ≤ 90° is:

$$f_{h,k} = \frac{0,082 \cdot \rho_k \cdot d^{-0,3}}{2,5 \cdot \cos^2 \alpha + \sin^2 \alpha} \quad [\text{N/mm}^2]$$

and accordingly for screws in pre-drilled holes in softwood and hardwoods beech and oak:

$$f_{h,k} = \frac{0,082 \cdot \rho_k \cdot (1 - 0,01 \cdot d)}{2,5 \cdot \cos^2 \alpha + \sin^2 \alpha} \quad [\text{N/mm}^2]$$

Where

ρ_k characteristic timber density [kg/m³], hardwood beech and oak with a maximum characteristic density of 590 kg/m³;

d outer thread diameter [mm];

α angle between screw axis and grain direction.

The embedding strengths given above may be applied for screws within single softwood layers in cross laminated timber, if the single layer is considered as a separate softwood member and the minimum spacing, end and edge distances are observed for the single layer. For inner layers, the edge distance perpendicular to the grain may be reduced to 3 · d.

Alternatively, the embedding strength for screws arranged parallel to the plane of cross laminated timber (layers of softwood), independent of the angle between screw axis and grain direction, $0° \le \alpha \le 90°$, may be calculated from:

$$f_{h,k} = 20 \cdot d^{-0,5} \quad [N/mm^2]$$

unless otherwise specified in the technical specification (ETA or hEN) for the cross laminated timber.
Where
d outer thread diameter [mm]

The embedding strength for screws in the wide face of cross laminated timber should be assumed as for solid timber based on the characteristic density of the outer layer. If relevant, the angle between force and grain direction of the outer layer should be taken into account.

The direction of the lateral force shall be perpendicular to the screw axis and parallel to the wide face of the cross laminated timber.

The embedding strength for screws in non-pre-drilled holes in softwood LVL arranged at an angle between screw axis and grain direction, $0° \le \alpha \le 90°$ is:

$$f_{h,k} = \frac{0,082 \cdot \rho_k \cdot d^{-0,3}}{\left(2,5 \cdot \cos^2 \alpha + \sin^2 \alpha\right)\left(1,5 \cdot \cos^2 \beta + \sin^2 \beta\right)}$$

[N/mm²]
and accordingly for screws in pre-drilled holes in softwood LVL :

$$f_{h,k} = \frac{0,082 \cdot \rho_k \cdot (1 - 0,01 \cdot d)}{\left(2,5 \cdot \cos^2 \alpha + \sin^2 \alpha\right)\left(1,5 \cdot \cos^2 \beta + \sin^2 \beta\right)}$$

[N/mm²]
Where
ρ_k characteristic timber density [kg/m³];
d outer thread diameter [mm];
α angle between screw axis and grain direction;
β angle between screw axis and the LVL's wide face ($0° \le \alpha \le 90°$).

The embedding strength for screws in pre-drilled or non-pre-drilled holes in Beech LVL according to EN 14374 or in FST according to ETA-14/0354 is:

$$f_{h,k} = \frac{0,082 \cdot \rho_k \cdot d^{-0,15}}{\left(2,5 \cdot \cos^2 \alpha + \sin^2 \alpha\right) \cdot k_\varepsilon \cdot k_\beta} \quad [N/mm^2]$$

Where
ρ_k characteristic density [kg/m³];
d outer thread diameter [mm];
α angle between screw axis and grain direction, $0° \le \alpha \le 90°$;
k_ε $= (0,5 + 0,024 \cdot d) \cdot \sin^2 \varepsilon + \cos^2 \varepsilon$;
ε angle between load and grain direction; $0° \le \varepsilon \le 90°$;
k_β $= 1,2 \cdot \cos^2 \beta + \sin^2 \beta$;
β angle between screw axis and wide face of LVL or FST member, $0° \le \beta \le 90°$.

For laterally loaded screws, the rules for multiple fastener connections in EN 1995-1-1, 8.3.1.1 (8) should be applied.

If the timber under each fastener in a connection is reinforced according to Annex E, the effective number n_{ef} for laterally loaded dowel-type fasteners may be taken as $n_{ef} = n$.

Axial withdrawal capacity
The characteristic axial withdrawal capacity of SWG screws in solid timber (softwood and hardwood with a maximum characteristic density of 590 kg/m³), glued laminated timber (softwood and hardwood with a maximum characteristic density of 590 kg/m³), cross-laminated timber or laminated veneer lumber (softwood and hardwood or FST according to ETA-14/0354 with maximum characteristic density of 750 kg/m³) members at an angle of $0° \le \alpha \le 90°$ to the grain shall be calculated according to EN 1995-1-1:2008 from:

$$F_{ax,\alpha,Rk} = \frac{n_{ef} \cdot k_{ax} \cdot f_{ax,k} \cdot d \cdot \ell_{ef}}{k_\beta} \left(\frac{\rho_k}{\rho_a}\right)^{0,8} \quad [N]$$

Where
$F_{ax,\alpha,RK}$ characteristic withdrawal capacity of the screws at an angle α to the grain [N]
n_{ef} effective number of screws according to EN 1995-1-1:2008
k_{ax} $k_{ax} = 1,0$ for $45° \le \alpha \le 90°$

$$k_{ax} = a + \frac{b \cdot \alpha}{45°} \text{ for } 0° \le \alpha < 45°$$

$$a = \begin{cases} 0,5 & \text{for LVL} \\ 0,3 & \text{for timber} \end{cases}$$

$$b = \begin{cases} 0,5 & \text{for LVL} \\ 0,7 & \text{for timber} \end{cases}$$

$$\text{If } \ell_{ef} \ge \min \begin{cases} 20 \cdot d \\ \dfrac{4 \cdot d}{\sin \alpha} \end{cases} \text{ and } \alpha \ge 15°,$$

k_{ax} may alternatively be taken as:

$$k_{ax} = \frac{1}{1,2 \cdot \cos^2 \alpha + \sin^2 \alpha}$$

k_β $k_\beta = 1{,}0$ for timber
$k_\beta = 1{,}5 \cdot \cos^2\beta + \sin^2\beta$ for LVL

$f_{ax,k}$ characteristic withdrawal parameter
For solid timber, glued laminated timber, cross laminated timber and laminated veneer lumber members with a maximum characteristic density of 590 kg/m³:
3,0 mm ≤ d ≤ 5,0 mm and ρ_a = 350 kg/m³:
$f_{ax,k}$ = 12,0 N/mm²
6,0 mm ≤ d ≤ 7,0 mm, Timtec Isotec screws and ρ_a = 350 kg/m³:
$f_{ax,k}$ = 11,5 N/mm²
8,0 mm ≤ d ≤ 10,0 mm, and ρ_a = 350 kg/m³: $f_{ax,k}$ = 11,0 N/mm²
d > 10,0 mm and ρ_a = 350 kg/m³:
$f_{ax,k}$ = 10,0 N/mm²
For laminated veneer lumber or FST (ETA-14/0354) with 590 kg/m³ ≤ ρ_k ≤ 750 kg/m³, 5,0 mm ≤ d ≤ 12,0 mm and ρ_a = 730 kg/m³:
$f_{ax,k}$ = 35,0 N/mm²

d outer thread diameter [mm]

ℓ_{ef} penetration length of the threaded part according to EN 1995-1-1:2008 [mm]

α angle between grain and screw axis (0° ≤ α ≤ 90°)

β angle between screw axis and the LVL's wide face (0° ≤ α ≤ 90°)

ρ_k characteristic density [kg/m³]

ρ_a associated density for $f_{ax,k}$ [kg/m³]

For screws penetrating more than one layer of cross laminated timber, the different layers may be taken into account proportionally.

The withdrawal capacities given above may be applied for screws within single softwood layers in cross laminated timber, if the single layer is considered as a separate softwood member and the minimum spacing, end and edge distances are observed for the single layer. For inner layers, the edge distance perpendicular to the grain may be reduced to 2 · d.

Alternatively, the axial withdrawal capacity for screws arranged parallel to the plane of cross laminated timber, independent of the angle between screw axis and grain direction, 0° ≤ α ≤ 90°, may be calculated from:

$$F_{ax,Rk} = 20 \cdot d^{0,8} \cdot \ell_{ef}^{0,9} \quad [N]$$

Where
d outer thread diameter [mm]
ℓ_{ef} Penetration length of the threaded part according to EN 1995-1-1:2008 [mm]

The axial withdrawal capacity is limited by the head pull-through capacity and the tensile or compressive capacity of the screw.

For axially loaded screws in tension, where the external force is parallel to the screw axes, the rules in EN 1995-1-1, 8.7.2 (8) should be applied.

For inclined screws in timber-to-timber or steel-to-timber shear connections, where the screws are arranged under an angle 30° ≤ α ≤ 60° between the shear plane and the screw axis, the effective number of screws n_{ef} should be determined as follows:

For one row of n screws parallel to the load, the load-carrying capacity should be calculated using the effective number of fasteners n_{ef}, where

$$n_{ef} = \max\left\{n^{0,9}\,;\,0,9 \cdot n\right\}$$

and n is the number of inclined screws in a row. If crossed pairs of screws are used in timber-to-timber connections, n is the number of crossed pairs of screws in a row.

Alternatively, the effective number of fasteners n_{ef} may be determined according to Annex G.

Note: For screws as compression reinforcement or inclined screws as fasteners in mechanically jointed beams or columns or for the fixing of thermal insulation material, $n_{ef} = n$.

The axial slip modulus K_{ser} of the threaded part of a screw for the serviceability limit state should be taken independent of angle α to the grain as:
$K_{ser} = 25 \cdot d \cdot \ell_{ef}$ [N/mm] for screws in softwood
$K_{ser} = 30 \cdot d \cdot \ell_{ef}$ [N/mm] for screws in hardwood
Where
d outer thread diameter [mm]
ℓ_{ef} penetration length in the timber member [mm]

Head pull-through capacity
The characteristic head pull-through capacity of SWG screws shall be calculated according to EN 1995-1-1:2008 from:

$$F_{ax,\alpha,Rk} = n_{ef} \cdot f_{head,k} \cdot d_h^2 \cdot \left(\frac{\rho_k}{350}\right)^{0,8} \quad [N]$$

where:
$F_{ax,\alpha,RK}$ characteristic head pull-through capacity of the connection at an angle α ≥ 30° to the grain [N]
n_{ef} effective number of screws according to EN 1995-1-1:2008

For inclined screws:

$$n_{ef} = \max\left\{n^{0,9}\,;\,0,9\cdot n\right\}$$

(see axial withdrawal capacity)

$f_{head,k}$ characteristic head pull-through parameter [N/mm²]

d_h diameter of the screw head or the washer [mm]. Outer diameter of washers $d_k > 32$ mm shall not be considered.

ρ_k characteristic density [kg/m³], for wood-based panels maximum $\rho_k = 380$ kg/m³, for hardwood maximum $\rho_k = 590$ kg/m³

Characteristic head pull-through parameter for SWG screws with a head diameter $d_h \leq 19$ mm in connections with timber and in connections with wood-based panels with thicknesses above 20 mm:
$f_{head,k} = 13,0$ N/mm²

Characteristic head pull-through parameter for SWG screws with a head diameter $d_h > 19$ mm in connections with timber and in connections with wood-based panels with thicknesses above 20 mm:
$f_{head,k} = 10,0$ N/mm²

Characteristic head pull-through parameter for SWG screws with a head diameter $d_h \leq 25$ mm in connections with LVL and FST (ETA-14/0354) members with characteristic density 590 kg/m³ $\leq \rho_k \leq$ 750 kg/m³ with thicknesses of at least 40 mm:

$$f_{head,k} = 40 - 0,5\cdot d_h$$

Characteristic head pull-through parameter for screws in connections with wood-based panels with thicknesses between 12 mm and 20 mm:
$f_{head,k} = 8$ N/mm²

Screws in connections with wood-based panels with a thickness below 12 mm (minimum thickness of the wood based panels of 1,2·d with d as outer thread diameter):
$f_{head,k} = 8$ N/mm²
limited to $F_{ax,Rk} = 400$ N

For SWG “Timtec plus VG” or “Timtec Isotec” screws, the withdrawal capacity of the thread in the member with the screw head may be taken into account instead of the head pull-through capacity.

The head diameter d_h shall be greater than $1,8\cdot d_s$, where d_s is the smooth shank or the wire diameter. Otherwise the characteristic head pull-through capacity $F_{ax,\alpha,Rk} = 0$.

The minimum thickness of wood-based panels according to the clause 2.1 must be observed.

In steel-to-timber connections the head pull-through capacity is not governing.

Tensile capacity

The characteristic tensile strength $f_{tens,k}$ of SWG screws made of carbon steel is:

d = 3,0 mm:	2,8 kN
d = 3,5 mm:	3,0 kN
d = 4,0 mm:	5,0 kN
d = 4,5 mm:	5,3 kN
d = 5,0 mm:	7,9 kN
d = 6,0 mm:	12,5 kN
d = 7,0 mm:	15 kN
d = 8,0 mm:	21,5 kN
d = 10,0 mm except “Timtec plus VG”:	26 kN
d = 10,0 mm “Timtec plus VG”:	33 kN
d = 12,0 mm except “Timtec plus VG”:	41 kN
d = 12,0 mm “Timtec plus VG”:	45 kN
d = 14,0 mm “Timtec plus VG”:	62 kN
d = 14,0 mm “Timtec plus VG hot-dip galvanised”:	47 kN
”Timtec Isotec”:	11 kN

The characteristic tensile strength $f_{tens,k}$ of SWG screws made of stainless steel is:

d = 3,0 mm:	1,8 kN
d = 3,5 mm:	2,4 kN
d = 4,0 mm:	3,1 kN
d = 4,5 mm:	3,6 kN
d = 5,0 mm:	4,2 kN
d = 5,5 mm:	5,9 kN
d = 6,0 mm:	7,1 kN
d = 6,5 mm:	8,3 kN
d = 8,0 mm:	12 kN
d = 10,0 mm:	19 kN

For screws used in combination with steel plates, the tear-off capacity of the screw head including a washer shall be greater than the tensile capacity of the screw. This also applies to angle washers allowing an angle of 45° between steel plate and screw axis.

Compressive capacity

The characteristic compressive capacity $F_{ax,Rk}$ of SWG “Timtec plus VG” or fully threaded “Timtec 3.0” screws embedded in timber shall be calculated from:

$$F_{ax,Rk} = \min\left\{k_{ax}\cdot f_{ax,k}\cdot d\cdot \ell_{ef}\left(\frac{\rho_k}{\rho_a}\right)^{0,8}\,;\,\kappa_c\cdot N_{pl,k}\right\} \quad [N]$$

Where

$$\kappa_c = \begin{cases} 1 & \text{for } \bar{\lambda}_k \le 0,2 \\ \dfrac{1}{k + \sqrt{k^2 - \bar{\lambda}_k^2}} & \text{for } \bar{\lambda}_k > 0,2 \end{cases}$$

$$k = 0,5 \cdot \left[1 + 0,49 \cdot (\bar{\lambda}_k - 0,2) + \bar{\lambda}_k^2 \right]$$

The relative slenderness ratio shall be calculated from:

$$\bar{\lambda}_k = \sqrt{\frac{N_{pl,k}}{N_{ki,k}}}$$

Where

$$N_{pl,k} = \pi \cdot \frac{d_1^2}{4} \cdot f_{y,k} \quad [N]$$

is the characteristic value for the axial capacity in case of plastic analysis referred to the inner thread cross section.

Characteristic yield strength for screws made of carbon steel except hot-dip galvanised screws:

$f_{y,k}$ = 1000 [N/mm²]

Characteristic yield strength for hot-dip galvanised screws:

$f_{y,k}$ = 800 [N/mm²]

Characteristic ideal elastic buckling load:

$$N_{ki,k} = \sqrt{c_h \cdot E_S \cdot I_S} \quad [N]$$

Elastic foundation of the screw:

$$c_h = (0,19 + 0,012 \cdot d) \cdot \rho_k \cdot \left(\frac{\alpha}{180°} + 0,5 \right)$$

[N/mm²]

Modulus of elasticity:

E_s = 210000 [N/mm²]

Second moment of area:

$$I_S = \frac{\pi}{64} \cdot d_1^4 \quad [mm^4]$$

d_1 inner thread diameter [mm]

α angle between screw axis and grain direction

ρ_k characteristic density [kg/m³]

Note: When determining design values of the compressive capacity it should be considered that $f_{ax,d}$ is to be calculated using k_{mod} and γ_M for timber according to EN 1995 while $N_{pl,d}$ is calculated using $\gamma_{M,1}$ for steel buckling according to EN 1993.

Combined laterally and axially loaded screws

For screwed connections subjected to a combination of axial and lateral load, the following expression should be satisfied:

$$\left(\frac{F_{ax,Ed}}{F_{ax,Rd}} \right)^2 + \left(\frac{F_{la,Ed}}{F_{la,Rd}} \right)^2 \le 1$$

where

$F_{ax,Ed}$ axial design load of the screw

$F_{la,Ed}$ lateral design load of the screw

$F_{ax,Rd}$ design load-carrying capacity of an axially loaded screw

$F_{la,Rd}$ design load-carrying capacity of a laterally loaded screw

Mechanically jointed beams

See Annex B

Compression reinforcement

See annex C

Shear reinforcement

See annex D

Reinforcement of dowelled or bolted connections

See annex E

Thermal insulation material on top of rafters

See annex F

3.10 Related aspects of serviceability

3.10.1 Corrosion protection in service class 1, 2 and 3.

The SWG screws are produced from carbon wire. They are brass-plated, nickel-plated bronze finished or electro-galvanised and e.g. yellow or blue chromated. The mean thickness of the zinc coating is 5 µm.

Steel no. 1.4006, 1.4009, 1.4021, 1.4301, 1.4401, 1.4539, 1.4567 or 1.4578 is used for screws made from stainless steel.

3.11 General aspects related to the intended use of the product

The screws are manufactured in accordance with the provisions of the European Technical Assessment using the automated manufacturing process as identified during the inspection of the plant by the assessment body issuing the ETA and the approved body and laid down in the technical documentation.

The installation shall be carried out in accordance with Eurocode 5 or an appropriate national code unless otherwise is defined in the following. Instructions from SWG Schraubenwerk Gaisbach GmbH should be considered for installation.

The screws are used for connections in load bearing timber structures between members of solid timber (softwood), glued laminated timber, cross-laminated timber (minimum diameter d = 6,0 mm), and laminated veneer lumber, similar glued members, wood-based panels or steel members. The screws are also used for connections in pre-drilled load bearing members of hardwood solid timber (beech or oak) or hardwood glued laminated timber (beech or oak).

The screws may be used for connections in load bearing timber structures with structural members according to an associated ETA, if according to the associated ETA of the structural member a connection in load bearing timber structures with screws according to a ETA is allowed.

SWG „Timtec plus VG" and fully threaded "Timtec 3.0" screws are also used as tensile or compressive reinforcement perpendicular to the grain and SWG "Timtec plus VG" and fully threaded "Timtec 3.0" screws with a diameter of 8 mm as shear reinforcement in softwood members.

Furthermore, the screws with diameters of at least 6 mm may also be used for the fixing of thermal insulation material on top of rafters. Screws must be screwed in the rafter through the battens or panels and the insulation without pre-drilling in one sequence.

A minimum of two screws should in general be used for connections in load bearing timber structures. This requirement does not apply for the fixing of boards, battens and wind braces, or for the fixing of rafters, purlins or similar on main beams or top plates, if the member is fixed with at least two screws.
A single screw may also be used in structural connections if the penetration length of the screw is at least 20 · d and the screw is only axially loaded. If the screw is used to connect wood-based members the load-bearing capacity of the single screw in this case shall be reduced by 50 %. If the screw is used as tensile or compressive reinforcement of timber structures perpendicular to the grain no reduction of the load-bearing capacity of the screw is required.

The minimum point side penetration length in structural members made of solid, glued or cross-laminated timber is 4·d.

Wood-based panels except solid wood panels, laminated veneer lumber and cross laminated timber and steel plates should only be arranged on the side of the screw head. The minimum thickness of wood-based panels should be 1,2·d. Furthermore, the minimum thickness for following wood-based panels should be:

- Plywood, Fibreboards: 6 mm
- Particleboards, OSB, Cement Particleboards: 8 mm
- Solid wood panels: 12 mm

For structural members according to ETA's the terms of the ETA's must be considered.

If screws with an outer thread diameter $d \geq 8$ mm are used in load bearing timber structures, the structural solid or glued laminated timber, laminated veneer lumber and similar glued members must be from spruce, pine, fir or beech (only Beech LVL according to EN 14374 or FST according to ETA-14/0354). This does not apply for screws in pre-drilled holes or for "Timtec plus" and "Timtec plus VG" screws.

The screws shall be driven into softwood without pre-drilling or after pre-drilling. The screws shall be driven into hardwood with a maximum characteristic density of 590 kg/m³ after pre-drilling. The screws made of carbon steel may be driven into Beech LVL according to EN 14374 or in FST according to ETA-14/0354 without pre-drilling with the maximum penetration lengths of the threaded parts given below
.
The drill hole diameters are:

Outer thread diameter [mm]	Drill hole diameter [mm]		
	Softwood	Hardwood	Beech LVL or FST
4,0	2,5	3,0	3,0
4,5	2,5	3,5	3,5
5,0	3,0	3,5	4,0
6,0	4,0	4,0	4,5
7,0	4,0	5,0	5,5
8,0	5,0	6,0	6,5
10,0	6,0	7,0	8,0
12,0	7,0	8,0	9,0
14,0	8,0	9,0	11,0

Maximum penetration lengths of the threaded parts for Timtec screws in Beech LVL or FST according to ETA-14/0354 without predrilling:

Outer thread diameter [mm]	Maximum penetration lengths of the threaded parts [mm]	
	Timtec plus	Timtec
5,0	-	50
6,0	30	60
7,0	-	70
8,0	48	80
10,0	80	100
12,0	96	-

The hole diameter in steel members must be predrilled with a suitable diameter.

Only the equipment prescribed by SWG Schraubenwerk Gaisbach GmbH shall be used for driving the screws. "Timtec plus VG" screws with outer thread diameter d = 14 mm and overall length $L \geq 800$ mm shall be driven

into softwood using a centring drilling with diameter of 8 mm and minimum length of 10 % from the screw length.

Screws with countersunk head made of carbon steel shall be used with countersunk washers pressed/turned according to Annex A. The washers must be flush with the surface of the connected structural member. For steel-to-timber connections screws with countersunk head shall be used with countersunk washers 45° according to Annex A. Screws made of carbon steel shall only be used with washers made of carbon steel. Screws made of stainless steel shall only be used with washers made of stainless steel.

In connections with screws with countersunk head according to Annex A, the head must be flush with the surface of the connected structural member. A deeper countersink is not allowed.

For screws arranged at angles $\alpha < 90°$ between screw axis and grain direction minimum spacing and distances are defined as follows:
Minimum spacing a_1 or a_2 is defined perpendicular to the screw axis, minimum end or edge distances $a_{1,c}$, $a_{1,t}$, $a_{2,c}$ or $a_{2,t}$ parallel or perpendicular to the grain, respectively, are defined between the centre of the threaded screw length (axial loading) or the screw length (lateral loading) in the respective timber member and the member surface as for axially loaded screws in Figure 8.11.a EN 1995-1-1.

For structural timber members, minimum spacing and distances for laterally or axially loaded screws in predrilled holes are given in EN 1995-1-1:2008 (Eurocode 5) clause 8.3.1.2 and table 8.2 as for nails in predrilled holes.

These minimum spacing and distances for screws in predrilled holes also apply for “Timtec plus” and “Timtec plus VG” screws in non-predrilled softwood members. Here, the outer thread diameter d must be considered. For angles α between load and grain direction the minimum values are:
Spacing a_1 in a plane parallel to grain: $a_1 = (4+|\cos \alpha|)\cdot d$
Spacing a_2 perpendicular to a plane parallel to grain:

$$a_2 = (3+|\sin \alpha|)\cdot d$$

Loaded end distance of the centre of gravity of the threaded part in the timber member:

$$a_{1,t,CG} = (7+5\cdot\cos \alpha)\cdot d$$

Unloaded end distance of the centre of gravity of the threaded part in the timber member: $a_{1,c,CG} = 7 \cdot d$

Loaded edge distance of the centre of gravity of the threaded part in the timber member for $d < 5$ mm:

$$a_{2,t,CG} = (3+2\cdot\sin \alpha)\cdot d$$

Loaded edge distance of the centre of gravity of the threaded part in the timber member for $d \geq 5$ mm:

$$a_{2,t,CG} = (3+4\cdot\sin \alpha)\cdot d$$

Unloaded edge distance of the centre of gravity of the threaded part in the timber member: $a_{2,c,CG} = 3 \cdot d$

Minimum thickness for predrilled structural members or for “Timtec plus” and “Timtec plus VG” screws in non-predrilled softwood members is $t = 24$ mm for screws with outer thread diameter $d < 8$ mm, $t = 30$ mm for screws with outer thread diameter $d = 8$ mm, $t = 40$ mm for screws with outer thread diameter $d = 10$ mm, $t = 80$ mm for screws with outer thread diameter $d = 12$ mm and $t = 100$ mm for screws with outer thread diameter $d = 14$ mm. These minimum thickness values generally apply for non-predrilled softwood members, if the spacing parallel to the grain and the end distance is at least $25\cdot d$ or if the timber in the connection area is reinforced according to Annex E.

In all other cases, minimum thicknesses for „Timtec 3.0” and “Timtec Isotec” screws in non-predrilled softwood members are given in EN 1995-1-1 (Eurocode 5) clause 8.3.1.2 as for nails in non-predrilled holes. Equation (8.18) may be applied for softwood members made of pine or for the fixing of boards, battens or wind braces, if the member is fixed with at least two screws. Otherwise EN 1995-1-1 clause 8.3.1.2 (7) applies.

Minimum distances from the unloaded edge perpendicular to the grain may be reduced to $3\cdot d$, if the spacing parallel to the grain and the end distance is at least $25\cdot d$.

These requirements do not apply for structural wood-based panels or LVL with cross layers.

For „Timtec 3.0” and “Timtec Isotec” screws in non-predrilled holes, minimum spacing and distances are given in EN 1995-1-1:2008 (Eurocode 5) clause 8.3.1.2 and table 8.2 as for nails in non-predrilled holes. For $\rho_k \leq 420$ kg/m³ the minimum values for angles α between load and grain direction are:
Spacing a_1 in a plane parallel to grain for $d < 5$ mm:

$$a_1 = (5+5|\cos \alpha|)\cdot d$$

Spacing a_1 in a plane parallel to grain for $d \geq 5$ mm:

$$a_1 = (5+7|\cos \alpha|)\cdot d$$

Spacing a_2 perpendicular to a plane parallel to grain:

$$a_2 = 5 \cdot d$$

Loaded end distance of the centre of gravity of the threaded part in the timber member:

$$a_{1,t,CG} = (10+5\cdot\cos\alpha)\cdot d$$

Unloaded end distance of the centre of gravity of the threaded part in the timber member: $a_{1,c,CG} = 10 \cdot d$

Loaded edge distance of the centre of gravity of the threaded part in the timber member for $d < 5$ mm:

$$a_{2,t,CG} = (5+2\cdot\sin\alpha)\cdot d$$

Loaded edge distance of the centre of gravity of the threaded part in the timber member for $d \geq 5$ mm:

$$a_{2,t,CG} = (5+5\cdot\sin\alpha)\cdot d$$

Unloaded edge distance of the centre of gravity of the threaded part in the timber member: $a_{2,c,CG} = 5 \cdot d$

For "Timtec plus", "Timtec plus VG" and "Timtec 3.0" screws with diameters 5 mm ≤ d ≤ 12 mm in Beech laminated veneer lumber or FST (ETA-14/0354) members type Q the minimum values given above for all member thicknesses.

For angles α between load and grain direction and 420 kg/m³ < ρ_k ≤ 500 kg/m³ as well as for "Timtec plus", "Timtec plus VG" and "Timtec 3.0" screws with diameters 5 mm ≤ d ≤ 12 mm in Beech laminated veneer lumber or FST (ETA-14/0354) members type S with characteristic density 590 kg/m³ ≤ ρ_k ≤ 750 kg/m³ and t ≥ 7 d the minimum values are:

Spacing a_1 in a plane parallel to grain:

$$a_1 = (7+8|\cos\alpha|)\cdot d$$

Spacing a_2 perpendicular to a plane parallel to grain:

$$a_2 = 7 \cdot d$$

Loaded end distance of the centre of gravity of the threaded part in the timber member:

$$a_{1,t,CG} = (15+5\cdot\cos\alpha)\cdot d$$

Unloaded end distance of the centre of gravity of the threaded part in the timber member: $a_{1,c,CG} = 15 \cdot d$

Loaded edge distance of the centre of gravity of the threaded part in the timber member for $d < 5$ mm:

$$a_{2,t,CG} = (7+2\cdot\sin\alpha)\cdot d$$

Loaded edge distance of the centre of gravity of the threaded part in the timber member for $d \geq 5$ mm:

$$a_{2,t,CG} = (7+5\cdot\sin\alpha)\cdot d$$

Unloaded edge distance of the centre of gravity of the threaded part in the timber member: $a_{2,c,CG} = 7 \cdot d$

Alternatively, minimum distances and spacing for exclusively axially loaded "Timtec plus" and "Timtec plus VG" screws in members of solid timber, glued laminated timber or similar glued products with a minimum thickness t = 10·d and a minimum width of 8·d or 60 mm, whichever is the greater, may be taken as:

Spacing a_1 parallel to the grain	$a_1 = 5 \cdot d$
Spacing a_2 perpendicular to the grain	$a_2 = 5 \cdot d$
Distance $a_{3,c}$ from centre of the screw-part in timber to the end grain	$a_{1,c,CG} = 5 \cdot d$
Distance $a_{4,c}$ from centre of the screw-part in timber to the edge	$a_{2,c,CG} = 3 \cdot d$

Spacing a_2 perpendicular to the grain may be reduced from 5·d to 2,5·d, if the condition $a_1 \cdot a_2 \geq 25 \cdot d^2$ is fulfilled.

Alternatively, minimum distances and spacing for exclusively axially loaded "Timtec plus" and "Timtec plus VG" screws in softwood laminated veneer members with a minimum thickness t = 6 ·d and a minimum width of 8·d or 60 mm, whichever is the greater, may be taken as:

Spacing a_1 parallel to the grain	$a_1 = 5 \cdot d$
Spacing a_2 perpendicular to the grain	$a_2 = 5 \cdot d$
Distance $a_{3,c}$ from centre of the screw-part in timber to the end grain	$a_{1,c,CG} = 5 \cdot d$
Distance $a_{4,c}$ from centre of the screw-part in timber to the edge	$a_{2,c,CG} = 3 \cdot d$

Spacing a_2 perpendicular to the grain may be reduced from 5·d to 2,5·d, if the condition $a_1 \cdot a_2 \geq 25 \cdot d^2$ is fulfilled.

For non-predrilled Douglas fir members, minimum spacing and distances parallel to the grain shall be increased by 50%.

Minimum distances and spacing for screws in the plane surface of cross laminated timber members with a minimum thickness t = 10·d may be taken as (see Annex B):

Spacing a_1 parallel to the grain	$a_1 = 4 \cdot d$
Spacing a_2 perpendicular to the grain	$a_2 = 2{,}5 \cdot d$
Distance $a_{3,c}$ from centre of the screw-part in timber to the unloaded end grain	$a_{1,c,CG} = 6 \cdot d$
Distance $a_{3,t}$ from centre of the screw-part in timber to the loaded end grain	$a_{1,t,CG} = 6 \cdot d$
Distance $a_{4,c}$ from centre of the screw-part in timber to the unloaded edge	$a_{2,c,CG} = 2{,}5 \cdot d$
Distance $a_{4,t}$ from centre of the screw-part in timber to the loaded edge	$a_{2,t,CG} = 6 \cdot d$

Minimum distances and spacing for screws in the edge surface of cross laminated timber members with a minimum thickness t = 10·d and a minimum penetration depth perpendicular to the edge surface ℓ_{ef} = 10·d may be taken as (see Annex B):

Spacing a_1 parallel to the CLT plane	$a_1 = 10 \cdot d$
Spacing a_2 perpendicular to the CLT plane	$a_2 = 4 \cdot d$
Distance $a_{3,c}$ from centre of the screw-part in timber to the unloaded end	$a_{1,c,CG} = 7 \cdot d$
Distance $a_{3,t}$ from centre of the screw-part in timber to the loaded end	$a_{1,t,CG} = 12 \cdot d$
Distance $a_{4,c}$ from centre of the screw-part in timber to the unloaded edge	$a_{2,c,CG} = 3 \cdot d$
Distance $a_{4,t}$ from centre of the screw-part in timber to the loaded edge	$a_{2,t,CG} = 6 \cdot d$

For a crossed screw couple the minimum spacing between the crossing screws is 1,5·d.

Minimum distances and spacing for “Timtec plus VG“ screws in mechanically jointed beams are given in Annex B.

Minimum distances and spacing for SWG screws in cross laminated timber are given in Annex B.

4 Attestation and verification of constancy of performance (AVCP)

4.1 AVCP system

According to the decision 97/176/EC of the European Commission1, as amended, the system(s) of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) is 3.

5 Technical details necessary for the implementation of the AVCP system, as foreseen in the applicable EAD

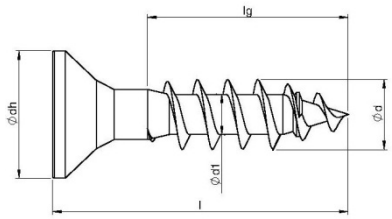
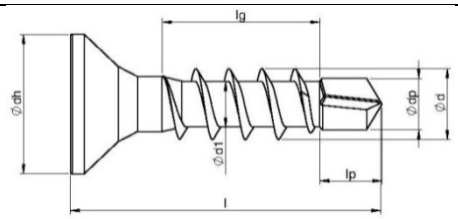
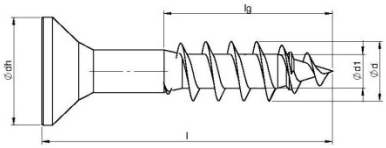
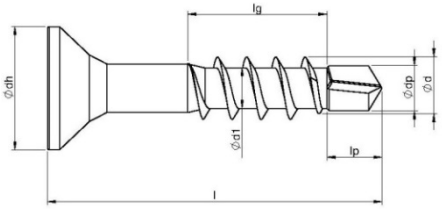
Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at ETA-Danmark prior to CE marking.

Issued in Copenhagen on 2019-02-28 by

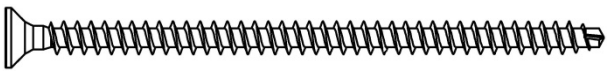
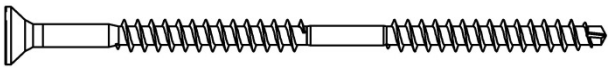
Thomas Bruun
Managing Director, ETA-Danmark

Annex A
Drawings, designation and material specification of Timtec screws

1) TIMTEC (all kinds without TIMTEC plus VG and TIMTEC Isotec)

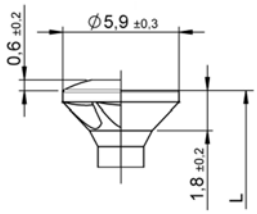
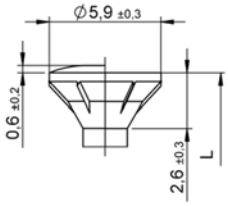
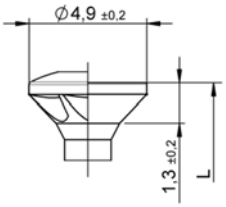
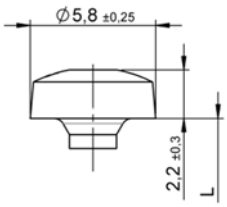
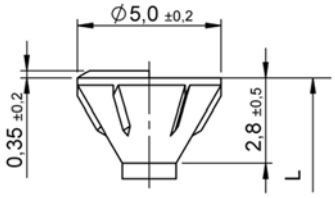
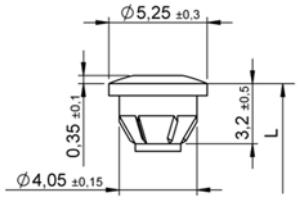
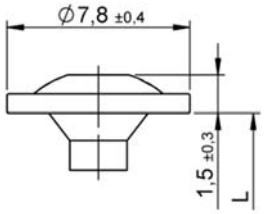
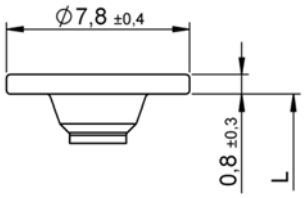
	
Full thread without drilling tip	Full thread with drilling tip
	
Partial thread without drilling tip	Partial thread with drilling tip

2) All SWG TIMTEC screws can be like on the drawing (I) or without thread in the middle of the screw (II) or without thread below head (III) or in combination (IV). The thread lengths can be manufactured to customer specific within 4 x d and lg max.

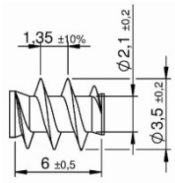
 (I)
 (II)
 (III)
 (IV)

SWG TIMTEC screws	Annex A
1. Design of SWG TIMTEC screws	

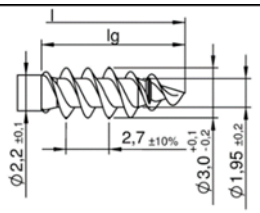
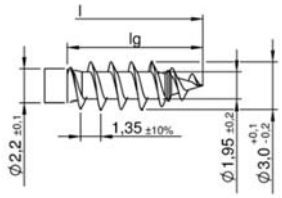
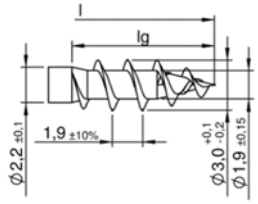
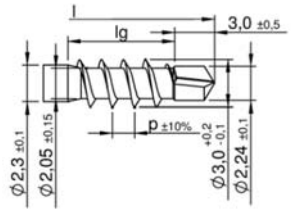
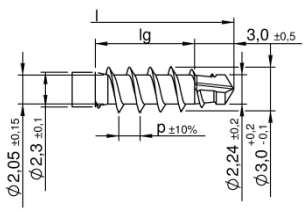
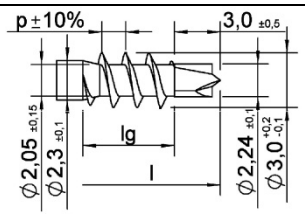
Head types for D=3.0

		
Countersunk head – design: with and without raise, with and without milling pockets	Countersunk head with cutter ribs - design with and without raise	Piano hinge head – design: with and without raise, with and without milling pockets
		
Pan head	Woodwork head – design with and without raise	Top head
		
Back panel screw head	Flat back panel head	

Underhead thread for D=3.0


Design with p=1,35

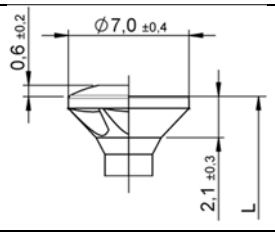
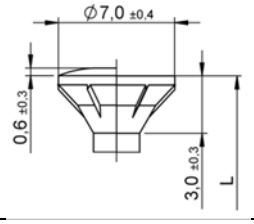
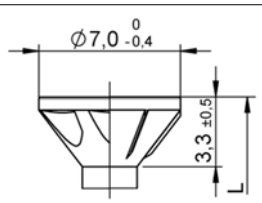
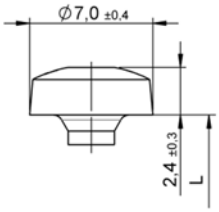
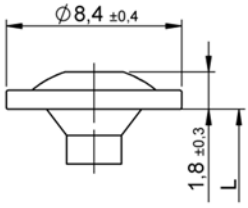
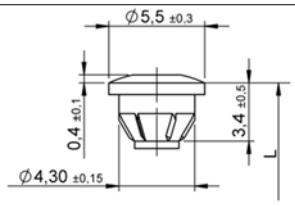
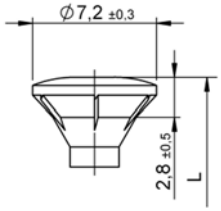
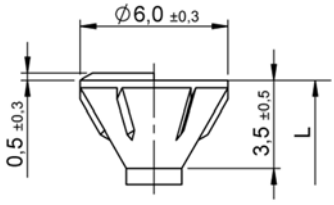
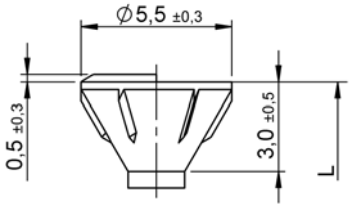
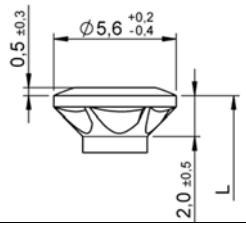
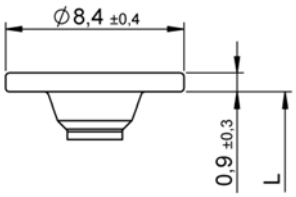
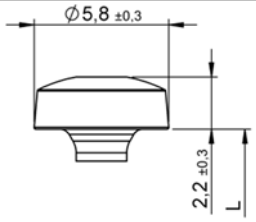
Thread types for D=3.0

		
TIMTEC double - thread	TIMTEC single - thread	TIMTEC coarse - thread
Design with and without ring respectively mating thread	Design with and without ring respectively mating thread	Design with and without mating thread respectively ring
		
TIMTEC plus	TIMTEC plus special	TIMTEC plus 3.0
Design with p=1,35 and 1,9	Design with p=1,35 and 1,9	Design with p=1,35 and 1,9

Lengths for D=3.0

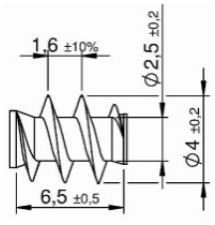
l +1.0 - 2.0	lg +1.0 - 2.0	Screws without thread in the middle of screw or without thread below head or in combination of both are possible (see page 1 of this Annex). The thread lengths can be manufactured to customer specific within lg min and lg max. All dimensions in mm.
13	12	
…	…	
50	49	

Head types for D=3.5

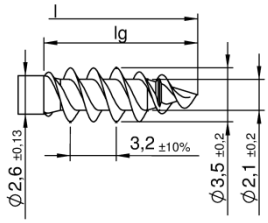
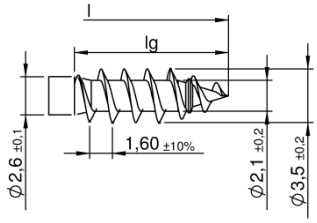
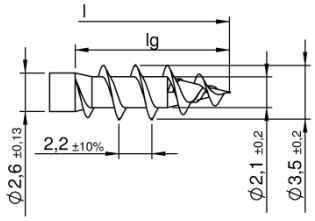
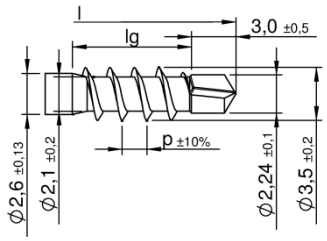
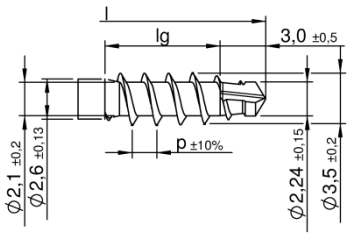
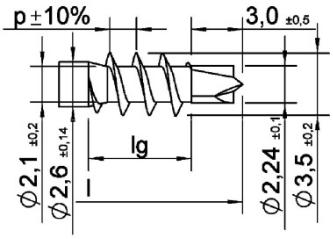
		
Countersunk head – design: with and without raise, with and without milling pockets	Countersunk head with cutter ribs - design with and without raise	75° head – design: with and without raise, with and without milling pockets, with and without cutter ribs
		
Pan head	Back panel screw head	Top head
		
FBS head	Woodwork head – design with and without raise	Woodwork head – design with and without raise
		
Decking screw head	Flat back panel head	Small Pan head

SWG TIMTEC screws	Annex A
2. TIMTEC and TIMTEC plus, Material carbon steel	

Underhead thread for D=3.5


Design with p=1.6

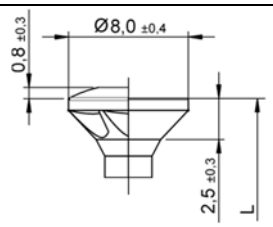
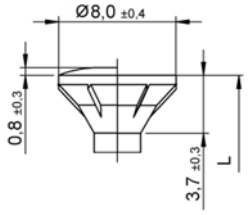
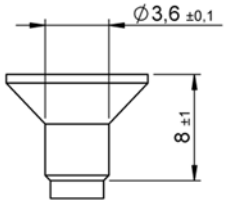
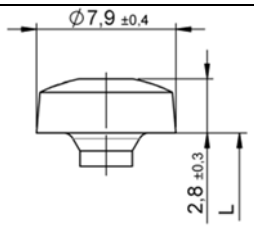
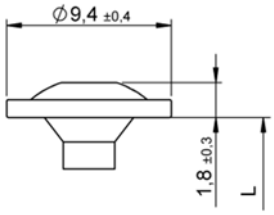
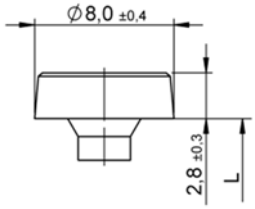
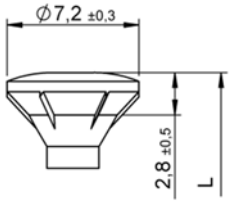
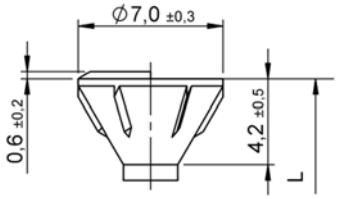
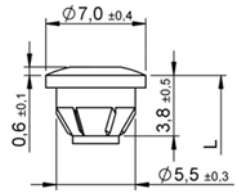
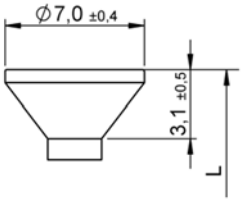
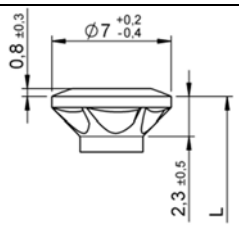
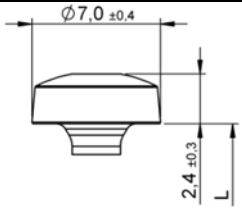
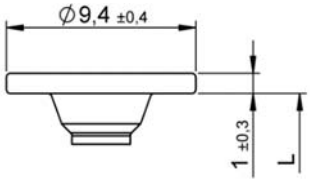
Thread types for D=3.5

		
TIMTEC double - thread	TIMTEC single - thread	TIMTEC coarse - thread
Design with and without ring respectively mating thread	Design with and without ring respectively mating thread	Design with and without mating thread respectively ring
		
TIMTEC plus	TIMTEC plus special	TIMTEC plus 3.0
Design with p=1.6 and 2.2	Design with p=1.6 and 2.2	Design with p=1.6 and 2.2

Lengths for D=3.5

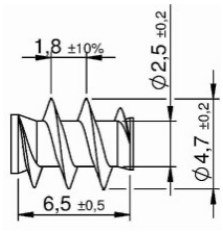
l +1.0 - 2.0	lg +1.0 - 2.0	Screws without thread in the middle of screw or without thread below head or in combination of both are possible (see page 1 of this Annex). The thread lengths can be manufactured to customer specific within lg min and lg max. All dimensions in mm.
16	14	
…	…	
50	48	

Head types for D=4.0

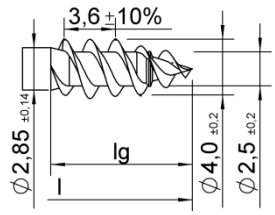
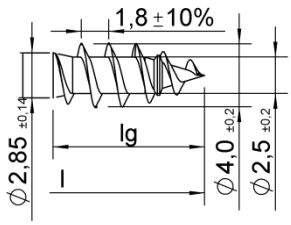
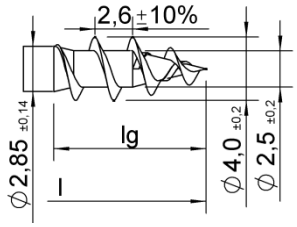
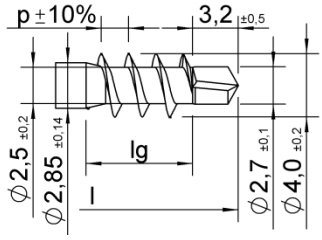
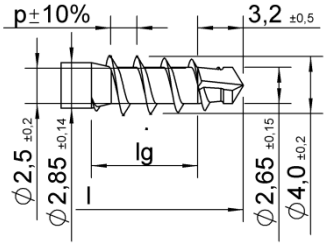
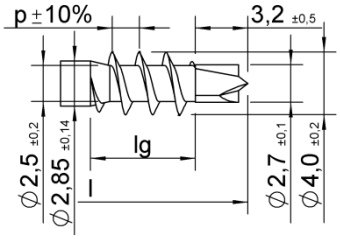
		
Countersunk head – design: with and without raise, with and without milling pockets	Countersunk head with cutter ribs - design with and without raise	Alternatively at countersunk heads: modification of the shank at drilled head
		
Pan head	Back panel screw head	Elmo-head
		
FBS head	Woodwork head – design with and without raise	Top head
		
75° FBS head	Decking screw head	Small Pan head
		
Flat back panel head		

SWG TIMTEC screws	Annex A
2. TIMTEC and TIMTEC plus, Material carbon steel	

Underhead thread for D=4.0


Design with p=1.8

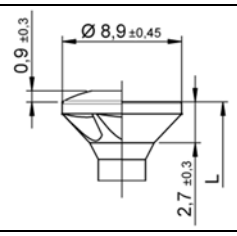
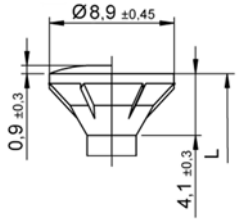
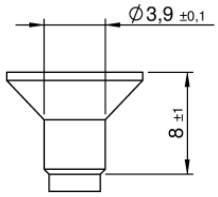
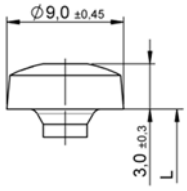
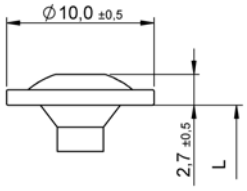
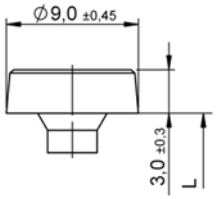
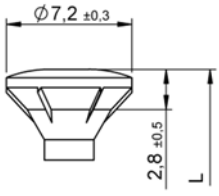
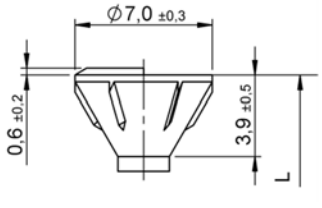
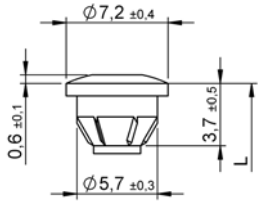
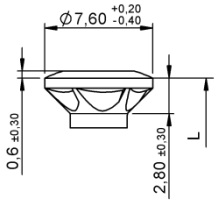
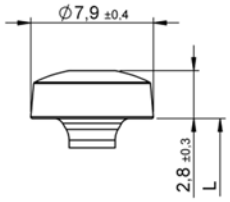
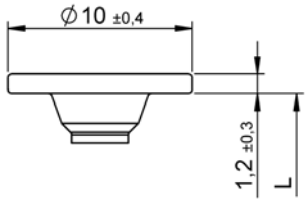
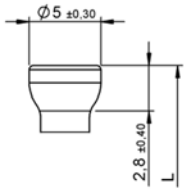
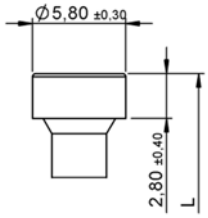
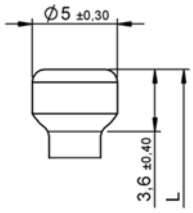
Thread types for D=4.0

		
TIMTEC double - thread	TIMTEC single - thread	TIMTEC coarse - thread
Design with and without ring respectively mating thread	Design with and without ring respectively mating thread	Design with and without mating thread respectively ring
		
TIMTEC plus	TIMTEC plus special	TIMTEC plus 3.0
Design with p=1.8 and 2.6	Design with p=1.8 and 2.6	Design with p=1.8 and 2.6

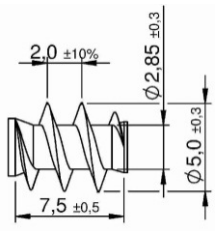
Lengths for D=4.0

l +1.0 - 2.0	lg +1.0 - 2.0	Screws without thread in the middle of screw or without thread below head or in combination of both are possible (see page 1 of this Annex). The thread lengths can be manufactured to customer specific within lg min and lg max. All dimensions in mm.
18	16	
…	…	
70	68	

Head types for D=4.5

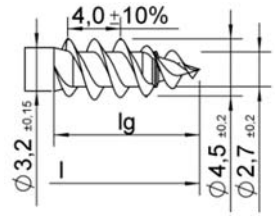
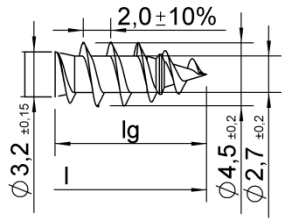
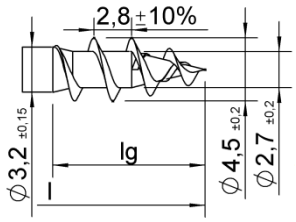
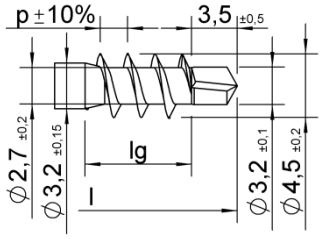
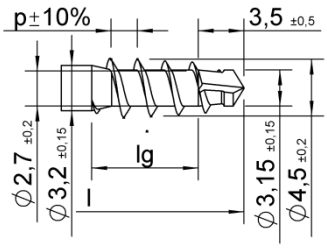
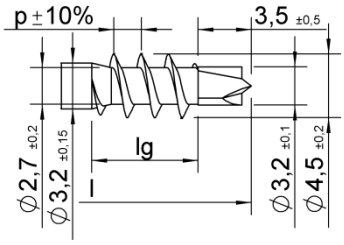
		
Countersunk head – design: with and without raise, with and without milling pockets	Countersunk head with cutter ribs - design with and without raise	Alternatively at countersunk heads: modification of the shank at drilled head
		
Pan head	Back panel screw head	Elmo-head
		
FBS head	Woodwork head – design with and without raise	Top head
		
Decking head screw	Small Pan head	Flat back panel head
		
Tulip shaped head	Cylinder head	Small cylinder head

Underhead thread for D=4.5



Design with p=2.0

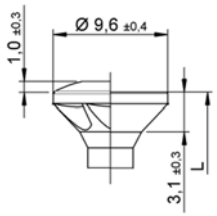
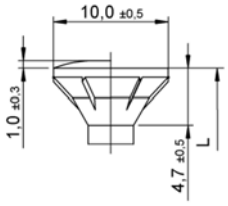
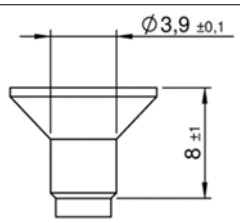
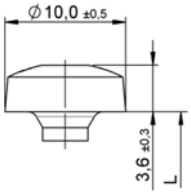
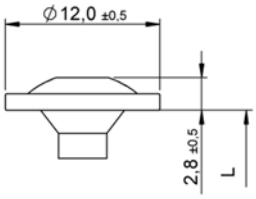
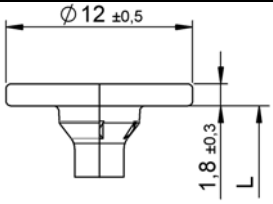
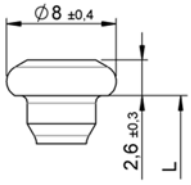
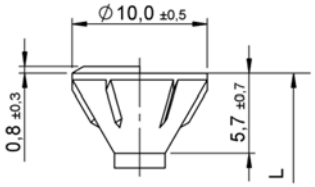
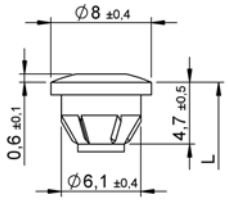
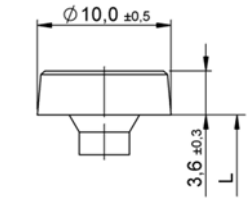
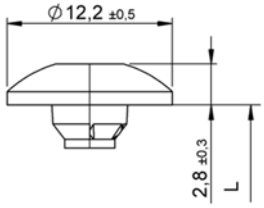
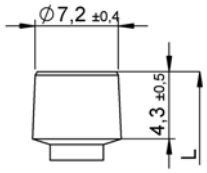
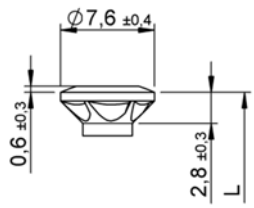
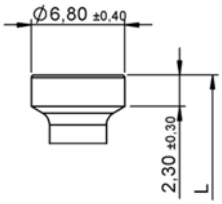
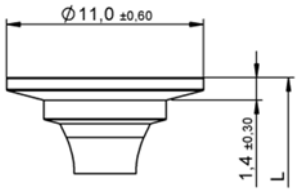
Thread types for D=4.5

		
TIMTEC double - thread	TIMTEC single - thread	TIMTEC coarse - thread
Design with and without ring respectively mating thread	Design with and without ring respectively mating thread	Design with and without mating thread respectively ring
		
TIMTEC plus	TIMTEC plus special	TIMTEC plus 3.0
Design with p=2.0 and 2.8	Design with p=2.0 and 2.8	Design with p=2.0 and 2.8

Lengths for D=4.5

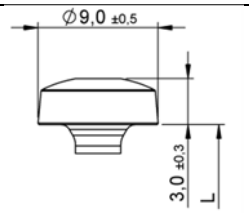
l +1.0 - 2.0	lg +1.0 - 2.0	Screws without thread in the middle of screw or without thread below head or in combination of both are possible (see page 1 of this Annex). The thread lengths can be manufactured to customer specific within lg min and lg max. All dimensions in mm.
20	18	
…	…	
100	78	

Head types for D=5.0

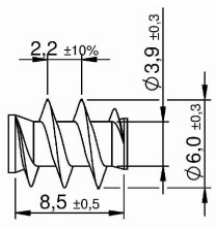
		
Countersunk head – design: with and without raise, with and without milling pockets	Countersunk head with cutter ribs - design with and without raise	Alternatively at countersunk heads: modification of the shank at drilled head
		
Pan head	Large washer head	Large washer head II - design: with and without cutter ribs
		
Joist hanger screw head	Woodwork head – design with and without raise	Top head
		
Elmo-head	Truss head - design: with and without cutter ribs	Cylinder head
		
Decking screw head	Decking screw head II	Washer head III

SWG TIMTEC screws	Annex A
2. TIMTEC and TIMTEC plus, Material carbon steel	

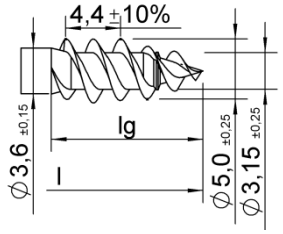
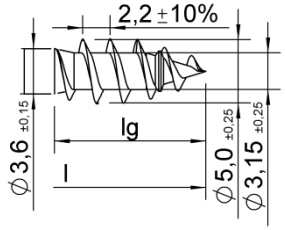
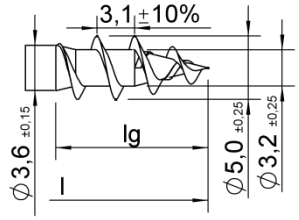
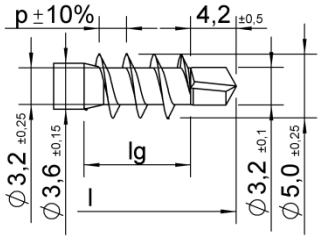
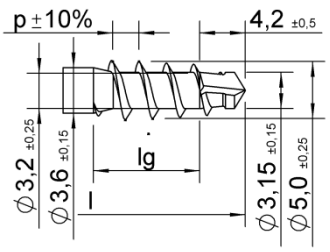
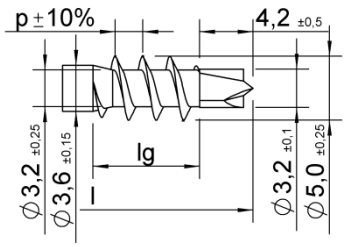
Head types for D=5.0

		
Small Pan head		

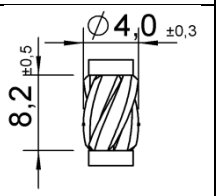
Underhead thread for D=5.0


Design with p=2.2

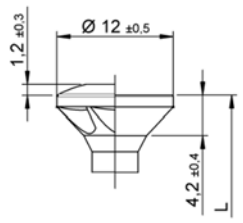
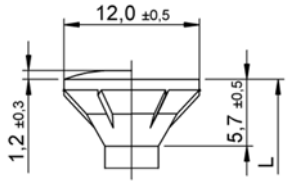
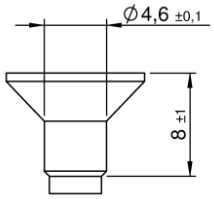
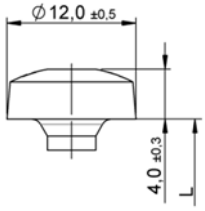
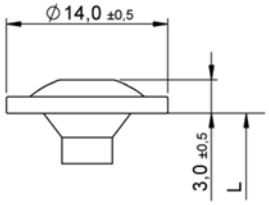
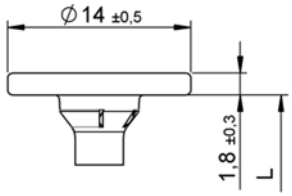
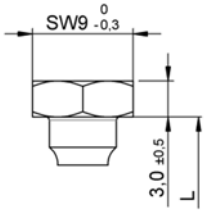
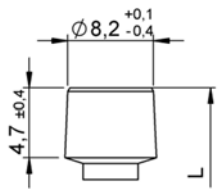
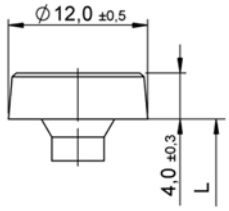
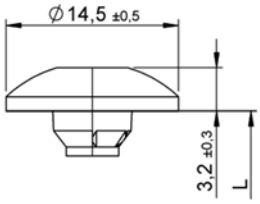
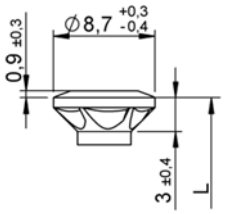
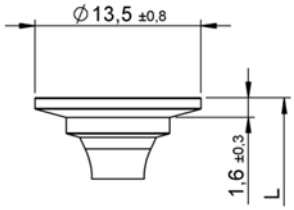
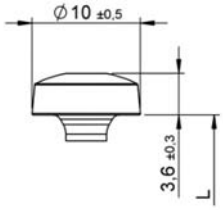
Thread types for D=5.0

		
TIMTEC double - thread	TIMTEC single - thread	TIMTEC coarse - thread
Design with and without ring respectively mating thread	Design with and without ring respectively mating thread	Design with and without mating thread respectively ring
		
TIMTEC plus	TIMTEC plus special	TIMTEC plus 3.0
Design with p=2.2 and 3.1	Design with p=2.2 and 3.1	Design with p=2.2 and 3.1

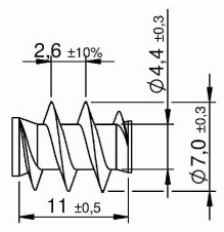
Lengths for D=5.0

l +1.0 - 2.5	lg +1.0 - 2.0	Shank cutter at TIMTEC partial thread	Shank cutter at TIMTEC plus /TIMTEC plus special / TIMTEC plus 3.0 partial thread	Shank cutter	Screws without thread in the middle of screw or without thread below head or in combination of both are possible (see page 1 of this Annex). The thread lengths can be manufactured to customer specific within lg min and lg max. All dimensions in mm.
22	20	up to L= 90: optional	over all lengths optional		
…	…	over L=90: yes			
120	90				

Head types for D=6.0

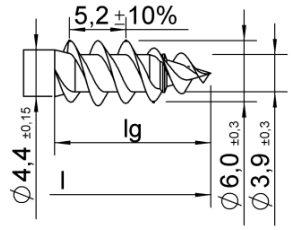
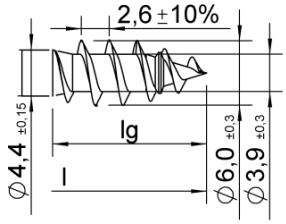
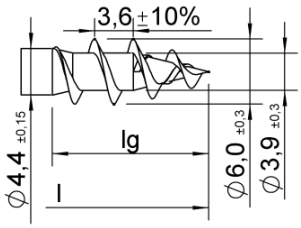
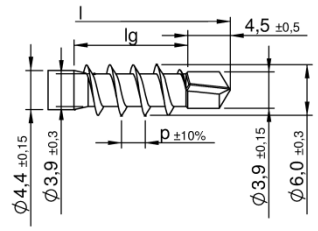
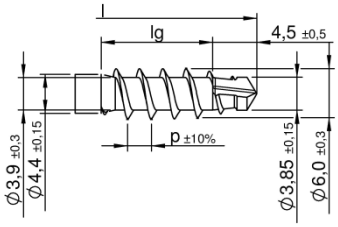
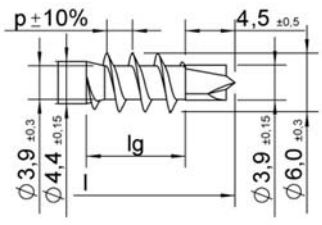
		
Countersunk head – design: with and without raise, with and without milling pockets	Countersunk head with cutter ribs - design with and without raise	Alternatively at countersunk heads: modification of the shank at drilled head
		
Pan head	Large washer head	Large washer head II - design: with and without cutter ribs
		
Kombi hexagonal head	Cylinder head	Elmo-head
		
Truss Head - design: with and without cutter ribs	Decking screw head	Washer head III
		
Small Pan head		

Underhead thread for D=6.0

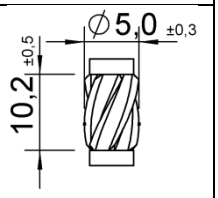


Design with p=2.6

Thread types for D=6.0

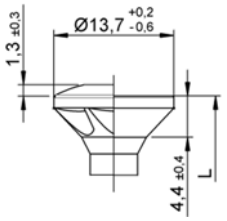
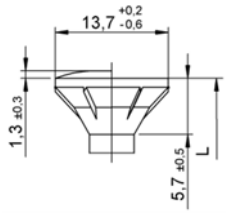
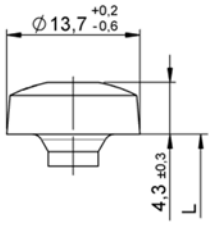
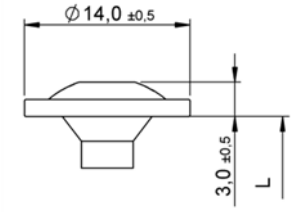
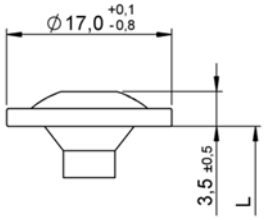
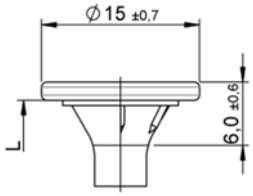
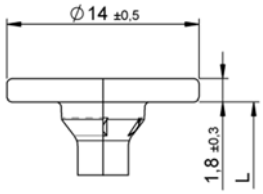
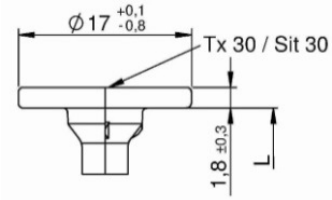
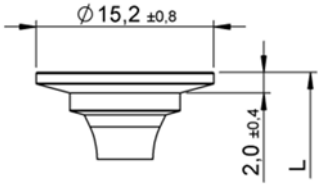
		
TIMTEC double - thread	TIMTEC single - thread	TIMTEC coarse - thread
Design with and without ring respectively mating thread	Design with and without ring respectively mating thread	Design with and without mating thread respectively ring
		
TIMTEC plus	TIMTEC plus special	TIMTEC plus 3.0
Design with p=2.6 and 3.6	Design with p=2.6 and 3.6	Design with p=2.6 and 3.6

Lengths for D=6.0

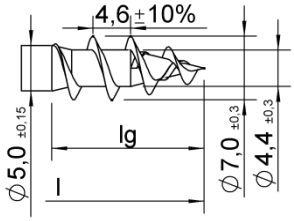
l +1.0 -3.5	lg +1.0 -2.5	Shank cutter at TIMTEC partial thread	Shank cutter at TIMTEC plus /TIMTEC plus special / TIMTEC plus 3.0 partial thread	Shank cutter	Screws without thread in the middle of screw or without thread below head or in combination of both are possible (see page 1 of this Annex). The thread lengths can be manufactured to customer specific within lg min and lg max. All dimensions in mm.
25	24	up to L= 120: optional	over all lengths optional		
47…	…	over L=120: yes			
300	180				

SWG TIMTEC screws	Annex A
2. TIMTEC and TIMTEC plus, Material carbon steel	

Head types for D=7.0

		
Countersunk head – design: with and without raise, with and without milling pockets	Countersunk head with cutter ribs - design with and without raise	Pan head
		
Large washer head	Large washer head	Large washer head – design: with and without cutter ribs
		
Large washer head II - design: with and without cutter ribs	Large washer head II - design: with and without cutter ribs	Washer head III

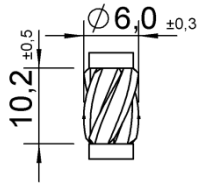
Thread types for D=7.0


TIMTEC coarse - thread
Design with and without mating thread respectively ring

Lengths for D=7.0

l +1.0 - 3.5	lg +1.0 - 2.5	Shank cutter at TIMTEC partial thread
30	28	up to L= 120: optional
…	…	over L=120: yes
600	210	

Shank cutter

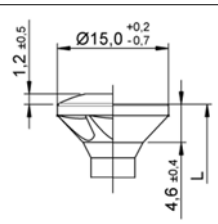
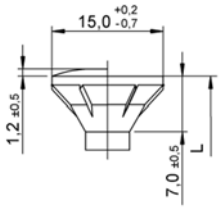
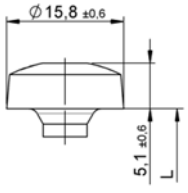
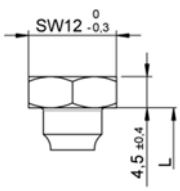
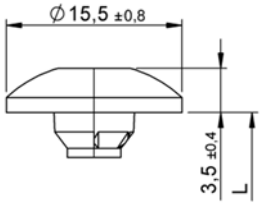
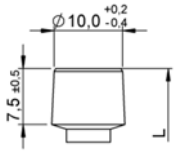
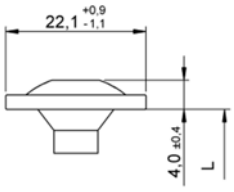
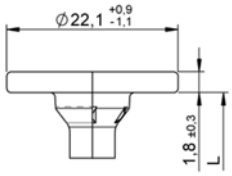
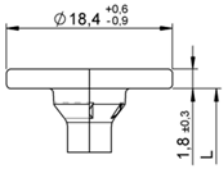
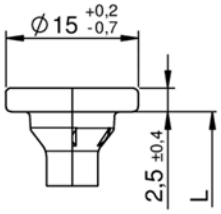
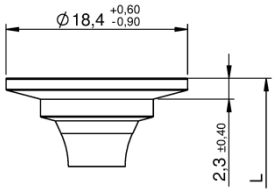


Screws without thread in the middle of screw or without thread below head or in combination of both are possible (see page 1 of this Annex). The thread lengths can be manufactured to customer specific within lg min and lg max.

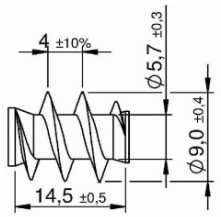
All dimensions in mm.

SWG TIMTEC screws	Annex A
2. TIMTEC and TIMTEC plus, Material carbon steel	

Head types for D=8.0

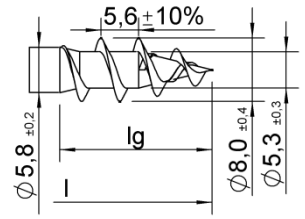
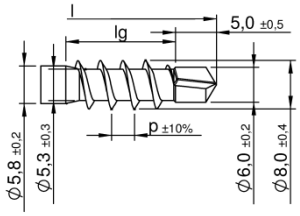
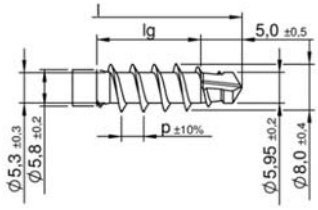
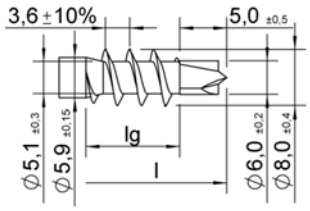
		
Countersunk head – design: with and without raise, with and without milling pockets	Countersunk head with cutter ribs - design with and without raise	Pan head
		
Kombi hexagonal head	Truss head - design: with and without cutter ribs	Cylinder head
		
Large washer head	Large washer head II - design: with and without cutter ribs	Large washer head III - design: with and without cutter ribs
		
Small washer head - design: with and without cutter ribs	Washer head III	

Underhead thread for D=8.0

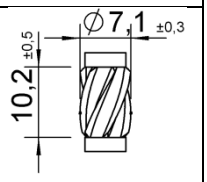

Design with p=4.0

SWG TIMTEC screws	Annex A
2. TIMTEC and TIMTEC plus, Material carbon steel	

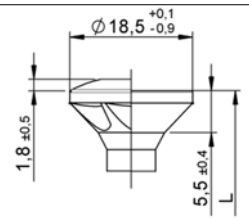
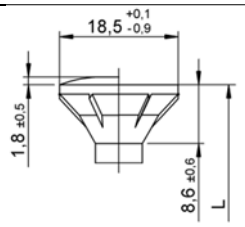
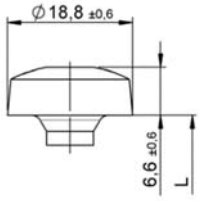
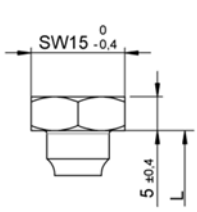
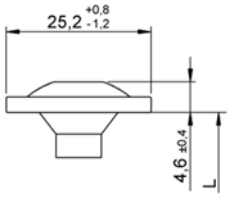
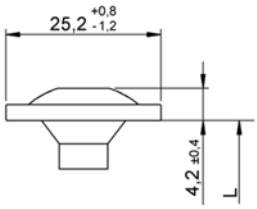
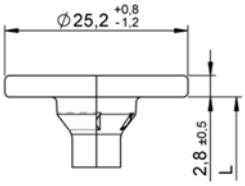
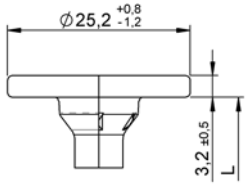
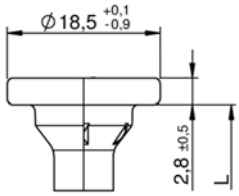
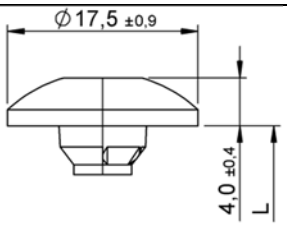
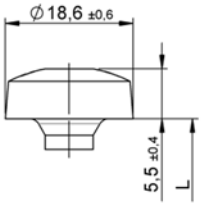
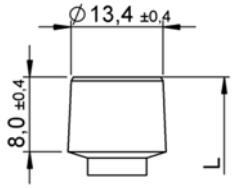
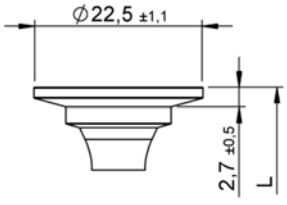
Thread types for D=8.0

		
TIMTEC coarse - thread		
Design with and without mating thread respectively ring		
		
TIMTEC plus	TIMTEC plus special	TIMTEC plus 3.0
Design with p=5.6	Design with p=5.6	Design with p=5.6

Lengths for D=8.0

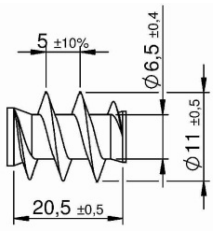
l +1.0 - 5.0	lg +1.0 - 2.5	Shank cutter at TIMTEC partial thread	Shank cutter at TIMTEC plus /TIMTEC plus special / TIMTEC plus 3.0 partial thread	Shank cutter 	Screws without thread in the middle of screw or without thread below head or in combination of both are possible (see page 1 of this Annex). The thread lengths can be manufactured to customer specific within lg min and lg max. All dimensions in mm.
35	32	up to L= 200: optional	over all lengths optional		
…	…	over L=200: yes			
800	240				

Head types for D=10.0mm

		
Countersunk head – design: with and without raise, with and without milling pockets	Countersunk head with cutter ribs - design with and without raise	Pan head
		
Kombi hexagonal head	Large washer head	Large washer head
		
Large washer head II - design: with and without cutter ribs	Large washer head II - design: with and without cutter ribs	Small washer head - design: with and without cutter ribs
		
Truss head - design: with and without cutter ribs	Pan head	Cylinder head
		
Washer head III		

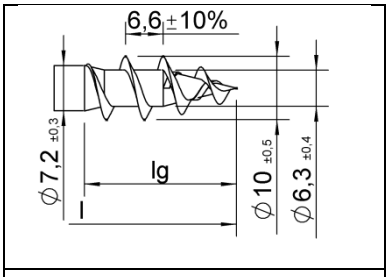
SWG TIMTEC screws	Annex A
2. TIMTEC and TIMTEC plus, Material carbon steel	

Underhead thread for D=10.0



Design with p=5.0

Thread types for D=10.0



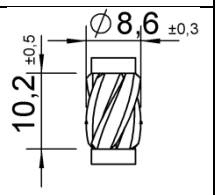
TIMTEC coarse - thread

Design with and without mating thread respectively ring

Lengths for D=10.0

l +1.0 - 5.0	lg +1.0 - 3.0	Shank cutter at TIMTEC partial thread
45	40	up to L= 200: optional
…	…	over L=200: yes
1000	300	

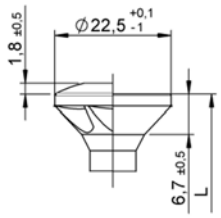
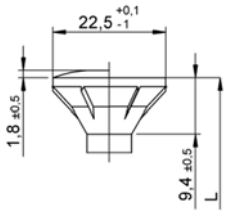
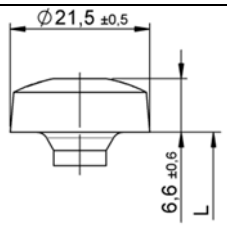
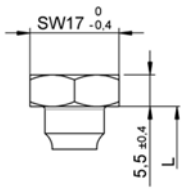
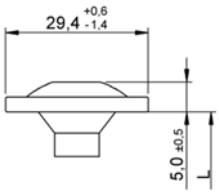
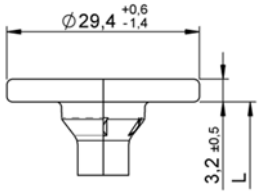
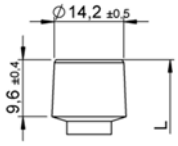
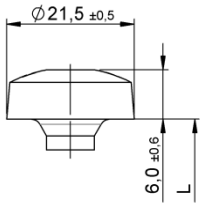
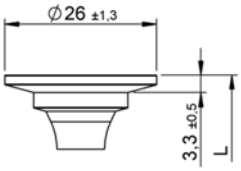
Shank cutter



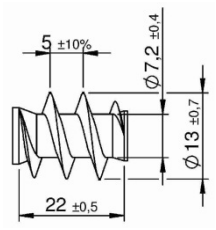
Screws without thread in the middle of screw or without thread below head or in combination of both are possible (see page 1 of this Annex). The thread lengths can be manufactured to customer specific within lg min and lg max.

All dimensions in mm.

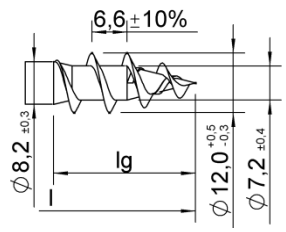
Head types for D=12.0mm

		
Countersunk head – design: with and without raise, with and without milling pockets	Countersunk head with cutter ribs - design with and without raise	Pan head
		
Kombi hexagonal head	Large washer head	Large washer head II - design: with and without cutter ribs
		
Cylinder head	Pan head	Washer head III

Underhead thread for D=12.0


Design with p=5.0

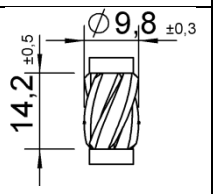
Thread types for D=12.0



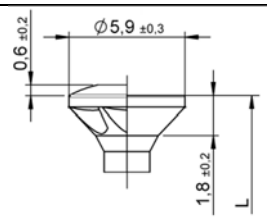
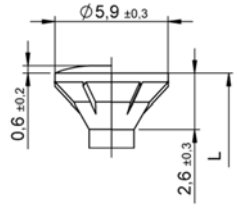
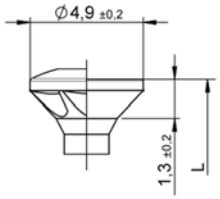
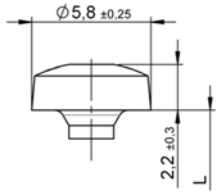
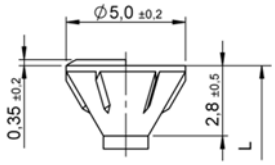
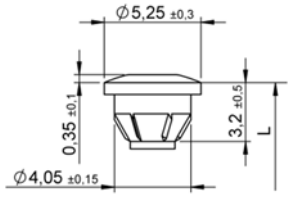
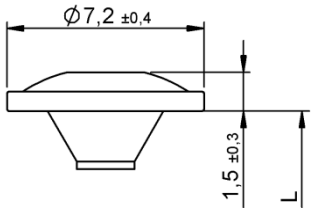
TIMTEC coarse - thread

Design with and without mating thread respectively ring

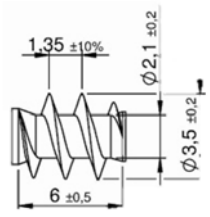
Lengths for D=12.0

l +1.0 - 5.0	lg +1.0 - 3.0	Shank cutter at TIMTEC partial thread	Shank cutter	Screws without thread in the middle of screw or without thread below head or in combination of both are possible (see page 1 of this Annex). The thread lengths can be manufactured to customer specific within lg min and lg max. All dimensions in mm.
60	50	up to L= 200: optional		
…	…	over L=200: yes		
600	360			

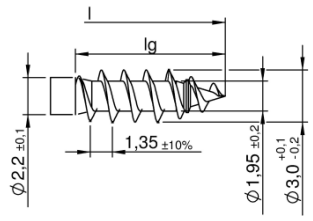
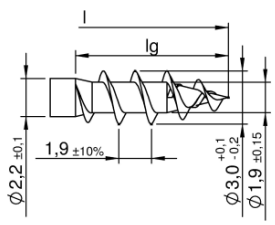
Head types for D=3.0

		
Countersunk head – design: with and without raise, with and without milling pockets	Countersunk head with cutter ribs - design with and without raise	Piano hinge head – design: with and without raise, with and without milling pockets
		
Pan head	Woodwork head – design with and without raise	Top head
		
Back panel screw head		

Underhead thread for D=3.0


Design with p=1.35

Thread types for D=3.0

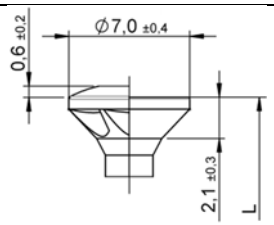
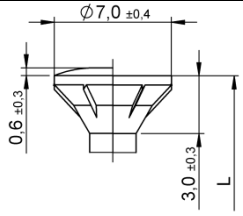
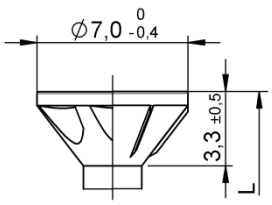
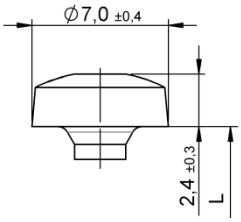
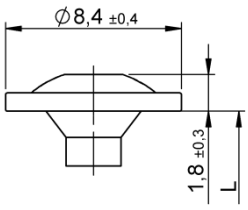
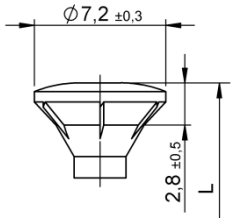
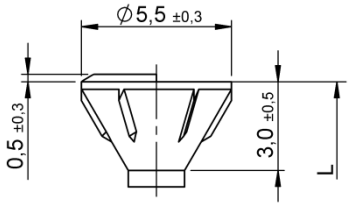
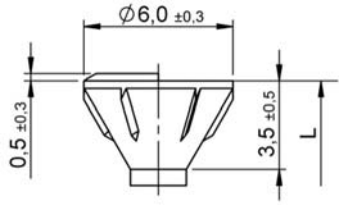
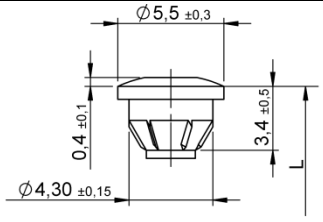
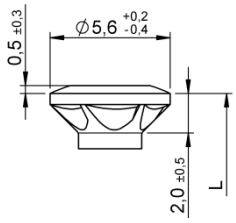
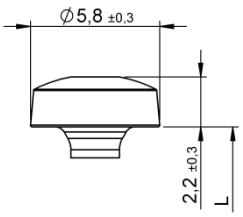
	
TIMTEC single - thread	TIMTEC coarse - thread
Design with and without ring respectively mating thread	Design with and without mating thread respectively ring

Lengths for D=3.0

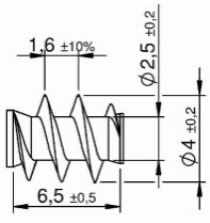
l +1.0 - 2.0	lg +1.0 - 2.0	Screws without thread in the middle of screw or without thread below head or in combination of both are possible (see page 1 of this Annex). The thread lengths can be manufactured to customer specific within lg min and lg max. All dimensions in mm.
13	12	
…	…	
50	49	

SWG TIMTEC screws	Annex A
3. TIMTEC, Material stainless steel	

Head types for D=3.5

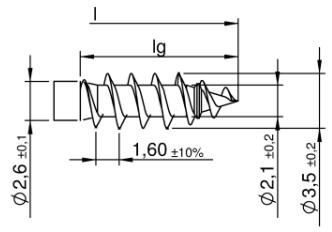
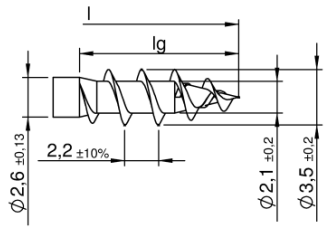
		
Countersunk head – design: with and without raise, with and without milling pockets	Countersunk head with cutter ribs - design with and without raise	75° head – design: with and without raise, with and without milling pockets, with and without cutter ribs
		
Pan head	Back panel screw head	FBS head
		
Woodwork head – design with and without raise	Woodwork head – design with and without raise	Top head
		
Decking screw head	Small Pan head	

Underhead thread for D=3.5


Design with p=1.6

SWG TIMTEC screws	Annex A
3. TIMTEC, Material stainless steel	

Thread types for D=3.5

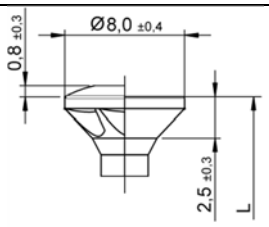
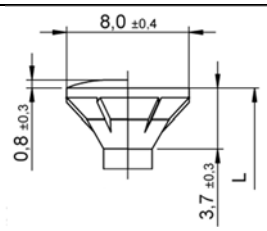
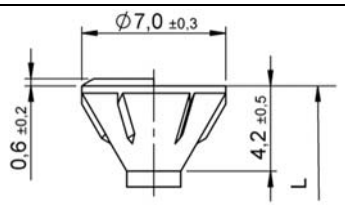
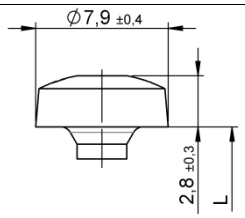
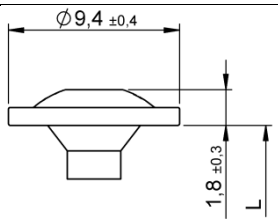
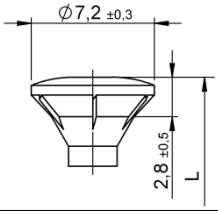
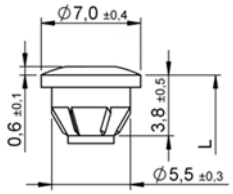
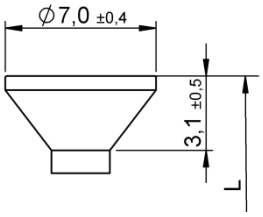
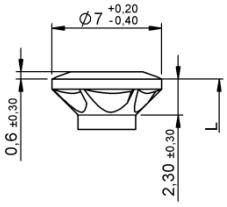
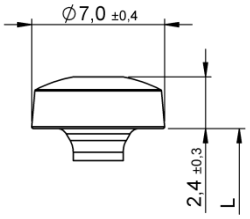
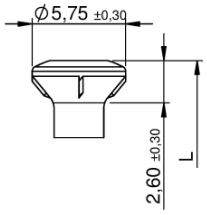
	
TIMTEC single - thread	TIMTEC coarse - thread
Design with and without ring respectively mating thread	Design with and without mating thread respectively ring

Lengths for D=3.5

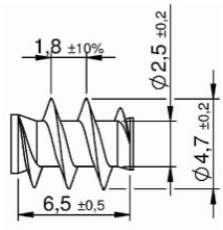
l +1.0 - 2.0	lg +1.0 - 2.0	Screws without thread in the middle of screw or without thread below head or in combination of both are possible (see page 1 of this Annex). The thread lengths can be manufactured to customer specific within lg min and lg max. All dimensions in mm.
16	14	
…	…	
50	48	

SWG TIMTEC screws	Annex A
3. TIMTEC, Material stainless steel	

Head types for D=4.0

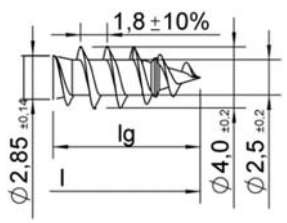
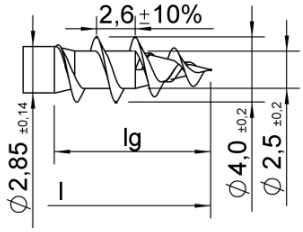
		
Countersunk head – design: with and without raise, with and without milling pockets	Countersunk head with cutter ribs - design with and without raise	Woodwork head - Design with and without raise
		
Pan head	Back panel screw head	FBS head
		
Top head	75° FBS head	Decking screw head
		
Small Pan head	80° head – design: with and without raise, with and without milling pockets, with and without cutter ribs	

Underhead thread for D=4.0


Design with p=1.8

SWG TIMTEC screws	Annex A
3. TIMTEC, Material stainless steel	

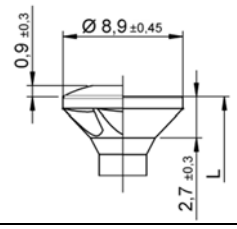
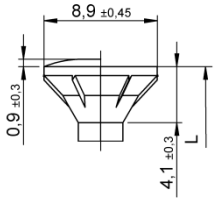
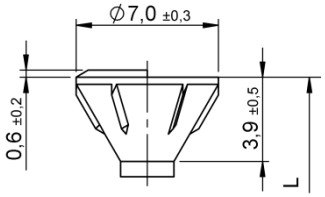
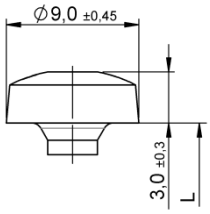
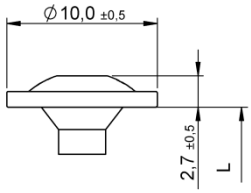
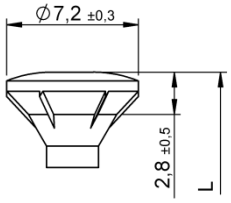
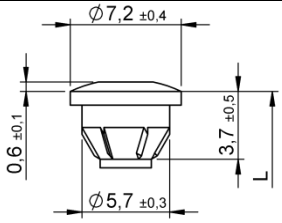
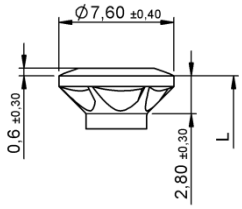
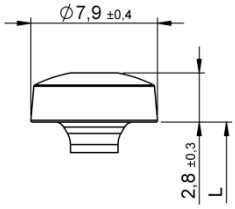
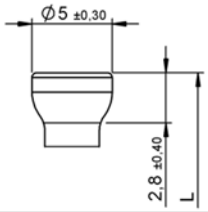
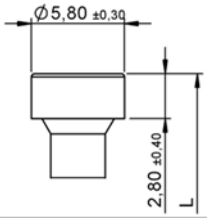
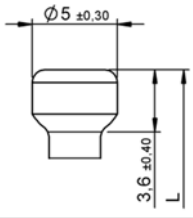
Thread types for D=4.0

	
TIMTEC single - thread	TIMTEC coarse - thread
Design with and without ring respectively mating thread	Design with and without mating thread respectively ring

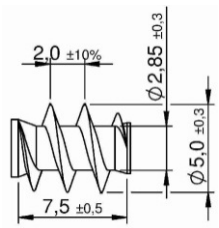
Lengths for D=4.0

l +1.0 - 2.0	lg +1.0 - 2.0	Screws without thread in the middle of screw or without thread below head or in combination of both are possible (see page 1 of this Annex). The thread lengths can be manufactured to customer specific within lg min and lg max. All dimensions in mm.
18	16	
…	…	
70	55	

Head types for D=4.5

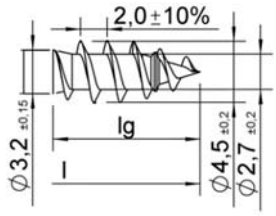
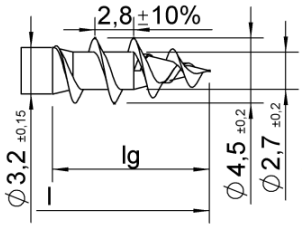
		
Countersunk head – design: with and without raise, with and without milling pockets	Countersunk head with cutter ribs - design with and without raise	Woodwork head - Design with and without raise
		
Pan head	Back panel screw head	FBS head
		
Top head	Decking screw head	Small Pan head
		
Tulip shaped head	Cylinder head	Small cylinder head

Underhead thread for D=4.5


Design with p=2.0

SWG TIMTEC screws	Annex A
3. TIMTEC, Material stainless steel	

Thread types for D=4.5

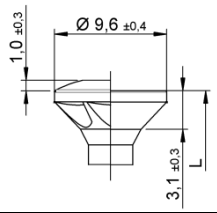
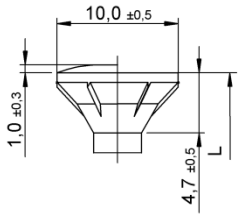
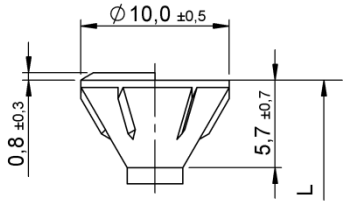
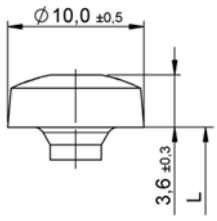
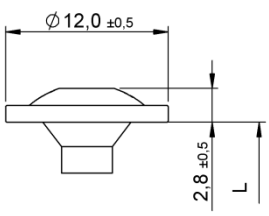
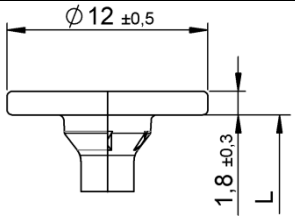
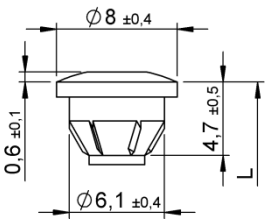
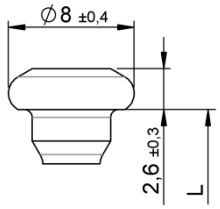
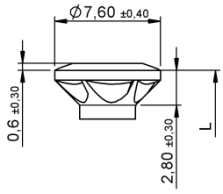
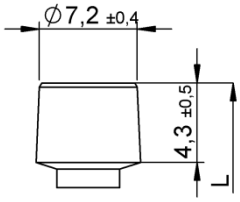
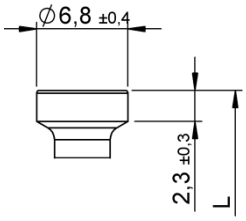
	
TIMTEC single - thread	TIMTEC coarse - thread
Design with and without ring respectively mating thread	Design with and without mating thread respectively ring

Lengths for D=4.5

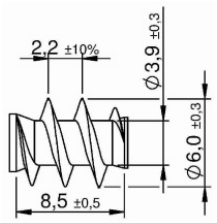
l +1.0 - 2.0	lg +1.0 - 2.0	Screws without thread in the middle of screw or without thread below head or in combination of both are possible (see page 1 of this Annex). The thread lengths can be manufactured to customer specific within lg min and lg max. All dimensions in mm.
20	18	
…	…	
80	60	

SWG TIMTEC screws	Annex A
3. TIMTEC, Material stainless steel	

Head types for D=5.0

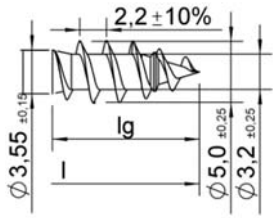
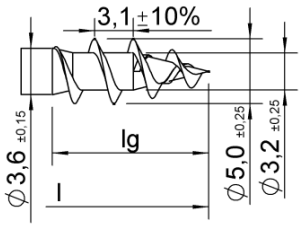
		
Countersunk head – design: with and without raise, with and without milling pockets	Countersunk head with cutter ribs - design with and without raise	Woodwork head - Design with and without raise
		
Pan head	Large washer head	Large washer head II - design: with and without cutter ribs
		
Top head	Joist hanger screw head	Decking screw head
		
Cylinder head	Decking screw head II	

Underhead thread for D=5.0

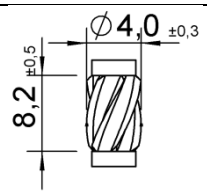

Design with p=2.2

SWG TIMTEC screws	Annex A
3. TIMTEC, Material stainless steel	

Thread types for D=5.0

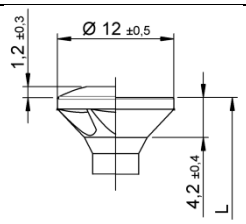
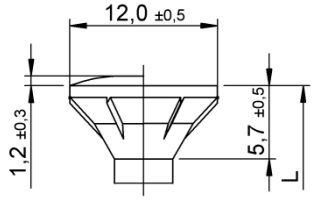
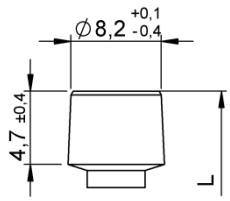
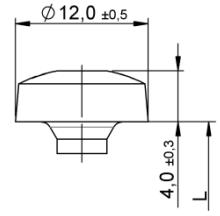
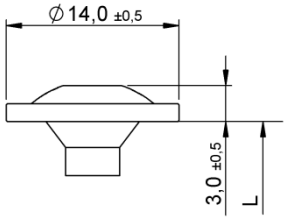
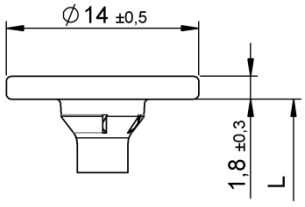
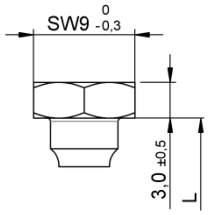
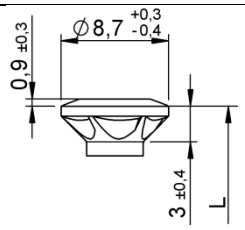
	
TIMTEC single - thread	TIMTEC coarse - thread
Design with and without ring respectively mating thread	Design with and without mating thread respectively ring

Lengths for D=5.0

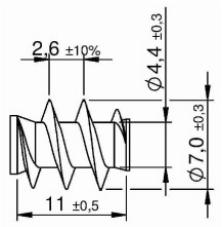
l +1.0 - 2.5	lg +1.0 - 2.0	Shank cutter at TIMTEC partial thread	Shank cutter	Screws without thread in the middle of screw or without thread below head or in combination of both are possible (see page 1 of this Annex). The thread lengths can be manufactured to customer specific within lg min and lg max. All dimensions in mm.
22	20	over all lengths optional		
…	…			
120	70			

SWG TIMTEC screws	Annex A
3. TIMTEC, Material stainless steel	

Head types for D=6.0

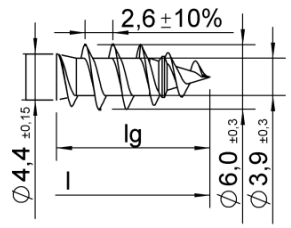
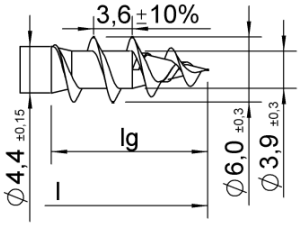
		
Countersunk head – design: with and without raise, with and without milling pockets	Countersunk head with cutter ribs - design with and without raise	Cylinder head
		
Pan head	Large washer head	Large washer head II - design: with and without cutter ribs
		
Kombi hexagonal head	Decking screw head	

Underhead thread for D=6.0

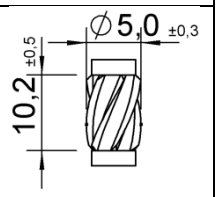

Design with p=2.6

SWG TIMTEC screws	Annex A
3. TIMTEC, Material stainless steel	

Thread types for D=6.0

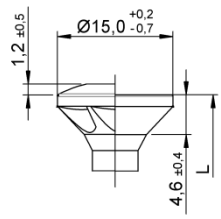
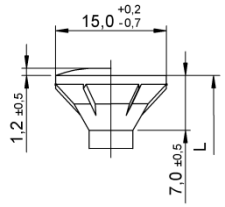
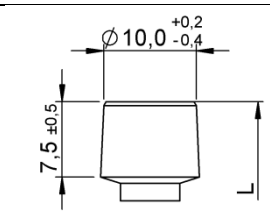
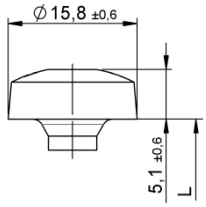
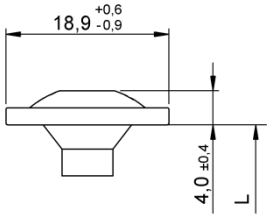
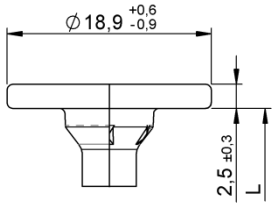
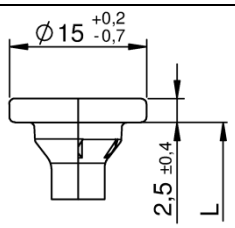
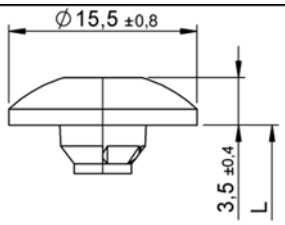
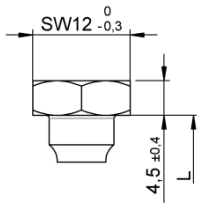
	
TIMTEC single - thread	TIMTEC coarse - thread
Design with and without ring respectively mating thread	Design with and without mating thread respectively ring

Lengths for D=6.0

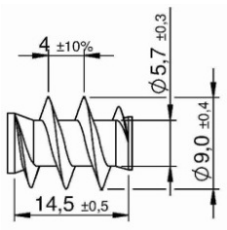
l +1.0 - 3.5	lg +1.0 - 2.5	Shank cutter at TIMTEC partial thread	Shank cutter	Screws without thread in the middle of screw or without thread below head or in combination of both are possible (see page 1 of this Annex). The thread lengths can be manufactured to customer specific within lg min and lg max. All dimensions in mm.
25	24	over all lengths optional		
…	…			
200	120			

SWG TIMTEC screws	Annex A
3. TIMTEC, Material stainless steel	

Head types for D=8.0

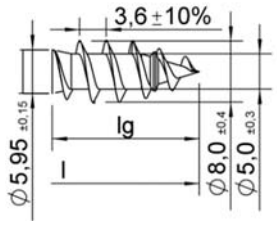
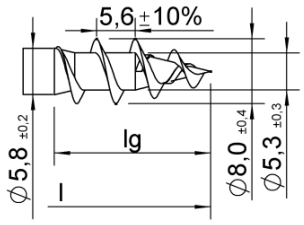
		
Countersunk head – design: with and without raise, with and without milling pockets	Countersunk head with cutter ribs - design with and without raise	Cylinder head
		
Pan head	Large washer head	Large washer head II - design: with and without cutter ribs
		
Small washer head - design: with and without cutter ribs	Truss Head - design: with and without cutter ribs	Kombi hexagonal head

Underhead thread for D=8.0

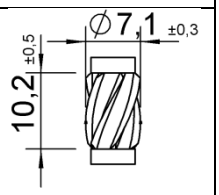

Design with p=4.0

SWG TIMTEC screws	Annex A
3. TIMTEC, Material stainless steel	

Thread types for D=8.0

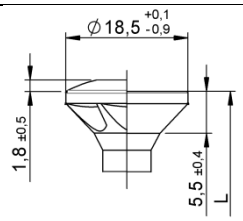
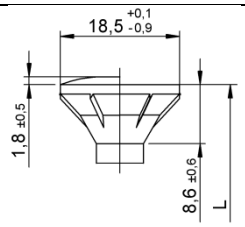
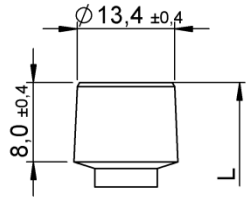
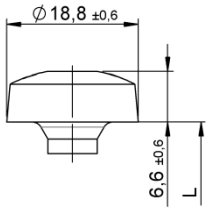
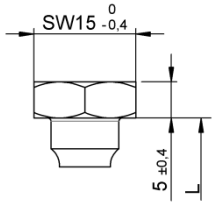
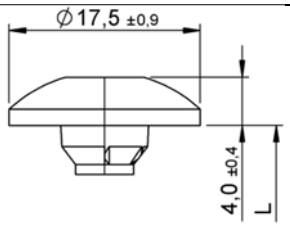
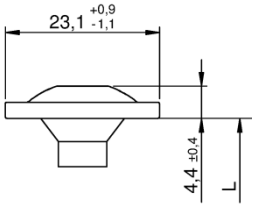
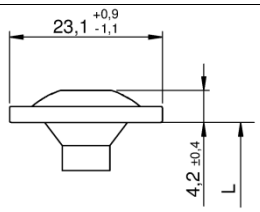
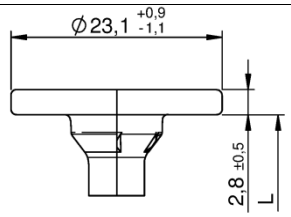
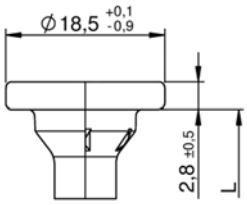
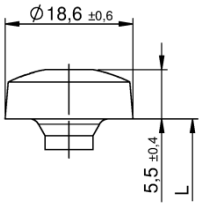
	
TIMTEC single - thread	TIMTEC coarse - thread
Design with and without ring respectively mating thread	Design with and without mating thread respectively ring

Lengths for D=8.0

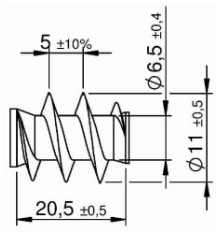
l +1.0 - 5.0	lg +1.0 - 2.5	Shank cutter at ASSY partial thread	Shank cutter	Screws without thread in the middle of screw or without thread below head or in combination of both are possible (see page 1 of this Annex). The thread lengths can be manufactured to customer specific within lg min and lg max. All dimensions in mm.
35	32	up to L= 150: optional		
…	…	over L=150: yes		
400	160			

SWG TIMTEC screws	Annex A
3. TIMTEC, Material stainless steel	

Head types for D=10.0mm

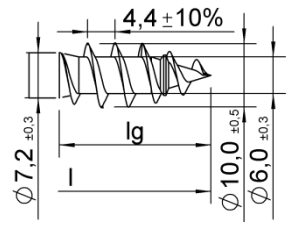
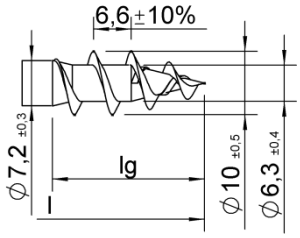
		
Countersunk head – design: with and without raise, with and without milling pockets	Countersunk head with cutter ribs - design with and without raise	Cylinder head
		
Pan head	Kombi hexagonal head	Truss Head - design: with and without cutter ribs
		
Large washer head	Large washer head	Large washer head II - design: with and without cutter ribs
		
Small washer head - design: with and without cutter ribs	Pan head	

Underhead thread for D=10.0

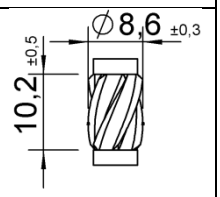

Design with p=5.0

SWG TIMTEC screws	Annex A
3. TIMTEC, Material stainless steel	

Thread types for D=10.0

	
TIMTEC single - thread	TIMTEC coarse - thread
Design with and without ring respectively mating thread	Design with and without mating thread respectively ring

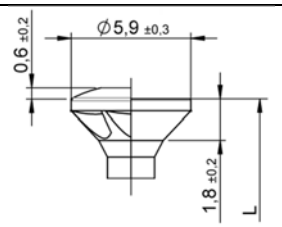
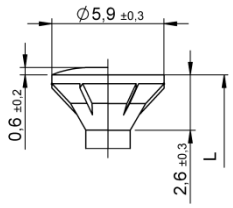
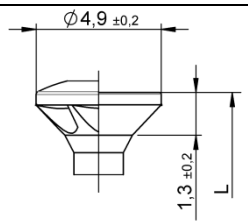
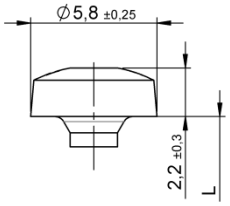
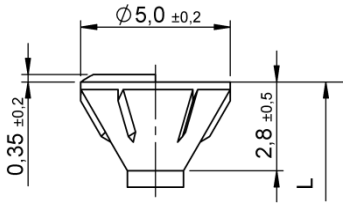
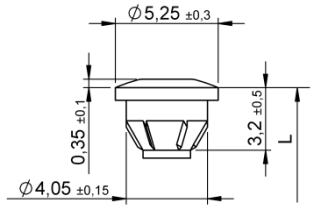
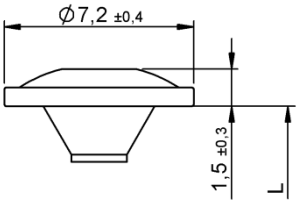
Lengths for D=10.0

l +1.0 - 5.0	lg +1.0 - 2.5	Shank cutter at TIMTEC partial thread	Shank cutter	Screws without thread in the middle of screw or without thread below head or in combination of both are possible (see page 1 of this Annex). The thread lengths can be manufactured to customer specific within lg min and lg max. All dimensions in mm.
45	40	up to L= 150: optional		
…	…	over L=150: yes		
400	200			

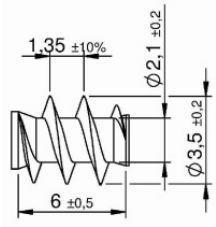
Truss Head - design: with and without cutter ribs

SWG TIMTEC screws	Annex A
3. TIMTEC, Material stainless steel	

Head types for D=3.0

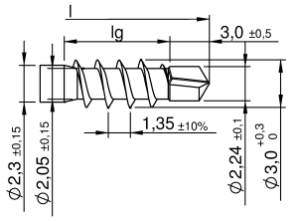
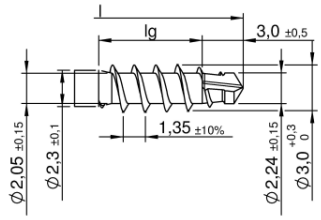
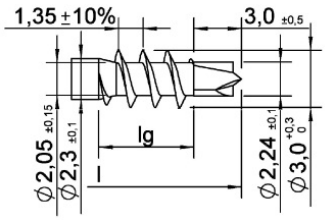
		
Countersunk head – design: with and without raise, with and without milling pockets	Countersunk head with cutter ribs - design with and without raise	Piano hinge head – design: with and without raise, with and without milling pockets
		
Pan head	Woodwork head – design with and without raise	Top head
		
Back panel screw head		

Underhead thread for D=3.0


Design with p=1.35

SWG TIMTEC screws	Annex A
4. TIMTEC plus, Material stainless steel	

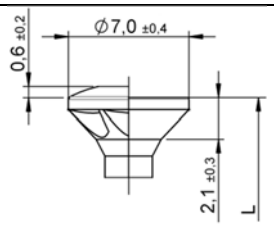
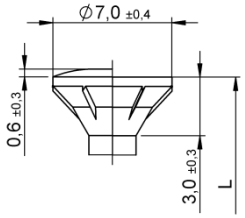
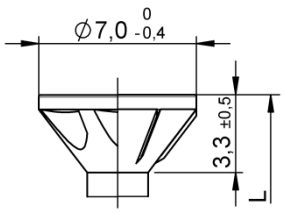
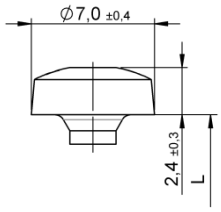
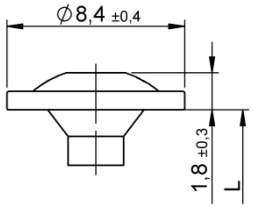
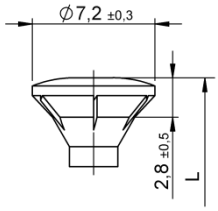
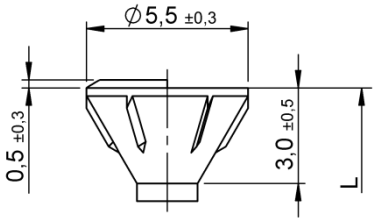
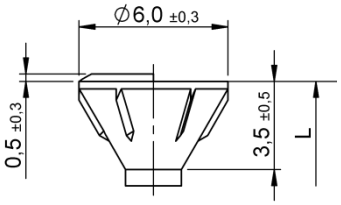
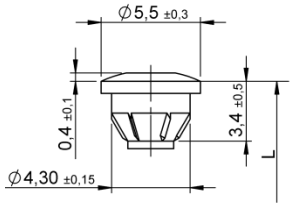
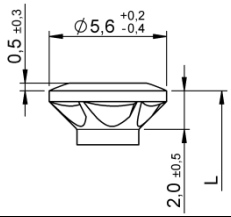
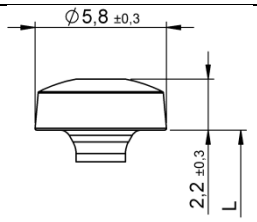
Thread types for D=3.0

		
TIMTEC plus	TIMTEC plus special	TIMTEC plus 3.0
Optional with thread pitch 1.9	Optional with thread pitch 1.9	Optional with thread pitch 1.9

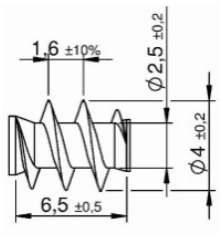
Lengths for D=3.0

l +1.0 - 2.0	lg +1.0 - 2.0	Screws without thread in the middle of screw or without thread below head or in combination of both are possible (see page 1 of this Annex). The thread lengths can be manufactured to customer specific within lg min and lg max. All dimensions in mm.
16	12	
…	…	
50	46	

Head types for D=3.5

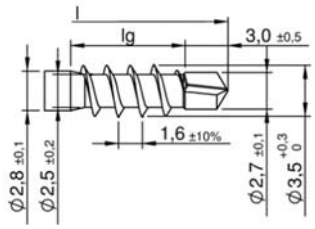
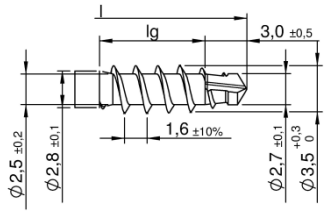
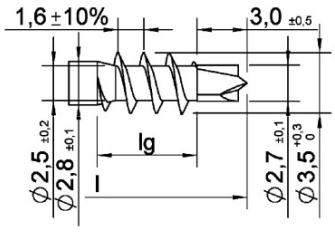
		
Countersunk head – design: with and without raise, with and without milling pockets	Countersunk head with cutter ribs - design with and without raise	75° head – design: with and without raise, with and without milling pockets, with and without cutter ribs
		
Pan head	Back panel screw head	FBS head
		
Woodwork head – design with and without raise	Woodwork head – design with and without raise	Top head
		
Decking screw head	Small Pan head	

Underhead thread for D=3.5


Design with p=1.6

SWG TIMTEC screws	Annex A
4. TIMTEC plus, Material stainless steel	

Thread types for D=3.5

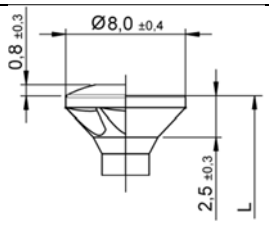
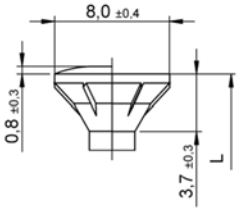
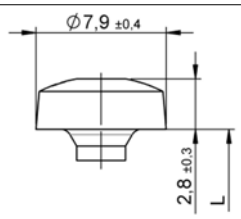
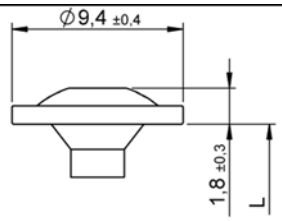
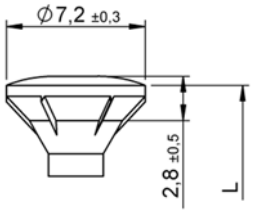
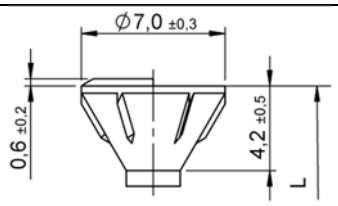
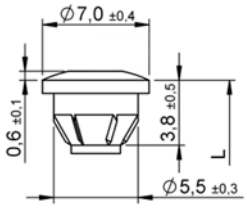
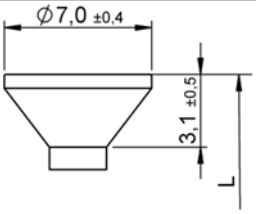
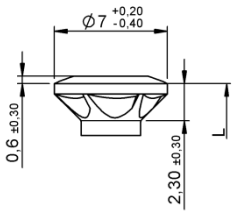
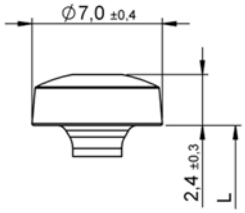
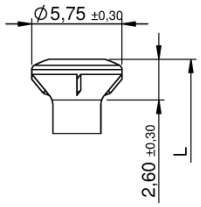
		
TIMTEC plus	TIMTEC plus special	TIMTEC plus 3.0
Optional with thread pitch 2.2	Optional with thread pitch 2.2	Optional with thread pitch 2.2

Lengths for D=3.5

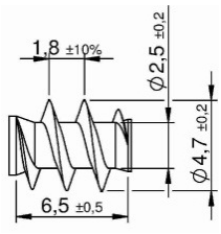
l +1.0 - 2.0	lg +1.0 - 2.0	Screws without thread in the middle of screw or without thread below head or in combination of both are possible (see page 1 of this Annex). The thread lengths can be manufactured to customer specific within lg min and lg max. All dimensions in mm.
19	14	
…	…	
50	45	

SWG TIMTEC screws	Annex A
4. TIMTEC plus, Material stainless steel	

Head types for D=4.0

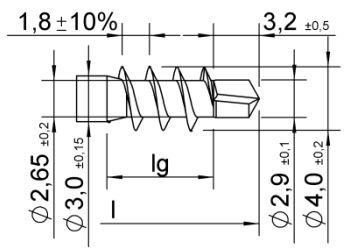
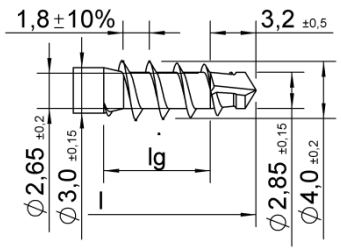
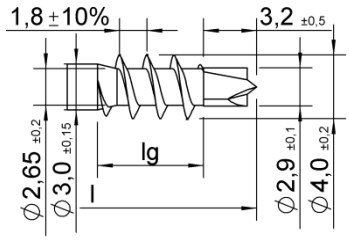
		
Countersunk head – design: with and without raise, with and without milling pockets	Countersunk head with cutter ribs - design with and without raise	Pan head
		
Back panel screw head	FBS head	Woodwork head – Design with and without raise
		
Top head	75° FBS head	Decking screw head
		
Small Pan head	80° head – design: with and without raise, with and without milling pockets, with and without cutter ribs	

Underhead thread for D=4.0


Design with p=1.8

SWG TIMTEC screws	Annex A
4. TIMTEC plus, Material stainless steel	

Thread types for D=4.0

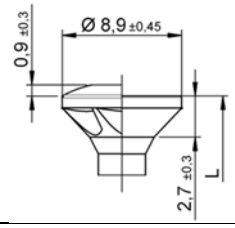
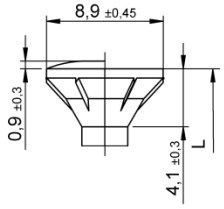
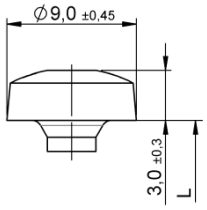
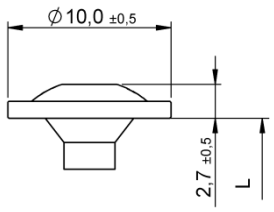
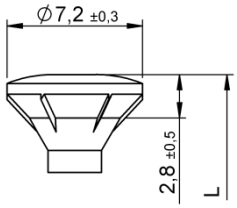
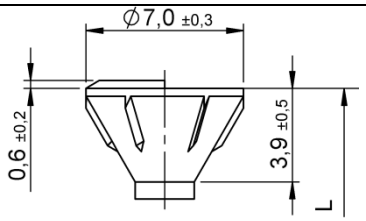
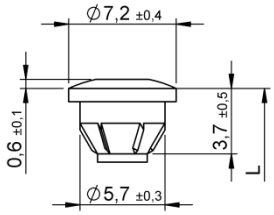
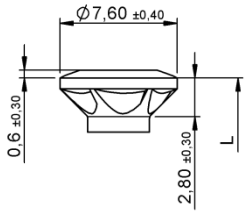
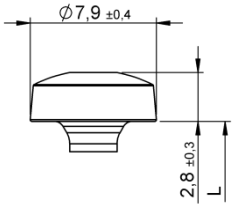
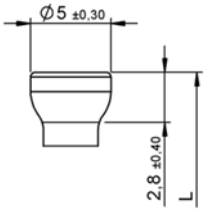
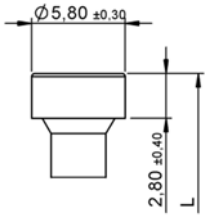
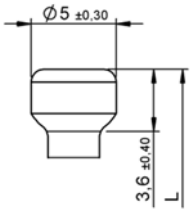
		
TIMTEC plus	TIMTEC plus special	TIMTEC plus 3.0
Optional with thread pitch 2.6	Optional with thread pitch 2.6	Optional with thread pitch 2.6

Lengths for D=4.0

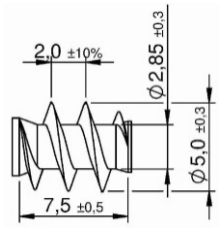
l +1.0 - 2.0	lg +1.0 - 2.0	Screws without thread in the middle of screw or without thread below head or in combination of both are possible (see page 1 of this Annex). The thread lengths can be manufactured to customer specific within lg min and lg max. All dimensions in mm.
23	16	
…	…	
70	64	

SWG TIMTEC screws	Annex A
4. TIMTEC plus, Material stainless steel	

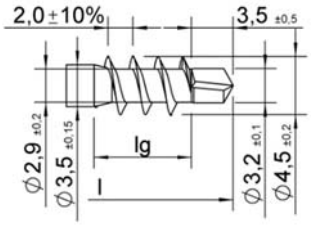
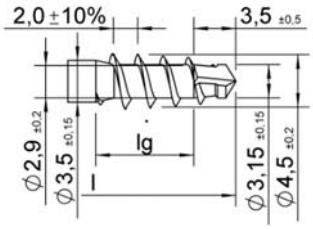
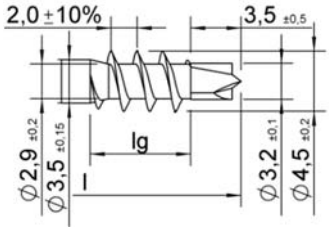
Head types for D=4.5

		
Countersunk head – design: with and without raise, with and without milling pockets	Countersunk head with cutter ribs - design with and without raise	Pan head
		
Back panel screw head	FBS head	Woodwork head – design with and without raise
		
Top head	Decking screw head	Small Pan head
		
Tulip shaped head	Cylinder head	Small cylinder head

Underhead thread for D=4.5


Design with p=2.0

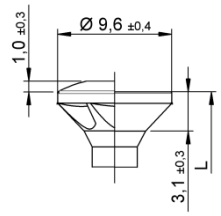
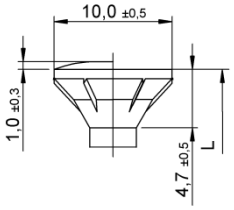
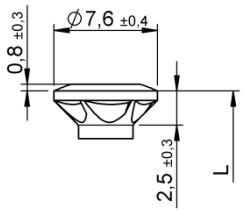
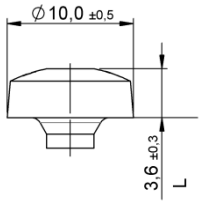
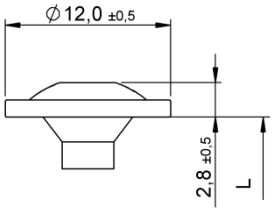
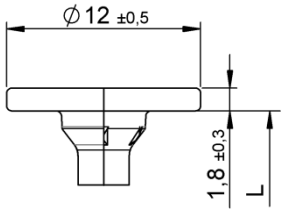
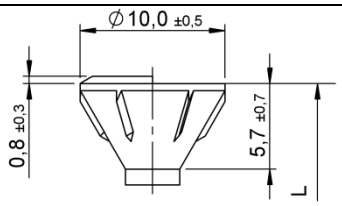
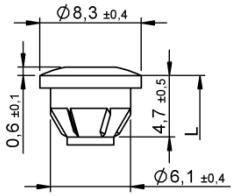
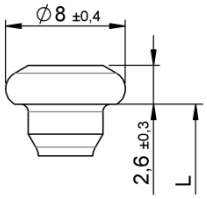
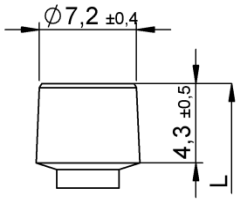
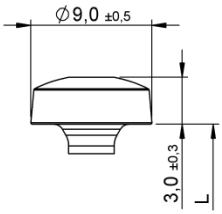
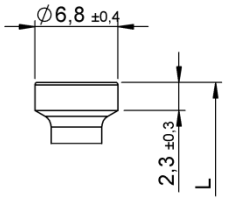
Thread types for D=4.5

		
TIMTEC plus	TIMTEC plus special	TIMTEC plus 3.0
Optional with thread pitch 2.8	Optional with thread pitch 2.8	Optional with thread pitch 2.8

Lengths for D=4.5

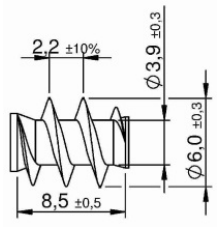
l +1.0 - 2.0	lg +1.0 - 2.0	Screws without thread in the middle of screw or without thread below head or in combination of both are possible (see page 1 of this Annex). The thread lengths can be manufactured to customer specific within lg min and lg max. All dimensions in mm.
23	18	
…	…	
80	78	

Head types for D=5.5

		
Countersunk head – design: with and without raise, with and without milling pockets	Countersunk head with cutter ribs - design with and without raise	decking screw head
		
Pan head	Large washer head	Large washer head II - design: with and without cutter ribs
		
Woodwork head – design with and without raise	Top head	Joist hanger screw head
		
Cylinder head	Small Pan head	decking screw head II

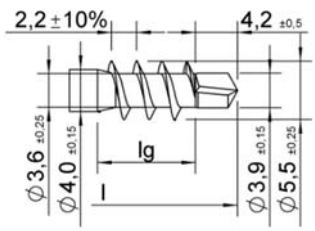
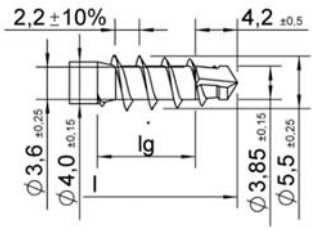
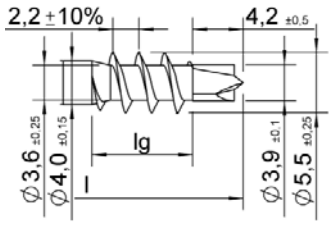
SWG TIMTEC screws	Annex A
4. TIMTEC plus, Material stainless steel	

Underhead thread for D=5.5

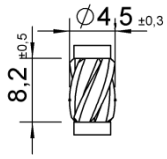
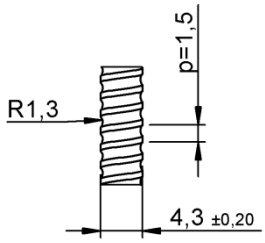
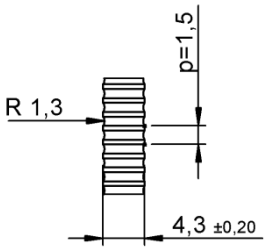


Design with p=2.2

Thread types for D=5.5

		
TIMTEC plus	TIMTEC plus special	TIMTEC plus 3.0
Optional with thread pitch 3.1	Optional with thread pitch 3.1	Optional with thread pitch 3.1

Lengths for D=5.5

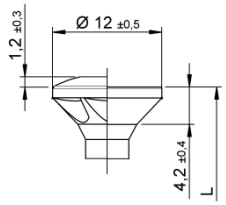
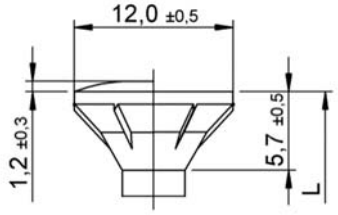
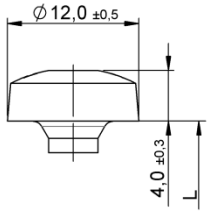
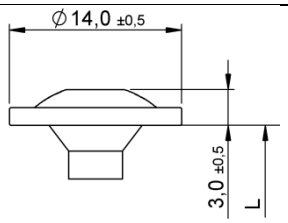
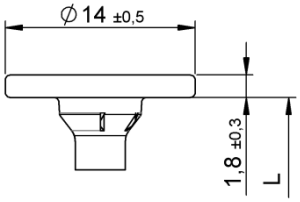
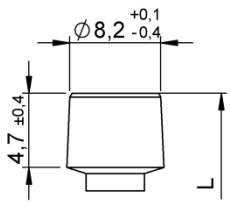
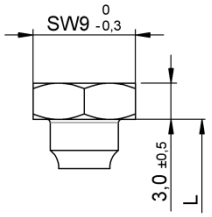
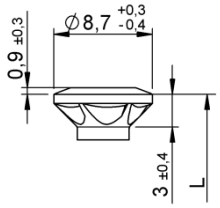
l +1.0 - 2.5	lg +1.0 - 2.0	Shank cutter at TIMTEC plus /TIMTEC plus special / TIMTEC plus 3.0 partial thread	Shank cutter	Optional: Thread of curves all over the shank at partial thread	Optional: Thread of curves all over the shank at partial thread
25	20	over all lengths optional			
…	…				
120	90				

Screws without thread in the middle of screw or without thread below head or in combination of both are possible (see page 1 of this Annex). The thread lengths can be manufactured to customer specific within lg min and lg max.

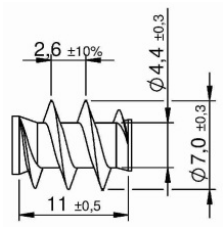
All dimensions in mm.

SWG TIMTEC screws	Annex A
4. TIMTEC plus, Material stainless steel	

Head types for D=6.5

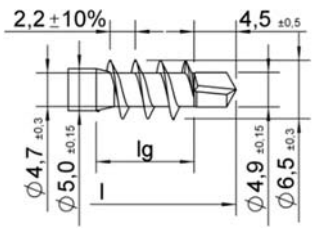
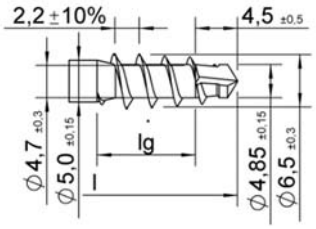
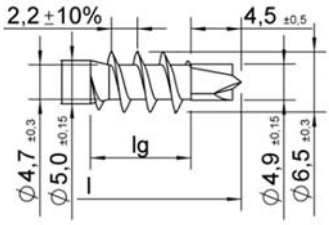
		
Countersunk head – design: with and without raise, with and without milling pockets	Countersunk head with cutter ribs - design with and without raise	Pan head
		
Large washer head	Large washer head II - design: with and without cutter ribs	Cylinder head
		
Kombi hexagonal head	Decking head screw	

Underhead thread for D=6.5

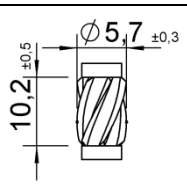

Design with p=2.6

SWG TIMTEC screws	Annex A
4. TIMTEC plus, Material stainless steel	

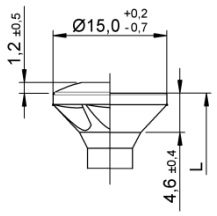
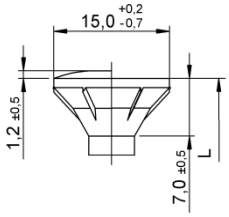
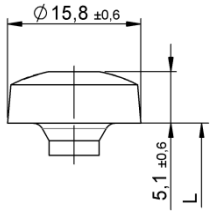
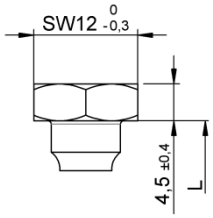
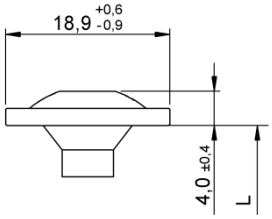
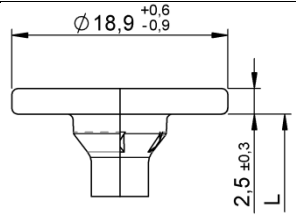
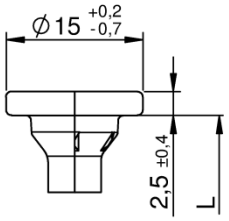
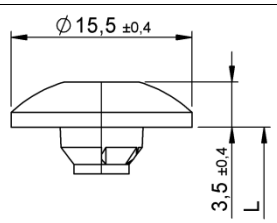
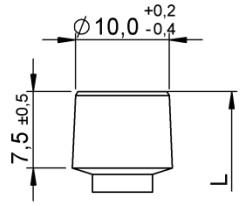
Thread types for D=6.5

		
TIMTEC plus	TIMTEC plus special	TIMTEC plus 3.0
Optional with thread pitch 3.1	Optional with thread pitch 3.1	Optional with thread pitch 3.1

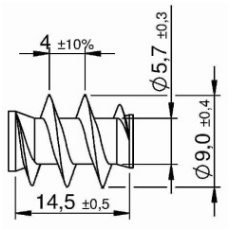
Lengths for D=6.5

l +1.0 - 3.5	lg +1.0 - 2.5	Shank cutter at TIMTEC plus /TIMTEC plus special /TIMTEC plus 3.0 partial thread	Shank cutter 	Screws without thread in the middle of screw or without thread below head or in combination of both are possible (see page 1 of this Annex). The thread lengths can be manufactured to customer specific within lg min and lg max. All dimensions in mm.
30	24	over all lengths optional		
…	…			
300	140			

Head types for D=8.0

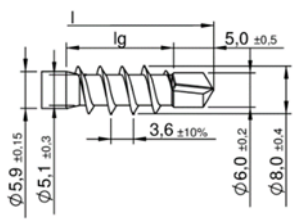
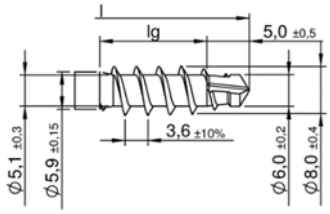
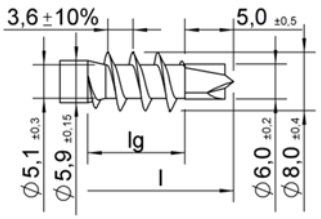
		
Countersunk head – design: with and without raise, with and without milling pockets	Countersunk head with cutter ribs - design with and without raise	Pan head
		
Kombi hexagonal head	Large washer head	Large washer head II - design: with and without cutter ribs
		
Small washer head - design: with and without cutter ribs	Truss head	Cylinder head

Underhead thread for D=8.0

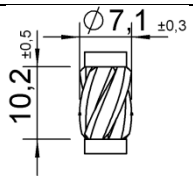

Design with p=4.0

SWG TIMTEC screws	Annex A
4. TIMTEC plus, Material stainless steel	

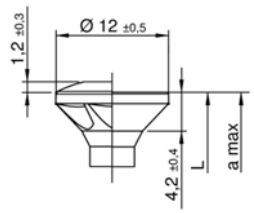
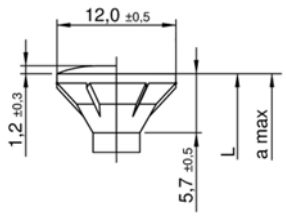
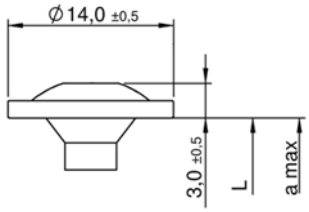
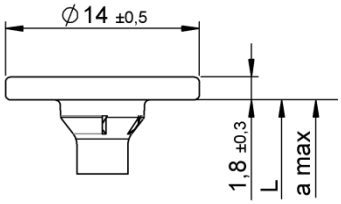
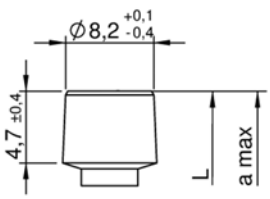
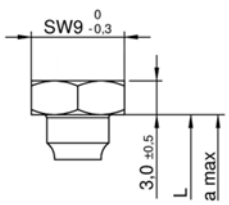
Thread types for D=8.0

		
TIMTEC plus	TIMTEC plus special	TIMTEC plus 3.0
Optional with thread pitch 5.6	Optional with thread pitch 5.6	Optional with thread pitch 5.6

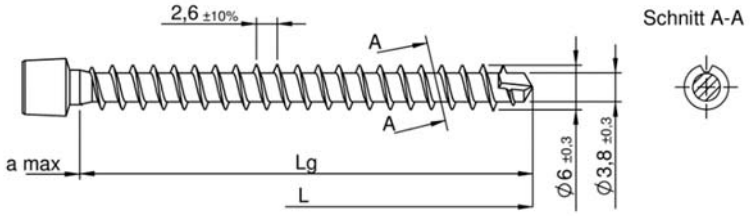
Lengths for D=8.0

l +1.0 - 5.0	lg +1.0 - 2.5	Shank cutter at TIMTEC plus /TIMTEC plus special / TIMTEC plus 3.0 partial thread	Shank cutter	Screws without thread in the middle of screw or without thread below head or in combination of both are possible (see page 1 of this Annex). The thread lengths can be manufactured to customer specific within lg min and lg max. All dimensions in mm.
40	32	over all lengths optional		
…	…			
440	240			

Head types for D=6.0

		
Countersunk head – design: with and without raise, with and without milling pockets	Countersunk head with cutter ribs - design with and without raise	Large washer head
		
Large washer head II - design: with and without cutter ribs	Cylinder head	Kombi hexagonal head

Thread types for D=6.0


Design with and without cutting edges (see Schnitt A-A)

SWG TIMTEC screws	Annex A
5. TIMTEC VG, Material carbon steel	

Lengths for D=6.0

Countersunk heads

L +1.0 - 3.0	Lg +2.0 - 6.0	a max
70	63	10.0
…	…	
120	113	10.0

Cylinder-, large washer- and Kombi hexagonal head

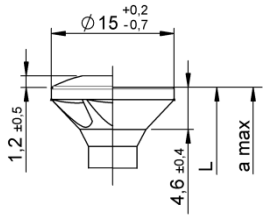
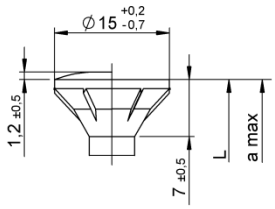
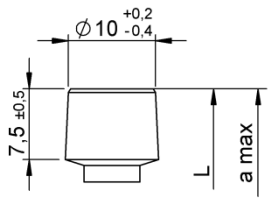
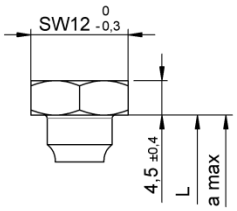
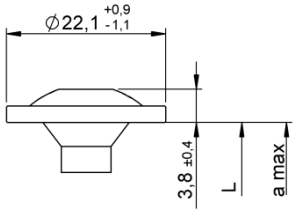
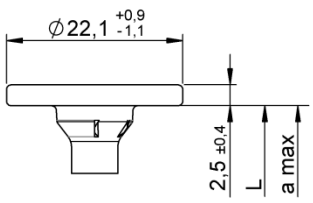
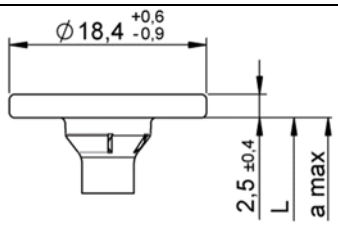
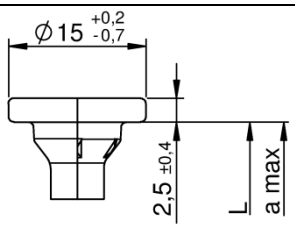
L +1.0 - 3.0	Lg +6.0 - 2.0	a max
70	63	6.0
…	…	…
120	113	6.0

L +1.0 - 5.0	Lg +2.0 - 10.0	a max
130	123	12.0
…	…	
260	253	12.0

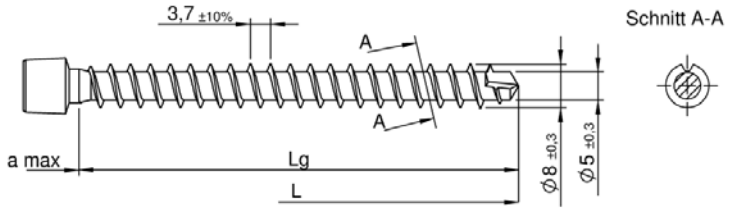
L +1.0 - 5.0	Lg +6.0 - 6.0	a max
130	123	8.0
…	…	…
260	253	8.0

For non-standard use (optional, see page 1 of Annex): Part without thread in the middle of the screw / Part without thread below head / Combination of both. All dimensions in mm.

Head types for D=8.0

		
Countersunk head – design: with and without raise, with and without milling pockets	Countersunk head with cutter ribs - design with and without raise	Cylinder head
		
Kombi hexagonal head	Large washer head	Large washer head II - design: with and without cutter ribs
		
Large washer head III - design: with and without cutter ribs	Small washer head - design: with and without cutter ribs	

Thread types for D=8.0


Design with and without cutting edges (see Schnitt A-A)

SWG TIMTEC screws	Annex A
5. TIMTEC VG, Material carbon steel	

Lengths for D=8.0

Countersunk- and Cylinder head

L +1.0 - 5.0	Lg +4.0 - 8.0	a max
80	69	14.0
…	…	
280	269	14.0

L +1.0 - 10.0	Lg +4.0 - 14.0	a max
290	279	15.0
…	…	
450	439	15.0

L +5.0 - 15.0	Lg +11.0 - 21.0	a max
460	446	20.0
…	…	
600	586	20.0

Large washer- and Kombi hexagonal head

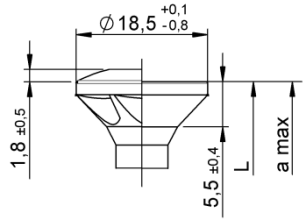
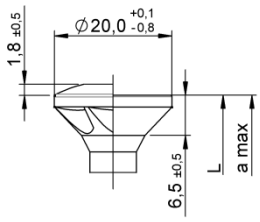
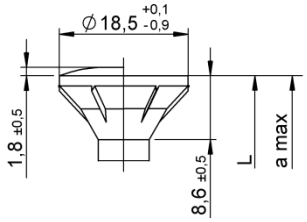
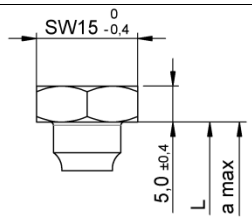
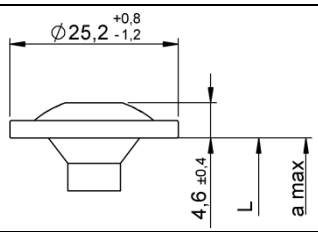
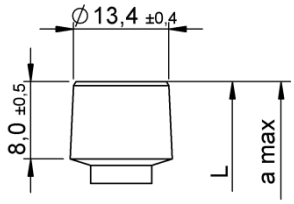
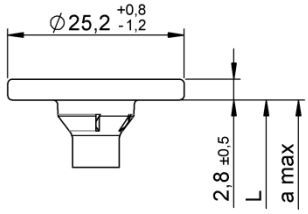
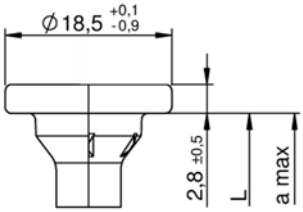
L +1.0 - 5.0	Lg +10.0 - 2.0	a max
80	69	8.0
…	…	
280	269	8.0

L +1.0 - 10.0	Lg +10.0 - 8.0	a max
290	279	9.0
…	…	…
450	439	9.0

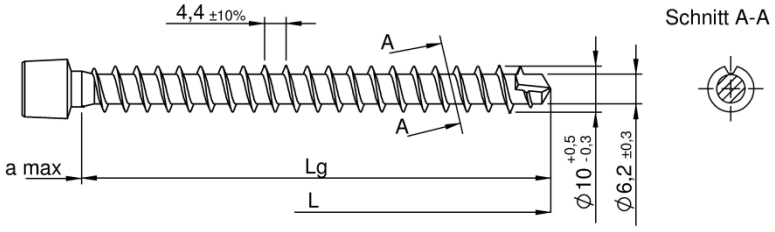
L +5.0 - 15.0	Lg +17.0 - 15.0	a max
460	446	14.0
…	…	…
600	586	14.0

For non-standard use (optional, see page 1 of Annex): Part without thread in the middle of the screw / Part without thread below head / Combination of both. All dimensions in mm.

Head types for D=10.0mm

		
Countersunk head – design: with and without raise, with and without milling pockets	Countersunk head – design: with and without raise, with and without milling pockets	Countersunk head with cutter ribs - design with and without raise
		
Kombi hexagonal head	Large washer head	Cylinder head
		
Large washer head II - design: with and without cutter ribs	Small washer head - design: with and without cutter ribs	

Thread types for D=10.0


Design with and without cutting edges (see Schnitt A-A)

SWG TIMTEC screws	Annex A
5. TIMTEC VG, Material carbon steel	

Lengths for D=10.0

Countersunk- and Cylinder head

L +1.0 - 5.0	Lg +5.0 - 11.0	a max
100	88	18.0
…	…	
280	268	18.0

L +1.0 - 10.0	Lg +5.0 - 16.0	a max
290	278	18.0
…	…	
450	438	18.0

L +5.0 - 15.0	Lg +12.0 - 23.0	a max
460	445	23.0
…	…	
800	785	23.0

Large washer- and Kombi hexagonal head

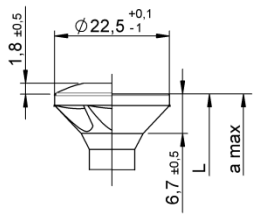
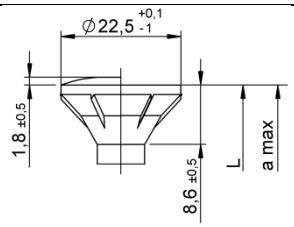
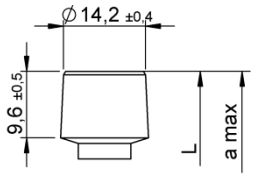
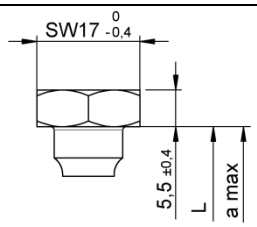
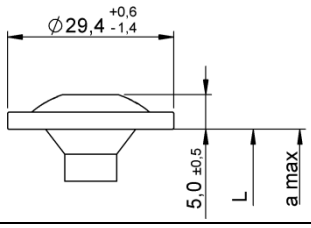
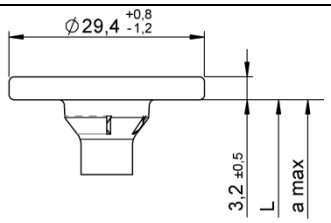
L +1.0 - 5.0	Lg +8.0 - 8.0	a max
100	88	15.0
…	…	…
280	268	15.0

L +1.0 - 10.0	Lg +8.0 - 13.0	a max
290	278	15.0
…	…	…
450	438	15.0

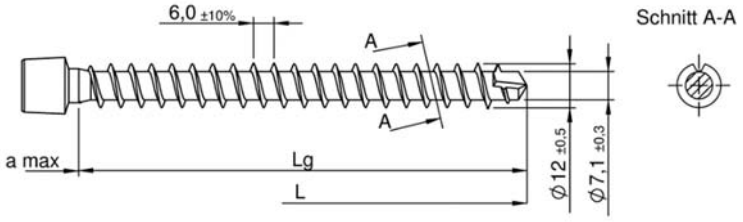
L +5.0 - 15.0	Lg +15.0 - 20.0	a max
460	445	20.0
…	…	…
800	785	20.0

For non-standard use (optional, see page 1 of Annex): Part without thread in the middle of the screw / Part without thread below head / Combination of both. All dimensions in mm.

Head types for D=12.0mm

		
Countersunk head – design: with and without raise, with and without milling pockets	Countersunk head with cutter ribs - design with and without raise	Cylinder head
		
Kombi hexagonal head	Large washer head	Large washer head II - design: with and without cutter ribs

Thread types for D=12.0



Design with and without cutting edges (see section (Schnitt) A-A)

SWG TIMTEC screws	Annex A
5. TIMTEC VG, Material carbon steel	

Lengths for D=12.0

Countersunk- and Cylinder head

L +1.0 - 5.0	Lg +6.0 - 11.0	a max
120	105	21.0
…	…	
240	225	21.0

L +5.0 - 15.0	Lg +12.0 - 24.0	a max
250	233	26.0
…	…	
600	583	26.0

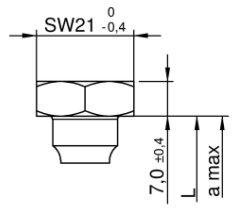
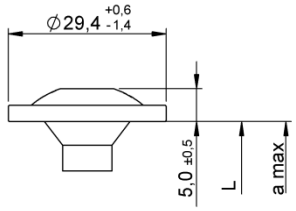
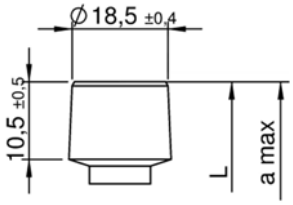
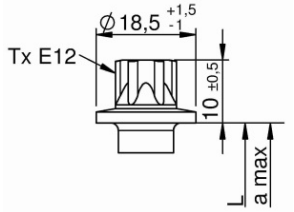
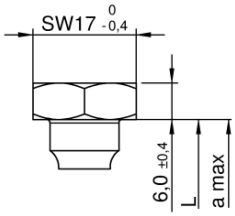
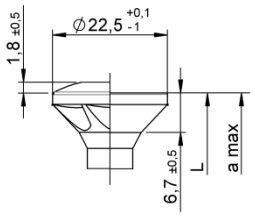
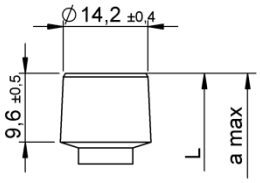
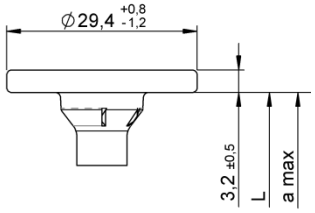
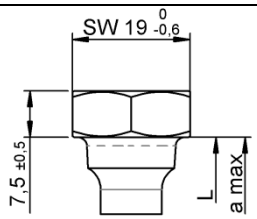
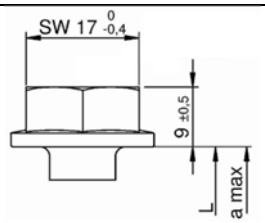
Large washer- and Kombi hexagonal head

L +1.0 - 5.0	Lg +10.0 - 7.0	a max
120	105	17.0
…	…	…
240	225	17.0

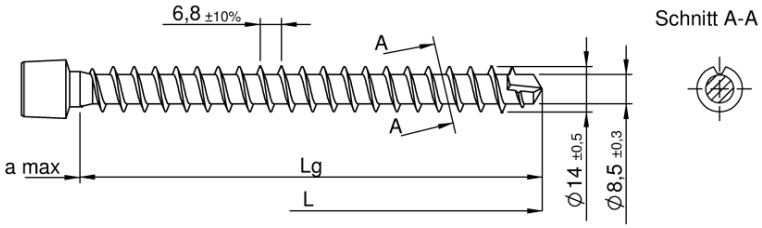
L +5.0 - 15.0	Lg +16.0 - 20.0	a max
250	233	22.0
…	…	…
600	583	22.0

For non-standard use (optional, see page 1 of Annex): Part without thread in the middle of the screw / Part without thread below head / Combination of both. All dimensions in mm.

Head types for D=14.0mm

			
Hexagonal head	Large washer head	Cylinder head	Hexalobular head
			
Hexagonal head	Countersunk head – design: with and without raise, with and without milling pockets	Cylinder head	Large washer head II - design: with and without cutter ribs
			
Hexagonal head	Hexagonal head with flange		

Thread types for D=14.0



Design with and without cutting edges (see section (Schnitt) A-A)

SWG TIMTEC screws	Annex A
5. TIMTEC VG, Material carbon steel	

Lengths for D=14.0

Countersunk- and Cylinder head

L +1.0 - 5.0	Lg +5.0 - 12.0	a max
120	105	22.0
…	…	
200	185	22.0

L +5.0 - 15.0	Lg +9.0 - 27.0	a max
210	195	27.0
…	…	
800	785	27.0

L +10.0 - 20.0	Lg +14.0 - 32.0	a max
810	795	27.0
…	…	
1500	1485	27.0

Large washer- and Hexagonal and Hexabular head

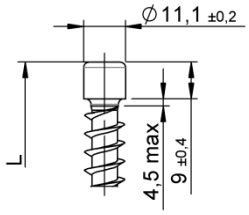
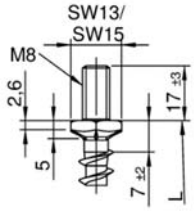
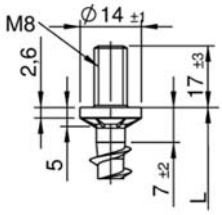
L +1.0 - 5.0	Lg +10.0 - 7.0	a max
120	105	17.0
…	…	…
200	185	17.0

L +5.0 - 15.0	Lg +14.0 - 22.0	a max
210	195	22.0
…	…	…
800	785	22.0

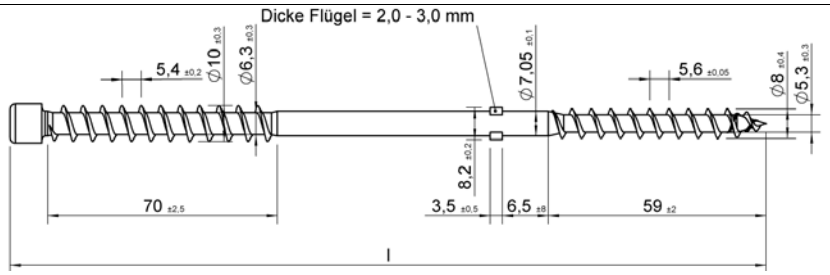
L +10.0 - 20.0	Lg +19.0 - 27.0	a max
810	795	22.0
…	…	…
1500	1485	22.0

For non-standard use (optional, see page 1 of Annex): Part without thread in the middle of the screw / Part without thread below head / Combination of both. All dimensions in mm.

Head types for D=8/10

		
Cylinder head	countersunk head with connection thread	Round countersunk head with connection thread

Thread types



TIMTEC coarse - thread – Design with and without mating thread in thread D=8; with and without wings (Flügel).

Lengths

l +1.0 - 3.0
160
…
560

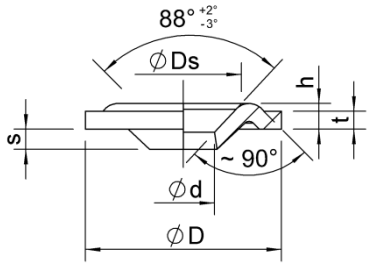
All dimensions in mm

SWG TIMTEC screws	Annex A
6. TIMTEC Isotec	

TIMTEC - Marking of heads

	
	
Marking at TIMTEC D=3-14 of designs: Mentioned head types are possible without marking, or with customer specific markings, too.	

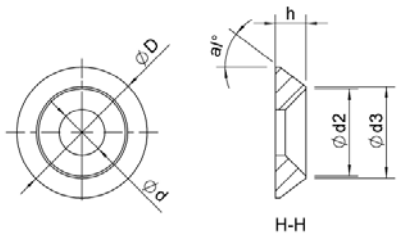
Countersunk washers pressed, material steel and stainless steel



Dimensions

	t ±0.4	D ±0.5	d +0.5	d1 ±1.0	h +0.5	Ds ±1	s ±0.75
6	2.5	22	6.5	8.8	3.0	13.0	2.4
8	3.0	28	8.5	9.6	3.5	16.0	3.3
10	3.0	33	10.5	11.3	4.3	19.5	3.4
12	4.0	42	12.5	15.8	5.0	23.0	3.0

Countersunk washers turned, material steel and stainless steel



Dimensions steel

	d ±0.2	D ±0.5	h ±0.3	al (°)	d2 ±0.3	d3 ±0.3
6	6.4	22	4.5	45	14.0	15.0
8	8.4	25.0	5.0	41	17.0	18.0
10	10.4	30.0	7.0	37	20.0	21.0

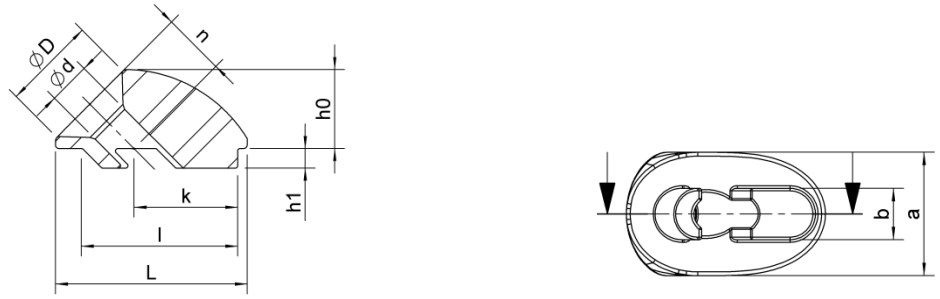
Dimensions stainless steel

	d1 ±0.2	D ±0.5	h ±0.3	al (°)	d2 ±0.3	d3 ±0.3
6	6.4	22	3.8	45	14.0	14.5
8	8.4	25.0	5.0	45	18.4	19.0
10	10.4	30.0	7.0	37	20.0	21.0

All dimensions in mm

SWG TIMTEC screws	Annex A
8. TIMTEC Washers	

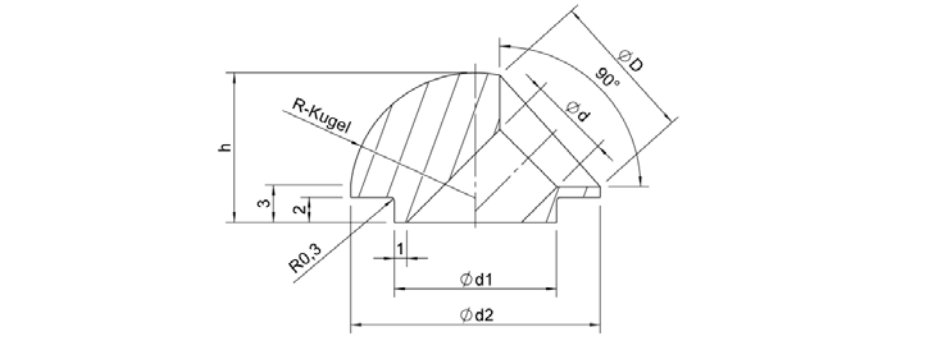
Countersunk washers 45°, material steel cast



Dimensions

	d ±0.3	D ±0.5	L ±1	a ±0.5	h0 ±0.8	h1 ±0.4	b ±0.2	l ±0.3	k ±0.3	n ±0.5
6	6.5	14.5	28.5	17.0	13.5	2.6	6.9	21.7	13.5	10.9
8	8.5	19.0	39.0	24.0	16.0	3.6	9.9	31.7	21.0	12.7
10	10.7	24.0	52.0	29.0	21.4	4.6	10.8	43.7	28.7	18.4
12	12.7	26.0	59.0	30.0	23.5	5.6	12.8	49.7	34.0	19.8

Countersunk washers 45°, material steel and stainless steel, turned



Dimensions

	d ±0.3	D ±0.5	d1 ±0.2	d2 ±0.5	h ±0.8	h1 ±0.3	R-Kugel ±0.5
6	6.5	12	12.9	20.0	10.0	1.9	10
8	8.5	15	15.9	25.0	11.5	2.9	12.5

Annex B
Minimum distances and spacing

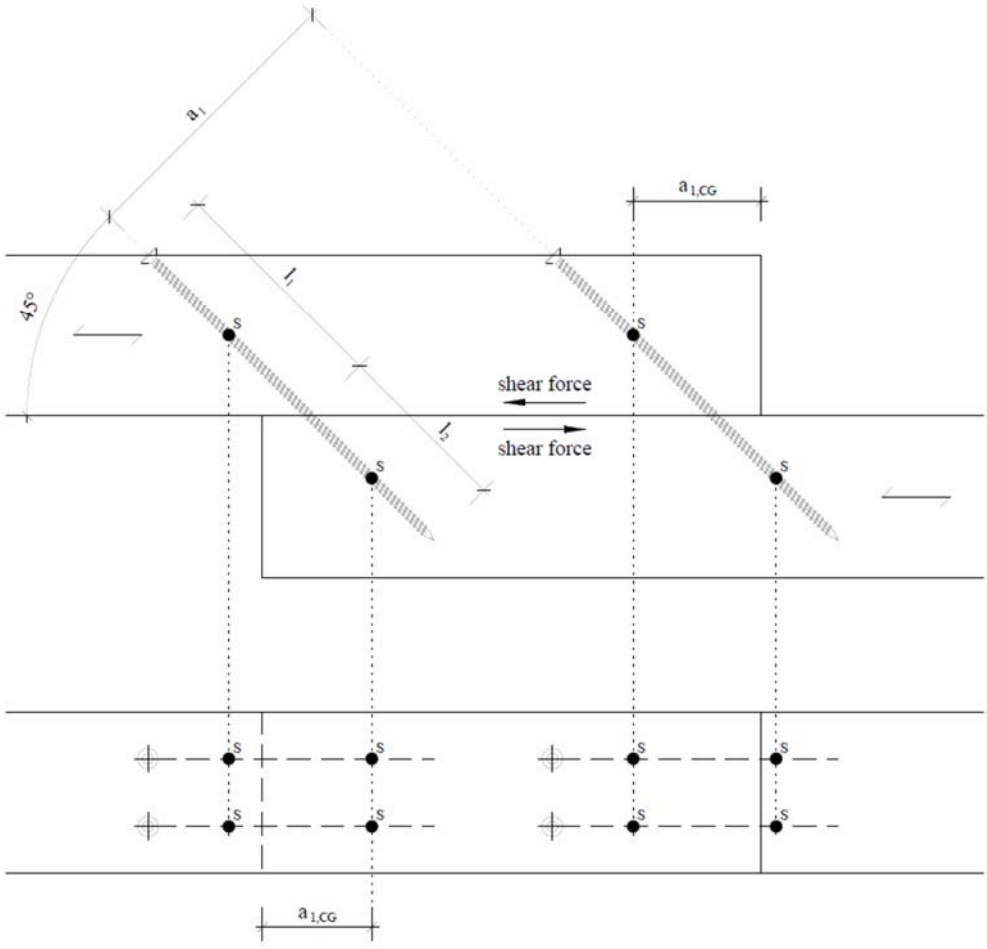
Mechanically jointed beams
"Timtec plus VG" screws with a full thread may be used for connections in structural members which are composed of several parts in mechanically jointed beams or columns.

The axial slip modulus K_{ser} of a screw with a full thread for the serviceability limit state should be taken independent of angle α to the grain as:

$C = K_{ser} = 25 \cdot d \cdot \ell_{ef}$ [N/mm] for screws in softwood
$C = K_{ser} = 30 \cdot d \cdot \ell_{ef}$ [N/mm] for screws in hardwood

Where
d outer thread diameter [mm]
ℓ_{ef} penetration length in the structural member [mm]

Axially loaded "Timtec plus VG" screws in solid or glued laminated timber or laminated veneer lumber
Single configuration

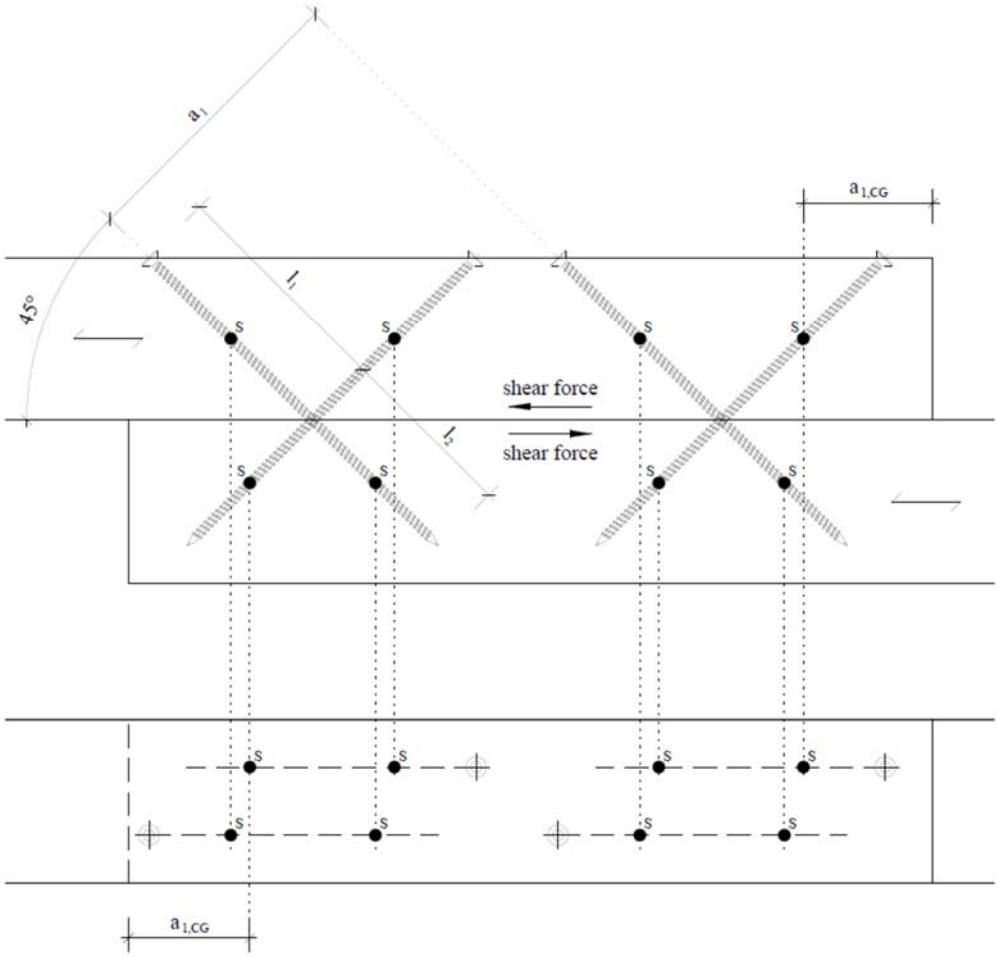


$a_1 \geq 5 \cdot d$ $a_2 \geq 2{,}5 \cdot d$ $a_{1,CG} \geq 5 \cdot d$ $a_{2,CG} \geq 3 \cdot d$ $a_1 \cdot a_2 \geq 25 \cdot d^2$

Minimum distances and spacing see also 3.11
Minimum timber thickness $t = 10 \cdot d$ for solid or glued laminated timber and $t = 6 \cdot d$ for laminated veneer lumber, see also 3.11

S = centroid of the part of the screw in the timber

Axially loaded “Timtec plus VG” screws in solid or glued laminated timber or laminated veneer lumber
Crosswise configuration



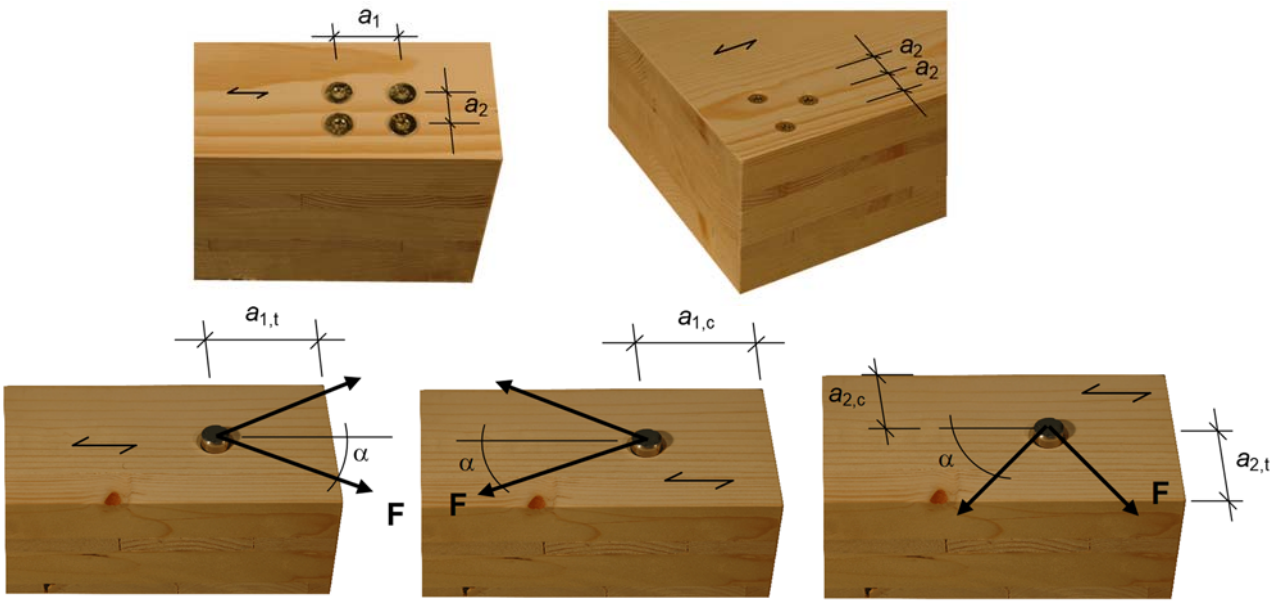
$a_1 \geq 5 \cdot d$ $a_2 \geq 2{,}5 \cdot d$ ($a_2 \geq 1{,}5 \cdot d$ between the crossing screws of a screw couple)
$a_{1,CG} \geq 5 \cdot d$ $a_{2,CG} \geq 3 \cdot d$
$a_1 \cdot a_2 \geq 25 \cdot d^2$

Minimum distances and spacing see also 3.11
Minimum timber thickness $t = 10 \cdot d$ for solid or glued laminated timber and $t = 6 \cdot d$ for laminated veneer lumber, see also 3.11

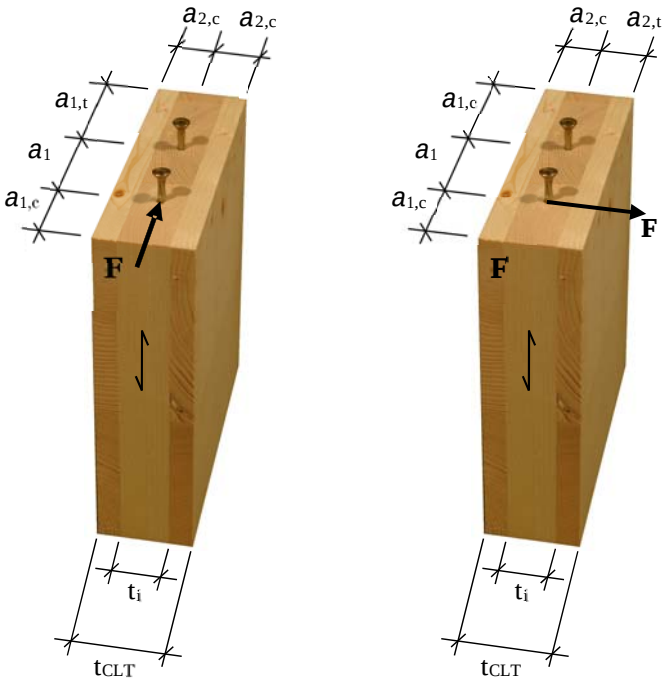
S = centroid of the part of the screw in the timber

Axially or laterally loaded screws in the plane or edge surface of cross laminated timber

Definition of spacing, end and edge distances in the plane surface:



Definition of spacing, end and edge distances in the edge surface:



Annex C
Compression reinforcement

„Timtec plus VG" screws with a full thread may be used for reinforcement of timber members with compression stresses at an angle α to the grain of $45° \leq \alpha \leq 90°$. The compression force must be evenly distributed over all screws. The screw head must be flush with the surface of the timber member.

The characteristic load-carrying capacity for a contact area with screws with a full thread at an angle α to the grain of $45° \leq \alpha \leq 90°$ shall be calculated from:

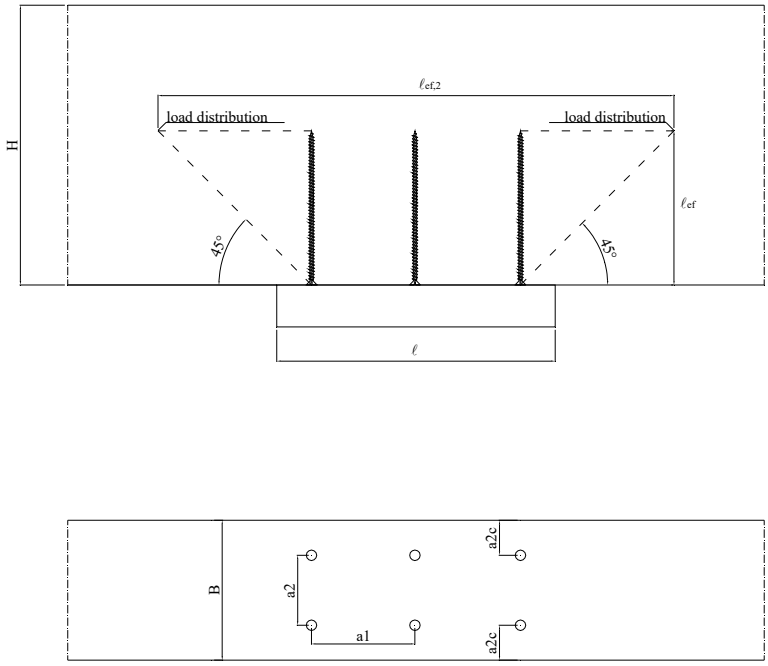
$$F_{90,Rk} = \min \begin{cases} k_{c,90} \cdot B \cdot \ell_{ef,1} \cdot f_{c,90,k} + n \cdot F_{ax,Rk} \\ B \cdot \ell_{ef,2} \cdot f_{c,90,k} \end{cases}$$

Where

$F_{90,Rk}$ Load-carrying capacity of reinforced contact area [N]
$k_{c,90}$ factor for compression perpendicular to the grain according to EN 1995-1-1
B bearing width [mm]
$\ell_{ef,1}$ effective length of contact area according to EN 1995-1-1 [mm]
$f_{c,90,k}$ characteristic compressive strength perpendicular to the grain [N/mm²]
n number of reinforcement screws, $n = n_0 \cdot n_{90}$
n_0 number of reinforcement screws arranged in a row parallel to the grain
n_{90} number of reinforcement screws arranged in a row perpendicular to the grain
$F_{ax,Rk}$ characteristic compressive capacity [N]
$\ell_{ef,2}$ effective distribution length in the plane of the screw tips [mm]
$\ell_{ef,2}$ $= \ell_{ef} + (n_0 - 1) \cdot a_1 + \min(\ell_{ef}; a_{1,c})$ for end-bearings [mm]
$\ell_{ef,2}$ $= 2 \cdot \ell_{ef} + (n_0 - 1) \cdot a_1$ for centre-bearings [mm]
ℓ_{ef} point side penetration length [mm]
a_1 spacing parallel to the grain [mm]
$a_{1,c}$ end distance [mm]

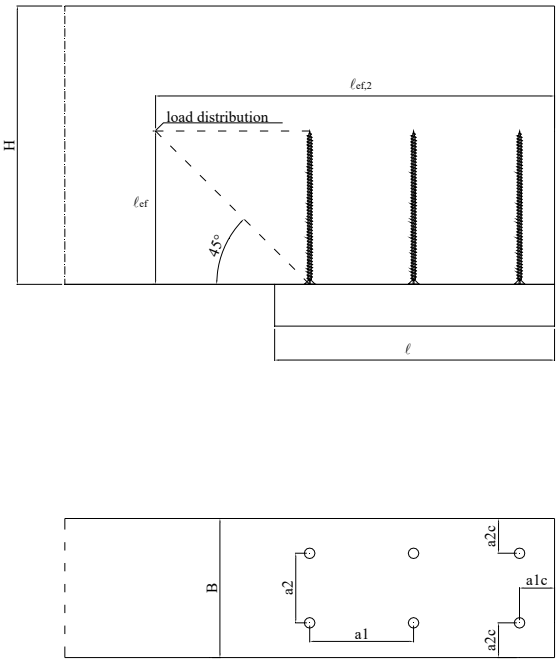
Reinforcing screws for wood-based panels and hardwoods are not covered by this European Technical Approval.

Reinforced centre-bearing



H component height [mm]
B bearing width [mm]
ℓ_{ef} point side penetration length [mm]
$\ell_{ef,2}$ effective distribution length in the plane of the screw tips [mm]
$= 2 \cdot \ell_{ef} + (n_0 - 1) \cdot a_1$ for centre-bearings

Reinforced end-bearing



H component height [mm]
B bearing width [mm]
ℓ_{ef} point side penetration length [mm]
$\ell_{ef,2}$ effective distribution length in the plane of the screw tips [mm]
$= \ell_{ef} + (n_0 - 1) \cdot a_1 + \min(\ell_{ef}; a_{1,c})$ for end-bearings

Annex D
Shear reinforcement

Unless specified otherwise in national provisions that apply at the installation site, the shear stress in reinforced areas of timber members with a stress component parallel to the grain shall fulfil the following condition:

$$\tau_d \le \frac{f_{v,d} \cdot k_\tau}{\eta_H}$$

Where: τ_d is the design shear stress disregarding the reinforcement;

$f_{v,d}$ is the design shear strength;

$$k_\tau = 1 - 0{,}46 \cdot \sigma_{90,d} - 0{,}052 \cdot \sigma_{90,d}^2$$

$\sigma_{90,d}$ is the design stress perpendicular to the grain (negative value for compression);

$$\sigma_{90,d} = \frac{F_{ax,d}}{\sqrt{2} \cdot b \cdot a_1}$$

$$F_{ax,d} = \frac{\sqrt{2} \cdot (1 - \eta_H) \cdot V_d \cdot a_1}{h}$$

$$\eta_H = \frac{G \cdot b}{G \cdot b + \frac{1}{2 \cdot \sqrt{2} \left(\frac{6}{\pi \cdot d \cdot h \cdot k_{ax}} + \frac{a_1}{EA_S} \right)}}$$

V_d is the design shear force;

G is the shear modulus of the timber member, G = 650 N/mm²,

b is the width of the timber member in mm,

d is the outer thread diameter in mm,

h is the depth of the timber member in mm,

k_{ax} is the connection stiffness between screw and timber member in N/mm³,
k_{ax} = 12,5 N/mm³ for SWG “Timtec plus VG” and fully threaded “Timtec 3.0” screws with d = 8 mm,

a_1 is the spacing parallel to the grain of the screws arranged in one row in mm ($a_1 \le h$),

EA_S is the axial stiffness of one rod or screw,

$$EA_S = \frac{E \cdot \pi \cdot d_2^2}{4} = 165.000\, d_2^2,$$

d_2 is the inner thread diameter of the rod or screw, d_2 = 5 mm for screws d = 8 mm.

The axial capacity of a threaded screw shall fulfil the following condition:

$$\frac{F_{ax,d}}{F_{ax,Rd}} \le 1$$

Where:

$F_{ax,Rd}$ Minimum of the design values of the withdrawal capacity and the tensile capacity of the reinforcing rods or screws. The effective penetration length is 50 % of the threaded length.

A minimum of four screws in a row are required in each reinforced area. Outside reinforced areas (shaded area in Figure E.1) the shear design shall fulfil the conditions for unreinforced members.

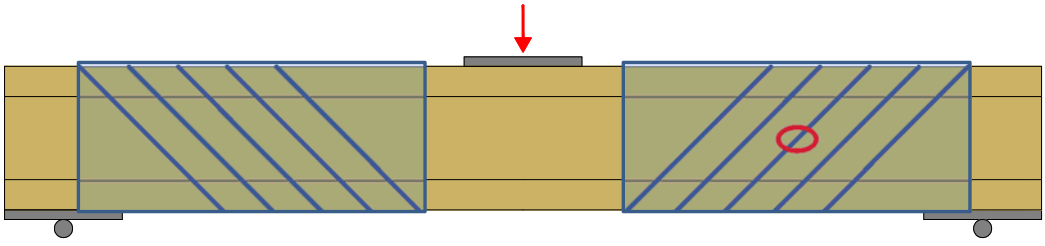


Figure D.1: Timber member with shear reinforcement; shaded areas: reinforced areas with screws arranged under 45°

Annex E
Reinforcement of connections with laterally loaded, dowel-type fasteners

Unless specified otherwise in national provisions that apply at the installation site, the axial capacity of a reinforcement of a steel-to-timber or timber-to-timber connection with laterally loaded dowel-type fasteners loaded by a connection force parallel to the grain shall fulfil the following condition:

$$\frac{0,3 \cdot F_{v,0,Ed}}{F_{ax,Rd}} \leq 1$$

Where

$F_{v,0,Ed}$ Design value of the fastener force component parallel to the grain [N],
For outer timber members $F_{v,0,Ed}$ is the load per fastener per shear plane, for inner timber members $F_{v,0,Ed}$ is the accumulated load per fastener for the two shear planes

$F_{ax,Rd}$ Minimum of the design values of the withdrawal capacity and the tensile capacity of the reinforcing full thread screws where ℓ_{ef} is the smaller value of the penetration depth at the screw tip or head (see Fig. E.1)

If the timber under each fastener in a connection is reinforced, the effective number n_{ef} according to EN 1995-1-1 equation (8.34) may be taken as $n_{ef} = n$.

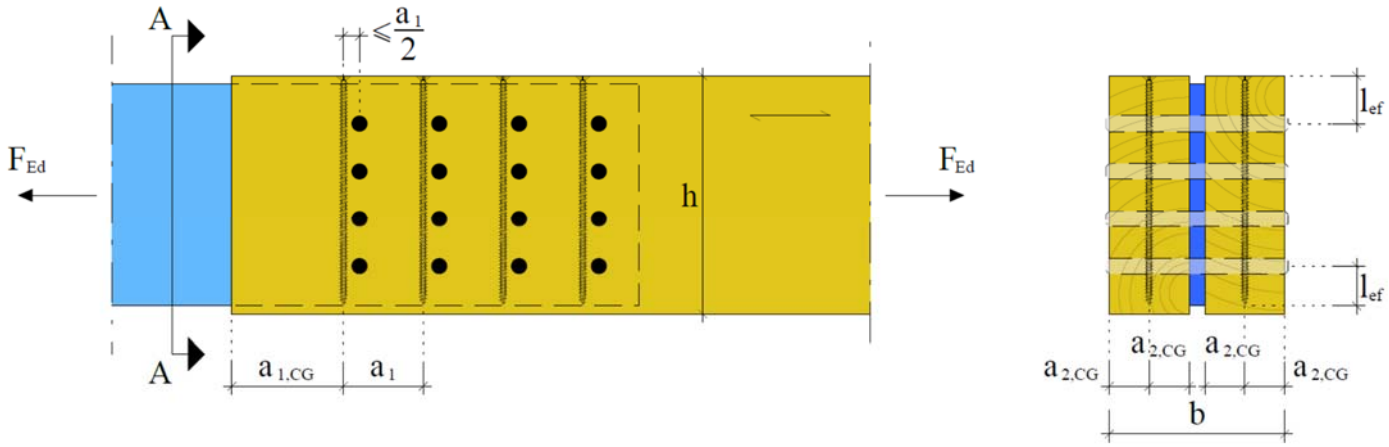


Figure E.1: Dowelled steel-to-timber connection with outer timber members and reinforcement;

Annex F
Thermal insulation material on top of rafters

SWG screws with an outer thread diameter 6 mm ≤ d ≤ 14 mm may be used for the fixing of thermal insulation material on top of rafters.

The thickness of the insulation shall not exceed 400 mm. The rafter insulation must be placed on top of solid timber or glued laminated timber rafters or cross-laminated timber members and be fixed by battens arranged parallel to the rafters or by wood-based panels on top of the insulation layer. The insulation of vertical facades is also covered by the rules given here.

Screws must be screwed in the rafter through the battens or panels and the insulation without pre-drilling in one sequence.

The angle α between the screw axis and the grain direction of the rafter should be between 30° and 90°.

The rafter consists of solid timber (softwood) according to EN 338, glued laminated timber according to EN 14081, cross-laminated timber, or laminated veneer lumber according to EN 14374 or to European Technical Assessment or similar glued members according to European Technical Assessment.

The battens must be from solid timber (softwood) according to EN 338:2003-04. The minimum thickness t and the minimum width b of the battens is given as follows:

Screws d ≤ 8,0 mm: b_{min} = 50 mm t_{min} = 30 mm
Screws d = 10 mm: b_{min} = 60 mm t_{min} = 40 mm
Screws d = 12 mm: b_{min} = 80 mm t_{min} = 100 mm
Screws d = 14 mm: b_{min} = 100 mm t_{min} = 100 mm

The insulation must comply with a European Technical Approval.

Friction forces shall not be considered for the design of the characteristic axial capacity of the screws.

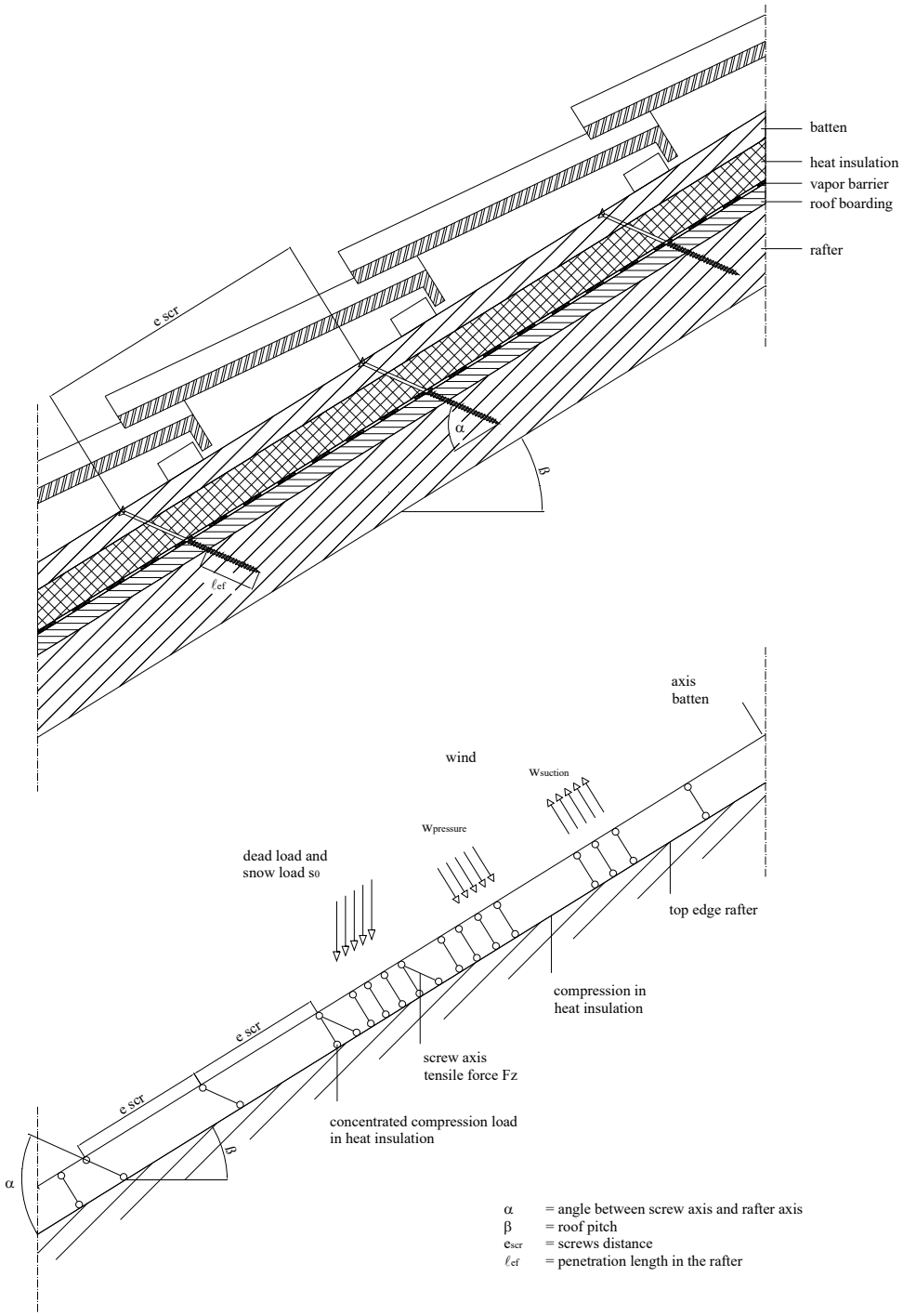
The anchorage of wind suction forces as well as the bending stresses of the battens or the boards, respectively, shall be considered in design. Additional screws perpendicular to the grain of the rafter (angle α = 90°) may be arranged if necessary.

The maximum screw spacing is e_{Scr} = 1,75 m.

Thermal insulation material on rafters with parallel inclined screws

Mechanical model

The system of rafter, heat insulation on top of rafter and battens parallel to the rafter may be considered as a beam on elastic foundation. The batten represents the beam, and the heat insulation on top of the rafter the elastic foundation. The minimum compression stress of the heat insulation at 10 % deformation, measured according to EN 826[1], shall be $\sigma_{(10\,\%)} = 0{,}05$ N/mm². The batten is loaded perpendicular to the axis by point loads F_b. Further point loads F_s are from the shear load of the roof due to dead and snow load, which are transferred from the screw heads into the battens.



[1] EN 826:1996 Thermal insulating products for building applications - Determination of compression behaviour

Design of the battens

The bending stresses are calculated as:

$$M = \frac{(F_b + F_s) \cdot \ell_{char}}{4}$$

Where

ℓ_{char} = characteristic length $\ell_{char} = \sqrt[4]{\frac{4 \cdot EI}{w_{ef} \cdot K}}$

EI = bending stiffness of the batten
K = coefficient of subgrade
w_{ef} = effective width of the heat insulation
F_b = Point loads perpendicular to the battens
F_s = Point loads perpendicular to the battens, load application in the area of the screw heads

The coefficient of subgrade K may be calculated from the modulus of elasticity E_{HI} and the thickness t_{HI} of the heat insulation if the effective width w_{ef} of the heat insulation under compression is known. Due to the load extension in the heat insulation the effective width w_{ef} is greater than the width of the batten or rafter, respectively. For further calculations, the effective width w_{ef} of the heat insulation may be determined according to:

$$w_{ef} = w + t_{HI} / 2$$

where
w = minimum width of the batten or rafter, respectively
t_{HI} = thickness of the heat insulation

$$K = \frac{E_{HI}}{t_{HI}}$$

The following condition shall be satisfied:

$$\frac{\sigma_{m,d}}{f_{m,d}} = \frac{M_d}{W \cdot f_{m,d}} \leq 1$$

For the calculation of the section modulus W the net cross section has to be considered.

The shear stresses shall be calculated according to:

$$V = \frac{(F_b + F_s)}{2}$$

The following condition shall be satisfied:

$$\frac{\tau_d}{f_{v,d}} = \frac{1{,}5 \cdot V_d}{A \cdot f_{v,d}} \leq 1$$

For the calculation of the cross section area the net cross section has to be considered.

Design of the heat insulation

The compressive stresses in the heat insulation shall be calculated according to:

$$\sigma = \frac{1{,}5 \cdot F_b + F_s}{2 \cdot \ell_{char} \cdot w}$$

The design value of the compressive stress shall not be greater than 110 % of the compressive stress at 10 % deformation calculated according to EN 826.

Design of the screws

The screws are loaded predominantly axially. The axial tension force in the screw may be calculated from the shear loads of the roof R_s:

$$T_S = \frac{R_S}{\cos\alpha}$$

The load-carrying capacity of axially loaded screws is the minimum design value of the axial withdrawal capacity of the threaded part of the screw, the head pull-through capacity of the screw and the tensile capacity of the screw.

In order to limit the deformation of the screw head for Thermal insulation material thicknesses over 200 mm or with compressive strength below 0,12 N/mm², respectively, the axial withdrawal capacity of the screws shall be reduced by the factors k_1 and k_2:

$$F_{ax,\alpha,Rd} = \min\left\{ \frac{k_{ax} \cdot f_{ax,d} \cdot d \cdot \ell_{ef} \cdot k_1 \cdot k_2}{k_\beta} \cdot \left(\frac{\rho_k}{\rho_a}\right)^{0.8} ; f_{head,d} \cdot d_h^2 \cdot \left(\frac{\rho_k}{350}\right)^{0.8} ; f_{tens,d} \right\} \quad \text{for screws with partial thread}$$

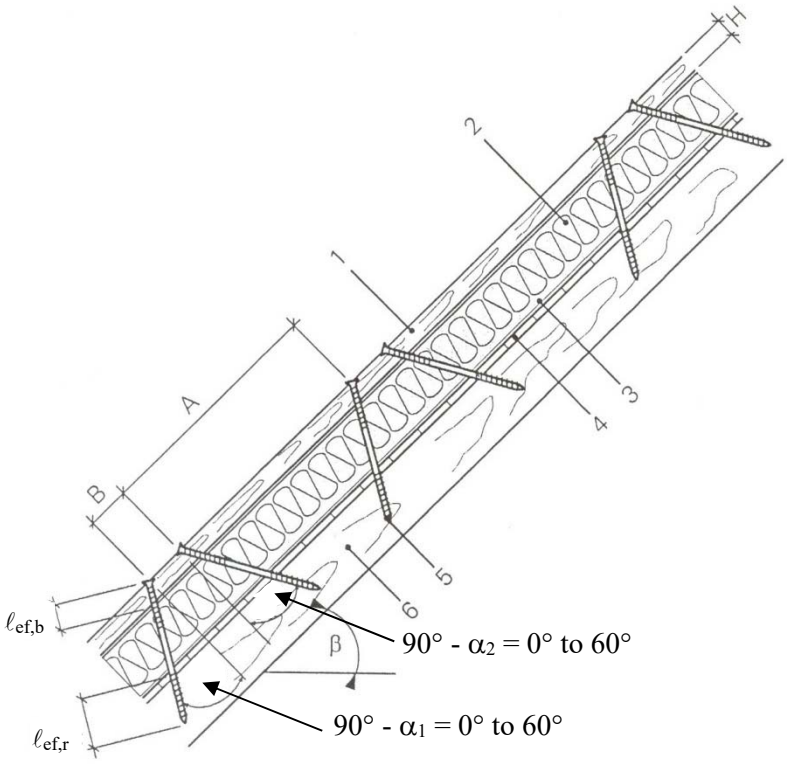
$$F_{ax,\alpha,Rd} = \min\left\{ \begin{array}{l} \dfrac{k_{ax} \cdot f_{ax,d} \cdot d \cdot \ell_{ef} \cdot k_1 \cdot k_2}{k_\beta} \cdot \left(\dfrac{\rho_k}{\rho_a}\right)^{0,8} \\ \max\left\{ f_{head,d} \cdot d_h^2 ; \dfrac{k_{ax} \cdot f_{ax,d} \cdot d \cdot \ell_{ef,b} \cdot k_1 \cdot k_2}{k_\beta} \right\} \cdot \left(\dfrac{\rho_k}{350}\right)^{0,8} \\ f_{tens,d} \end{array} \right\} \quad \begin{array}{l} \text{for screws with full thread or} \\ \text{“Timtec Isotec”} \end{array}$$

Where:

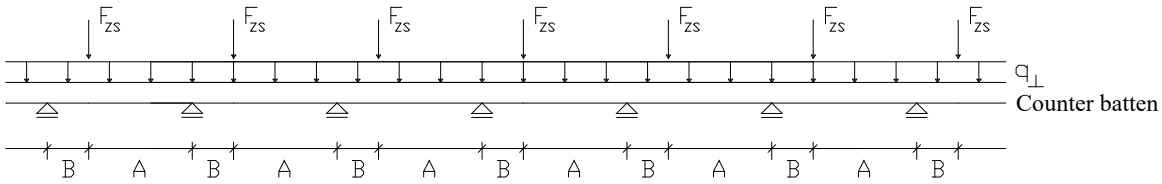
$f_{ax,d}$	design value of the axial withdrawal parameter of the threaded part of the screw
d	outer thread diameter of the screw
ℓ_{ef}	Point side penetration length of the threaded part of the screw in the rafter, $l_{ef} \geq 40$ mm
$\ell_{ef,b}$	Length of the threaded part in the batten including the head for tensile and excluding the head for compressive force [mm]
ρ_k	characteristic density of the wood-based member [kg/m³]
$f_{head,d}$	design value of the head pull-through capacity of the screw
d_h	head diameter
$f_{tens,d}$	design value of the tensile capacity of the screw
k_1	min {1; 200/t_{HI}}
k_2	min {1; $\sigma_{10\%}$/0,12}
t_{HI}	thickness of the heat insulation [mm]
$\sigma_{10\%}$	compressive stress of the heat insulation under 10 % deformation [N/mm²]

If equation k_1 and k_2 are considered, the deflection of the battens does not need to be considered. Alternatively, to the battens, panels with a minimum thickness of 20 mm from plywood according to EN 636, particle board according to EN 312, oriented strand board according to EN 300 or European Technical Assessment and solid wood panels according to EN 13353 or cross laminated timber may be used.

Thermal insulation material on rafters with alternatively inclined screws



1 Counter batten
2 Insulation
3 Vapour barrier
4 Sheathing
5 Compressive screw
6 Rafter



Mechanical model

Depending on the screw spacing and the arrangement of tensile and compressive screws with different inclinations the battens are loaded by significant bending moments. The bending moments are derived based on the following assumptions:

- The tensile and compressive loads in the screws are determined based on equilibrium conditions from the actions parallel and perpendicular to the roof plane.
  These actions are constant line loads $q_\perp$ and $q_{||}$.
- The screws act as hinged columns supported 10 mm within the batten or rafter, respectively. The effective column length consequently equals the length of the screw between batten and rafter plus 20 mm.
- The batten is considered as a continuous beam with a constant span ℓ = A + B.
  The compressive screws constitute the supports of the continuous beam while the tensile screws transfer concentrated loads perpendicular to the batten axis.

The screws are predominantly loaded in withdrawal or compression, respectively. The screw's normal forces are determined based on the loads parallel and perpendicular to the roof plane:

Compressive screw: $$F_{c,Ed} = (A+B)\cdot\left(-\frac{q_{II}}{\cos\alpha_1 + \sin\alpha_1 / \tan\alpha_2} - \frac{q_\perp \cdot \sin(90° - \alpha_2)}{\sin(\alpha_1 + \alpha_2)}\right)$$

Tensile screw: $$F_{t,Ed} = (A+B)\cdot\left(\frac{q_{II}}{\cos\alpha_2 + \sin\alpha_2 / \tan\alpha_1} - \frac{q_\perp \cdot \sin(90° - \alpha_1)}{\sin(\alpha_1 + \alpha_2)}\right)$$

The bending moments in the batten follow from the constant line load $q_{\perp}$ and the load components perpendicular to the batten from the tensile screws. The span of the continuous beam is (A + B). The load component perpendicular to the batten from the tensile screw is:

$$F_{ZS,Ed} = (A+B)\cdot\left(\frac{q_{II}}{1/\tan\alpha_1 + 1/\tan\alpha_2} - \frac{q_{\perp}\cdot\sin(90°-\alpha_1)\cdot\sin\alpha_2}{\sin(\alpha_1+\alpha_2)}\right)$$

Where:

q_{II} Constant line load parallel to batten
$q_{\perp}$ Constant line load perpendicular to batten
α_1 Angle between compressive screw axis and grain direction
α_2 Angle between tensile screw axis and grain direction

A positive value for F_{ZS} means a load towards the rafter, a negative value a load away from the rafter.

Design of the screws

The load-carrying capacity of the screws shall be calculated as follows:

Screws loaded in tension:

$$F_{ax,\alpha,Rd} = \min\left\{\frac{k_{ax}\cdot f_{ax,d}\cdot d\cdot \ell_{ef,b}}{k_{\beta}}\cdot\left(\frac{\rho_{b,k}}{\rho_a}\right)^{0.8}; \frac{k_{ax}\cdot f_{ax,d}\cdot d\cdot \ell_{ef,r}}{k_{\beta}}\cdot\left(\frac{\rho_{r,k}}{\rho_a}\right)^{0.8}; f_{tens,d}\right\}$$

Screws loaded in compression:

$$F_{ax,\alpha,Rd} = \min\left\{\frac{k_{ax}\cdot f_{ax,d}\cdot d\cdot \ell_{ef,b}}{k_{\beta}}\cdot\left(\frac{\rho_{b,k}}{\rho_a}\right)^{0.8}; \frac{k_{ax}\cdot f_{ax,d}\cdot d\cdot \ell_{ef,r}}{k_{\beta}}\cdot\left(\frac{\rho_{r,k}}{\rho_a}\right)^{0.8}; \frac{\kappa_c\cdot N_{pl,k}}{\gamma_{M1}}\right\}$$

where:

$f_{ax,d}$ design value of the axial withdrawal capacity of the threaded part of the screw
d outer thread diameter of the screw
$\ell_{ef,b}$ penetration length of the threaded part of the screw in the batten
$\ell_{ef,r}$ penetration length of the threaded part of the screw in the rafter, $l_{ef} \geq 40$ mm
$\rho_{b,k}$ characteristic density of the batten [kg/m³]
$\rho_{r,k}$ characteristic density of the rafter [kg/m³]
α angle α_1 or α_2 between screw axis and grain direction, $30° \leq \alpha_{\square} \leq 90°$, $30° \leq \alpha_2 \leq 90°$
$f_{tens,d}$ design value of the tensile capacity of the screw
γ_{M1} partial factor according to EN 1993-1-1 or to the particular national annex
$\kappa_c \cdot N_{pl,k}$ Buckling capacity of the screw

Free screw length [mm]	Timtec plus VG 6,0 mm	Timtec plus VG 8,0 mm	Timtec plus VG 10,0 mm	Timtec plus VG 12,0 mm	Timtec plus VG 14,0 mm	Timtec Isotec
	$\kappa_c \cdot N_{pl,k}$ [kN]	$\kappa_c \cdot N_{pl,k}$ [kN]	$\kappa_c \cdot N_{pl,k}$ [kN]	$\kappa_c \cdot N_{pl,k}$ [kN]	$\kappa_c \cdot N_{pl,k}$ [kN]	$\kappa_c \cdot N_{pl,k}$ [kN]
≤ 100	1,12	3,26	8,24	13,3	21,7	10,1
120	0,85	2,48	6,37	10,4	17,3	8,30
140	0,66	1,95	5,05	8,32	14,0	6,84
160	0,53	1,57	4,10	6,79	11,5	5,70
180	0,43	1,29	3,39	5,63	9,62	4,80
200		1,08	2,86	4,74	8,13	4,08
220		0,91	2,43	4,05	6,96	3,51
240		0,79	2,09	3,50	6,02	3,05
260		0,68	1,82	3,05	5,26	2,67
280		0,60	1,59	2,68	4,65	2,36
300		0,53	1,41	2,37	4,12	2,10
320		0,47	1,26	2,12	3,68	1,88
340		0,42	1,13	1,90	3,30	1,69
360		0,38	1,02	1,71	2,98	1,53
380		0,34	0,92	1,55	2,70	1,39
400		0,31	0,84	1,41	2,47	1,27
420		0,29	0,77	1,29	2,26	1,16
440		0,26	0,70	1,19	2,07	1,07
460		0,42	0,65	1,10	1,91	0,99
480		0,22	0,60	1,01	1,77	0,91

Annex G
Effective number of screws n_{ef}

Alternatively to section 2.1, the load-carrying capacity may be calculated using the effective number of fasteners n_{ef} for one row of n inclined screws or crossed screw couples in timber-to-timber or steel-to-timber single shear connections parallel to the load, where the screws are arranged under an angle $30° \le \alpha \le 60°$ between the shear plane and the screw axis:

$$n_{ef} = \frac{1}{\max\left(\delta_1;\delta_2\right)}$$

Where:

$$\mu = -\frac{1}{1+\frac{E_1A_1}{E_2A_2}}$$

E_1A_1 Axial stiffness of side member 1

E_2A_2 Axial stiffness of side or middle member 2. If member 2 is a middle member, A_2 is only half of the member cross-section

$$\omega = 2 + K_u \cdot a_1\left(\frac{m}{E_1A_1}+\frac{m}{E_2A_2}\right)$$

K_u Slip modulus parallel to the shear plane per screw (inclined screws) or per screw couple (crossed screws) for the ultimate limit state

a_1 Screw spacing parallel to grain

m Number of rows of inclined screws or crossed screw couples per shear plane

$$m_1 = 0{,}5\cdot\left(\omega+\sqrt{\omega^2-4}\right)$$

$$m_2 = 0{,}5\cdot\left(\omega-\sqrt{\omega^2-4}\right)$$

$$\delta_1 = 1 - m_1\cdot(1+\mu)+\mu+\frac{m_1-m_2}{m_1^n-m_2^n}\cdot(m_1^n\cdot(1+\mu)-\mu)$$

$$\delta_2 = -\mu + m_1^{n-1}\cdot(1+\mu)-\frac{m_1^{n-1}-m_2^{n-1}}{m_1^n-m_2^n}\cdot(m_1^n\cdot(1+\mu)-\mu)$$

n Number of inclined screws or crossed screw couples per row