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Authorised and notified according to Article 29 of the Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011

MEMBER OF EOTA

European Technical Assessment ETA-19/0628 of 2025/01/24

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:	KNAPP T-JOINT connectors
Product family to which the above construction product belongs:	Three-dimensional nailing plate
Manufacturer:	Knapp GmbH Wassergasse 31 A-3324 Euratsfeld Tel.: +43 (0) 7474 79910-0 Telefax: +43 (0) 7474 79910-99 Internet: www.knapp-verbinder.com
Manufacturing plant:	Knapp GmbH Wassergasse 31 A-3324 Euratsfeld
This European Technical Assessment contains:	17 pages including 2 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 130186-00-0603 for Three Dimensional Nailing Plates
This version replaces:	The ETA with the same number issued on 2022-06-13

II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of the product

Technical description of the product

KNAPP T-JOINT connectors are one-piece, face-fixed connectors to be used in timber-to-timber connections.

The KNAPP T-JOINT connectors are made from stainless steel grade GX5CrNi 19-10 (AISI304) with minimum yield strength R_e of 175 MPa. Dimensions, hole positions and typical installations are shown in Annexes A and B.

2 Specification of the intended use in accordance with the applicable European Assessment Document (hereinafter EAD)

KNAPP T-JOINT connectors are intended for use in making connections in load bearing timber structures, as a connection between two solid timber or wood based members, where requirements for mechanical resistance and stability and safety in use in the sense of the Basic Works Requirements 1 and 4 of Regulation (EU) 305/2011 shall be fulfilled.

KNAPP T-JOINT connectors D35/W45, D35/W30, D30/W30 and D20/W45 are installed as connections between wood based members such as:

- Structural solid timber of soft- or hardwood according to EN 338 / EN 14081,
- Glulam made of soft- or hardwood, classified according to EN 14080, or with ETA or national approval,
- Glued solid timber made of softwood, classified according to EN 14080, or with ETA or national approval,
- LVL according to EN 14374, or with ETA or national approval,
- Cross laminated timber and similar structural glued products according EN16351 or ETA.

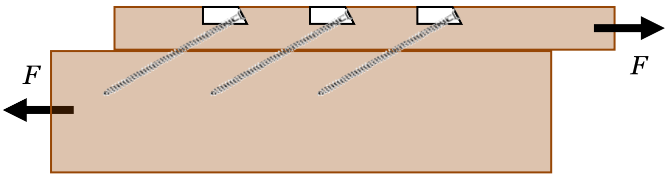
KNAPP T-JOINT connectors D40/W30 are installed as connections between wood based members such as:

- Structural solid timber of softwood according to EN 338 / EN 14081,
- Glulam made of softwood, classified according to EN 14080, or with ETA or national approval,
- Glued solid timber made of softwood, classified according to EN 14080, or with ETA or national approval,
- LVL made of softwood according to EN 14374, or with ETA or national approval,
- Cross laminated timber and similar structural glued products made of softwood according EN16351 or ETA.

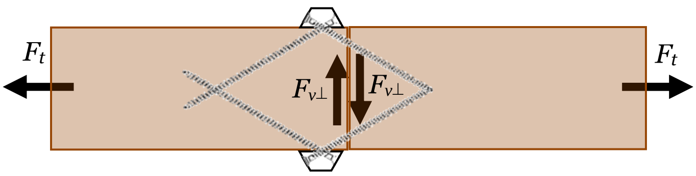
However, the calculation methods are only allowed for a characteristic wood density of up to 730 kg/m³ for KNAPP T-JOINT connectors D35/W45, D35/W30, D30/W30 and D20/W45 and up to 510 kg/m³ for KNAPP T-JOINT connectors D40/W30. Even though the wood based material may have a larger density, this must not be used in the formulas for the load-carrying capacities of the fasteners.

Annex B states the formulas for the characteristic load-carrying capacities and stiffness of the connections with KNAPP T-JOINT connectors. The design of the connections shall be in accordance with Eurocode 5 or a similar national Timber Code.

For KNAPP T-JOINT connectors D35/W45, D35/W30, D30/W30 and D20/W45 it is assumed that the forces acting on the connection are parallel to the interface between the timber members.



For KNAPP T-JOINT connectors D40/W30 it is assumed that the forces F_t acting on the connection are perpendicular to the joint line between the timber members. Forces $F_{v\perp}$ and $F_{v\parallel}$ are acting parallel to the joint line between the timber members, either perpendicular or parallel to the member surface.



The force F_t acts parallel to the axis of the connector and parallel to the timber member surface.

It is a condition for a force F_t or $F_{v\perp}$ or $F_{v\parallel}$ that the T-Joint connector is connected to a wood-based member with screws in all holes marked.

The connectors are intended for use in connections subject to static or quasi static loading. The stainless steel connectors are for use in timber structures subject to conditions defined by the service classes 1, 2 and 3 of

EN 1995-1-1:2008, (Eurocode 5). The screws to be used shall be made from suitable material.

Details of the corrosion protection system are deposited at ETA-Danmark.

The scope of the connectors regarding resistance to corrosion shall be defined according to national provisions that apply at the installation site considering environmental conditions.

The provisions made in this European Technical Assessment are based on an assumed intended working life of the connectors 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)	
Joint Strength - Characteristic load-carrying capacity	See Annex B
Joint Stiffness	See Annex B
Joint ductility	No performance assessed
Resistance to seismic actions	No performance assessed
Resistance to corrosion and deterioration	See section 3.6
3.2 Safety in case of fire (BWR2)	
Reaction to fire	The connectors are made from steel classified as Euroclass A1 in accordance with EN 13501-1 and Commission Delegated Regulation 2016/364
Resistance to fire	No performance assessed
3.3 General aspects related to the performance of the product	The connectors 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 class 1, 2 and 3
Identification	See Annex A

*) See additional information in section 3.7 – 3.9.

3.7 Methods of verification

The characteristic load-carrying capacities are based on the characteristic values of the connectors and the timber members.

According to EN 1990 (Eurocode – Basis of design) paragraph 6.3.5 the design value of load-carrying capacity can be determined by reducing the characteristic values of the load-carrying capacity with different partial factors.

Therefore, to obtain design values according to the Eurocodes or appropriate national codes of practice, the capacities have to be multiplied with different partial factors for the material properties and – for the connectors mounted in wood – also the coefficient k_{mod} that takes into account the load duration class.

Thus, the characteristic or design values of the load–carrying capacity are determined also for timber failure $F_{Rk,H}$ (obtaining the embedment strength of connectors subjected to shear or the withdrawal capacity of the screw, respectively (see Annex B) as well as for steel failure of the screw $F_{tens,Rd}$. The design value of the load–carrying capacity is the smaller value of both load–carrying capacities.

$$F_{Rd} = \min\left\{\frac{k_{mod} \cdot F_{Rk,H}}{\gamma_{M,H}}; F_{tens,Rd}\right\}$$

Therefore, for timber failure the load duration class and the service class are included. The different partial factors γ_M for steel or timber, respectively, are also correctly taken into account.

3.8 Mechanical resistance and stability

See annex B for characteristic load-carrying capacities of the connectors.

The characteristic capacities of the connectors are determined by calculation assisted by testing as described in EAD 130186-00-0603. They should be used for designs in accordance with Eurocode 5 or a similar national Timber Code.

The design models allow the use of fasteners described in Annex A:

Screws in accordance with EN 14592 or ETA

In the formulas in Annex B the capacities for self-drilling screws calculated from the formulas of Eurocode 5 are used when calculating the axial screw load-carrying-capacity.

No performance has been assessed in relation to connection stiffness or ductility of a joint under cyclic testing. The contribution to the performance of structures in seismic zones, therefore, has not been assessed.

3.9 Related aspects of serviceability

3.9.1 Corrosion protection in service class 1, 2 or 3.

In accordance with EAD 130186-00- 0603 the stainless steel connectors are produced from corrosion resistant steel castings. The steel employed is GX5CrNi 19-10 according to EN 10283:2010-06 with minimum yield strength R_e of 175 MPa.

Connector joints

A connector joint is deemed fit for its intended use provided:

- Connectors are fastened to wood-based members by screws.
- There shall be screws in all marked holes as prescribed in Annex A.
- The characteristic capacity of the connector joint is calculated according to the manufacturer’s technical documentation, dated 2019-08-09 and 2021-03-08.
- The connector joint is designed in accordance with Eurocode 5 or an appropriate national code.
- There is no gap between the timber member surfaces or between the member surface and the connector.
- The cross section of the timber members at the connector joint shall have sharp edges e, i.e. it shall be without wane.
- The dimensions of the timber members shall be so large that the minimum fastener end and edge distances are observed.
- Screws to be used shall have a diameter, which fits the holes of the connectors.

4 Assessment and verification of constancy of performance (AVCP) (hereinafter AVCP) system applied, with reference to its legal base.

4.1 AVCP system

According to the decision 97/638/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 2+.

5 Technical details necessary for the implementation of the AVCP system, as provided for 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

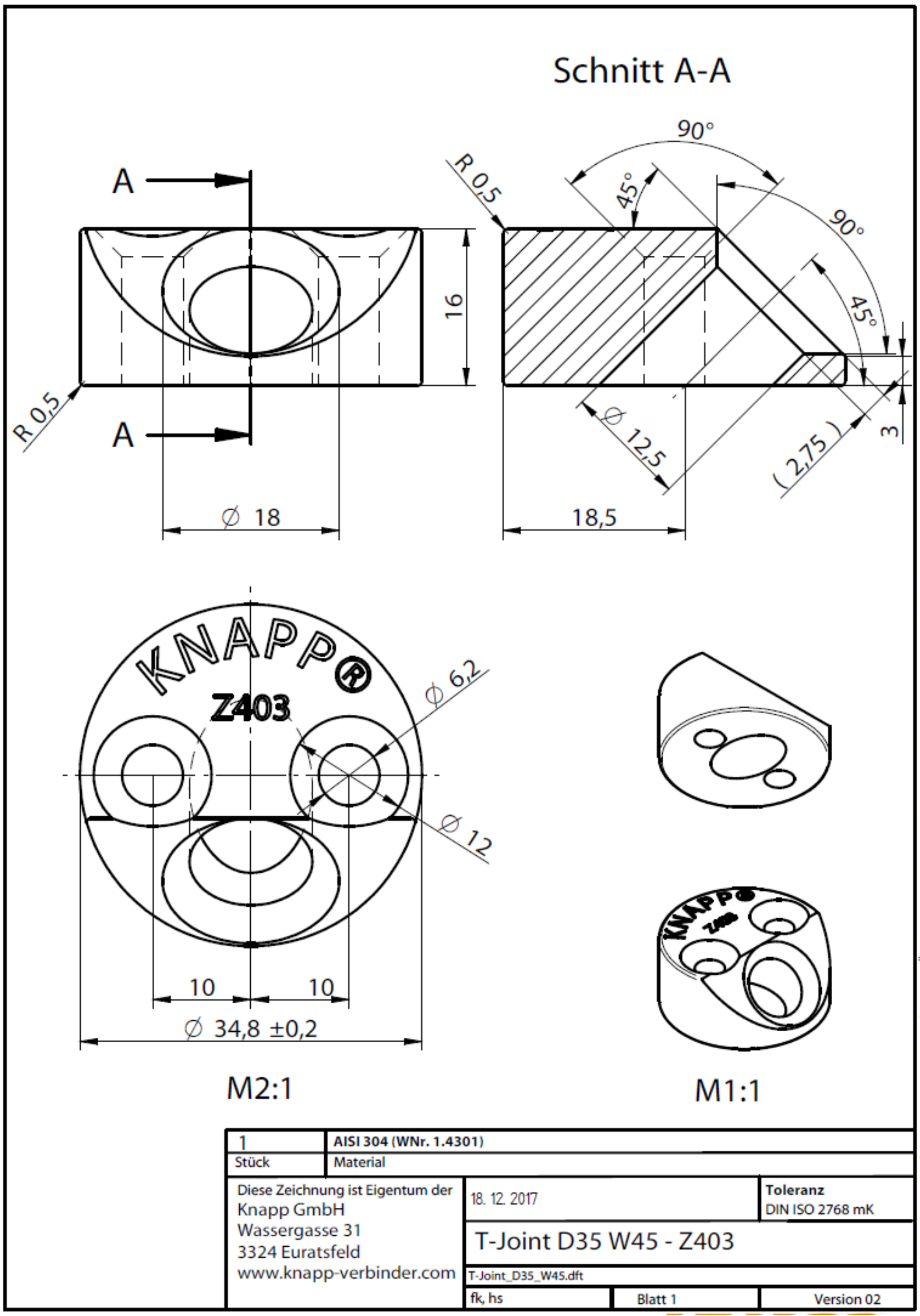
Issued in Copenhagen on 2025-01-24 by

Thomas Bruun
Managing Director, ETA-Danmark

Annex A
Product details and definitions

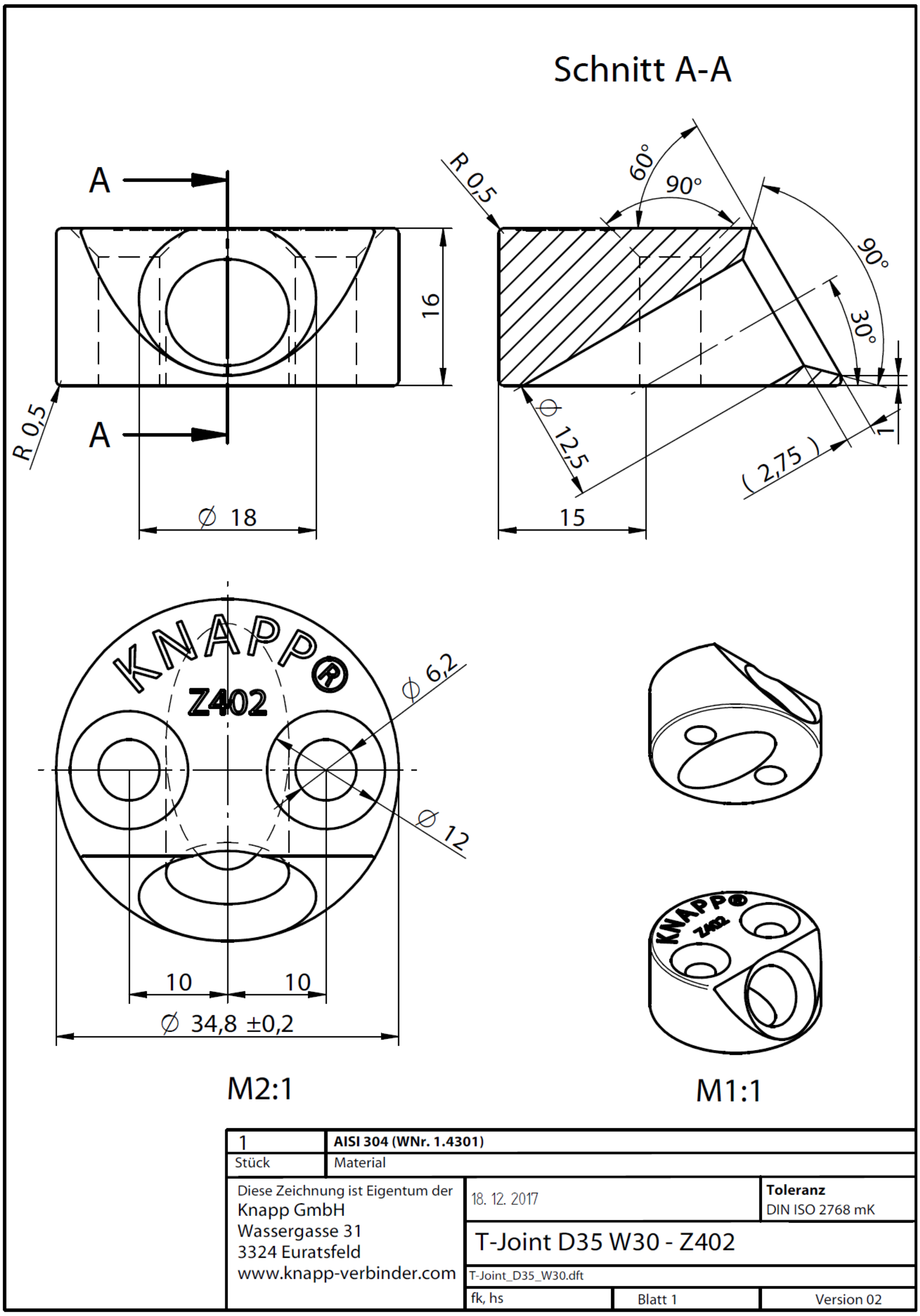
KNAPP T-JOINT connector D35/W45

Face mount one-piece connector. Steel casting for structural use GX5CrNi 19-10 according to EN 10283:2010-06 with minimum yield strength R_e of 175 MPa. Steel-to-timber connections with countersunk screw diameter 8 mm or 10 mm or 12 mm.



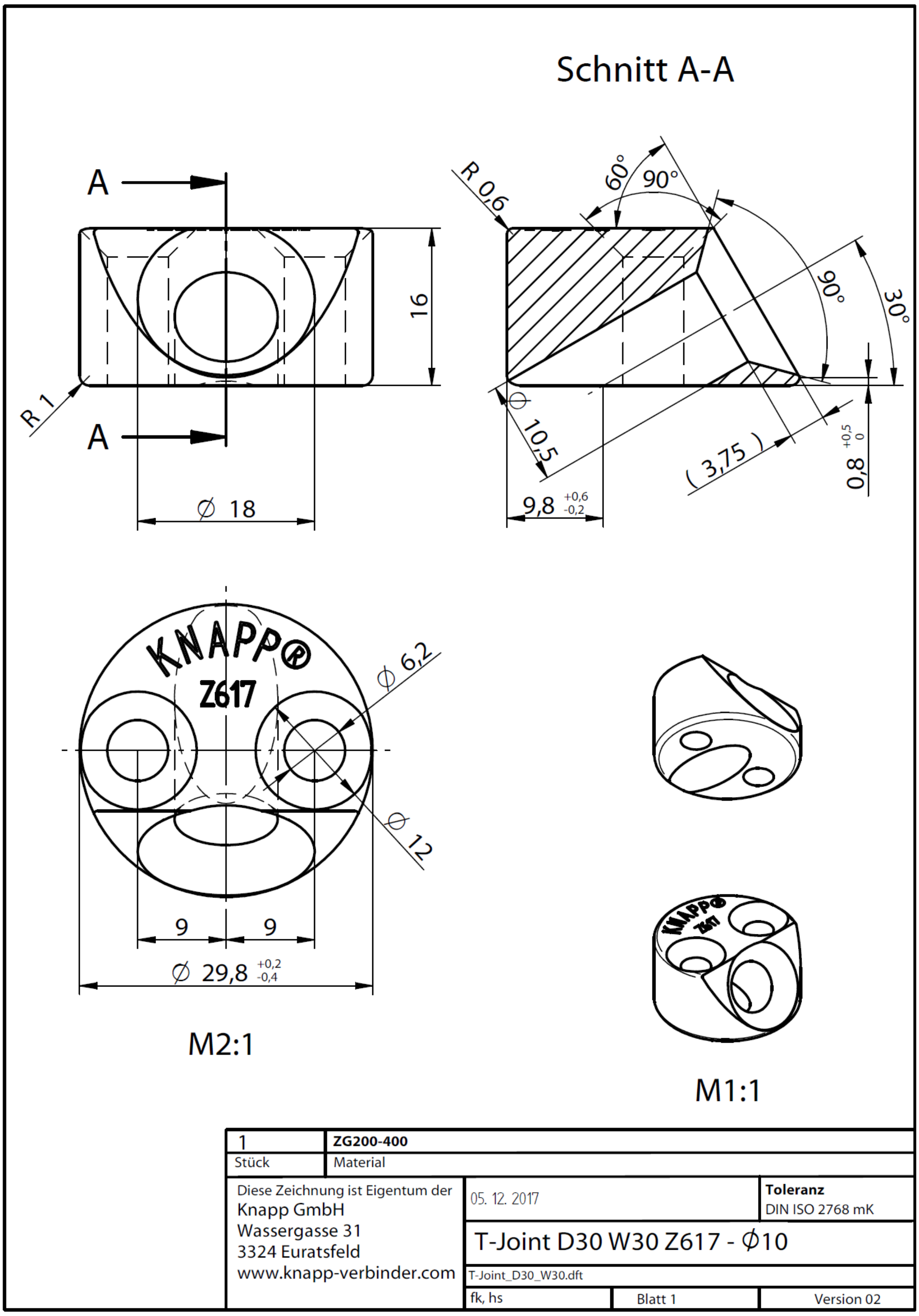
KNAPP T-JOINT connector D35/W30

Face mount one-piece connector. Steel casting for structural use GX5CrNi 19-10 according to EN 10283:2010-06 with minimum yield strength R_e of 175 MPa. Steel-to-timber connections with countersunk screw diameter 8 mm or 10 mm or 12 mm.



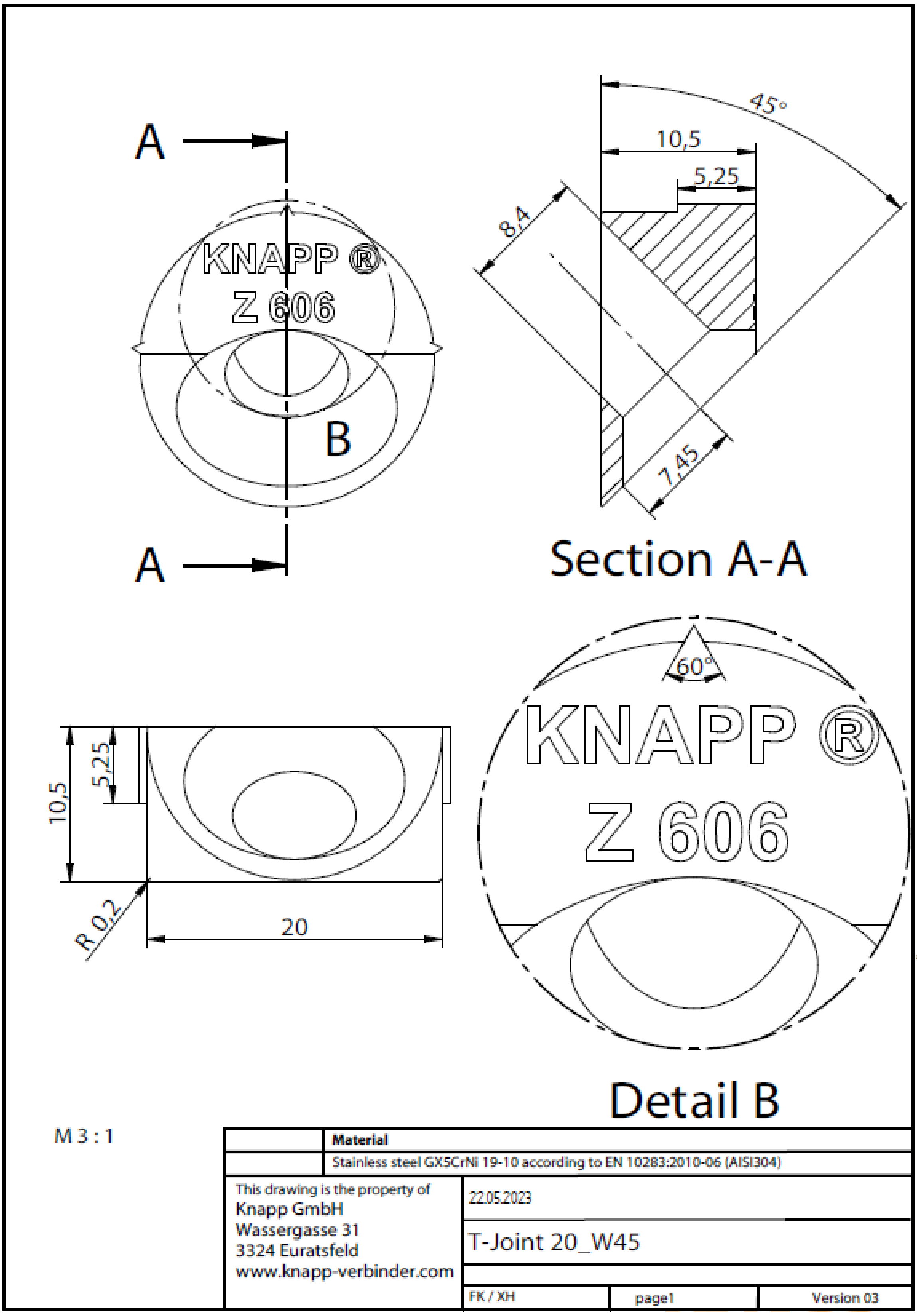
KNAPP T-JOINT connector D30/W30

Face mount one-piece connector. Steel casting for structural use GX5CrNi 19-10 according to EN 10283:2010-06 with minimum yield strength R_e of 175 MPa. Steel-to-timber connections with countersunk screw diameter 8 mm or 10 mm.



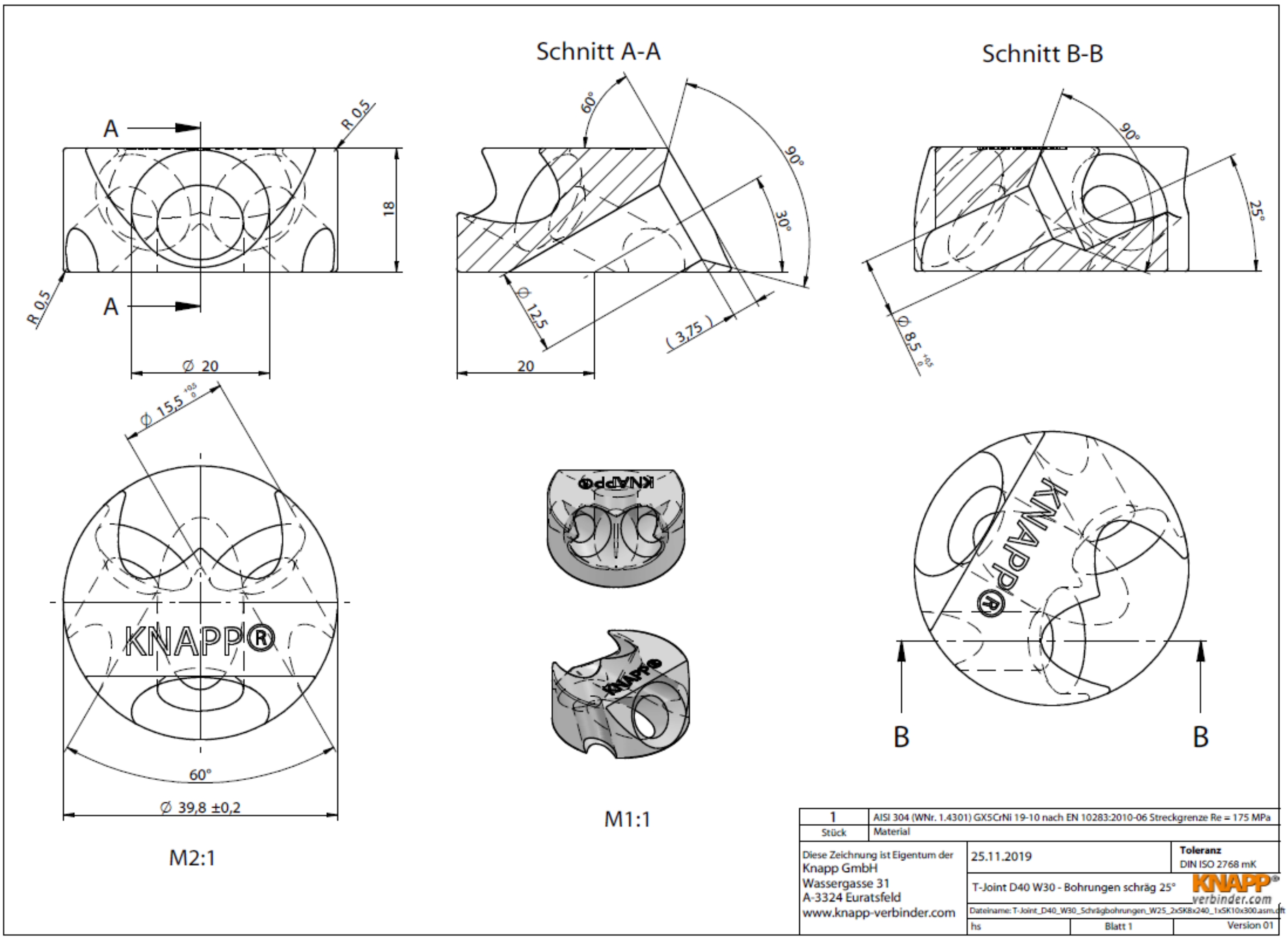
KNAPP T-JOINT connector D20/W45

Face mount one-piece connector. Steel casting for structural use GX5CrNi 19-10 according to EN 10283:2010-06 with minimum yield strength R_e of 175 MPa. Steel-to-timber connections with countersunk screw diameter 6 mm or 8 mm.



KNAPP T-JOINT connector D40/W30

Face mount one-piece connector. Steel casting for structural use GX5CrNi 19-10 according to EN 10283:2010-06 with minimum yield strength R_e of 175 MPa. Steel-to-timber connections with countersunk screw diameter 8 mm or 10 mm.

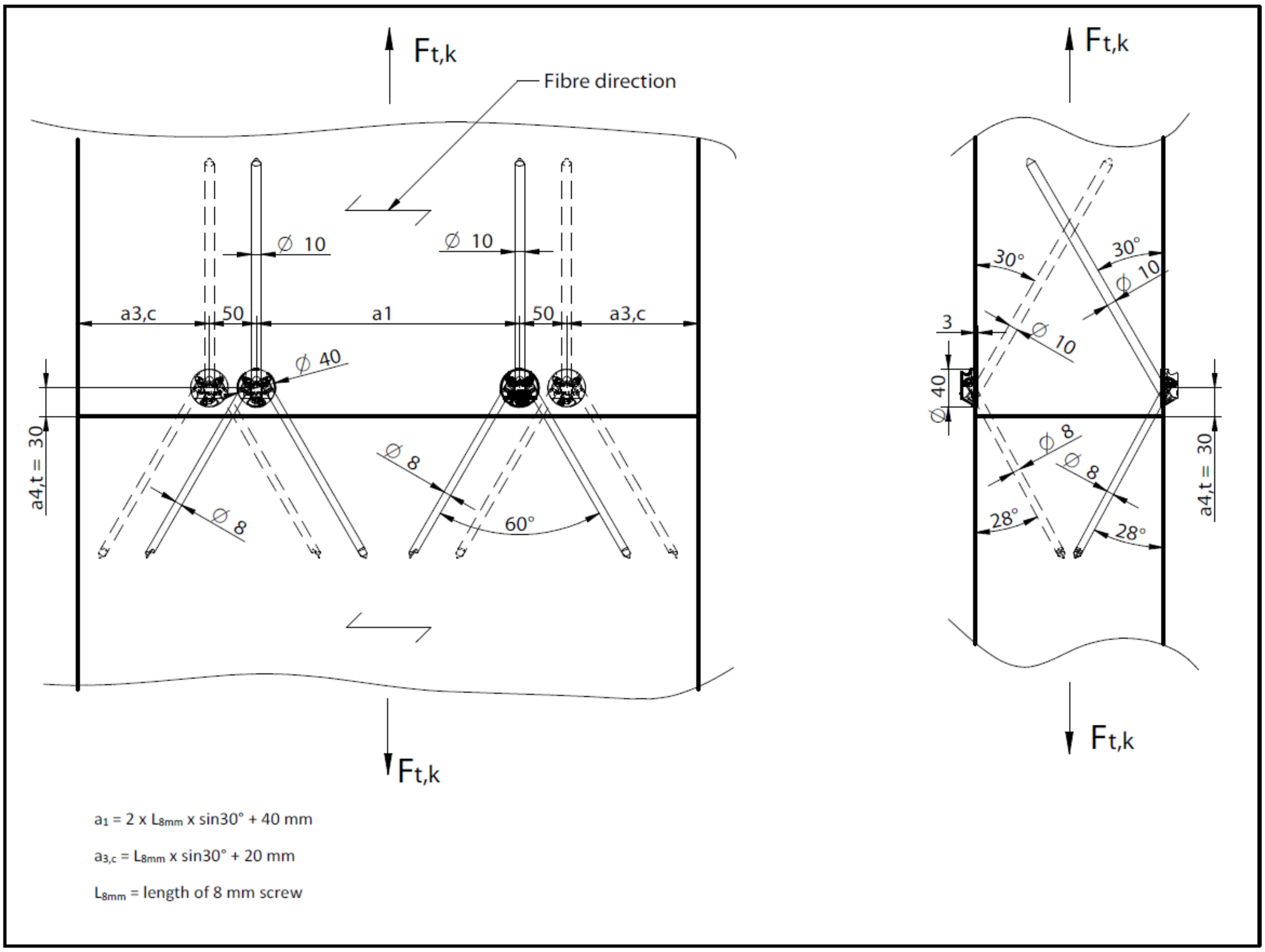


Fastener types and sizes

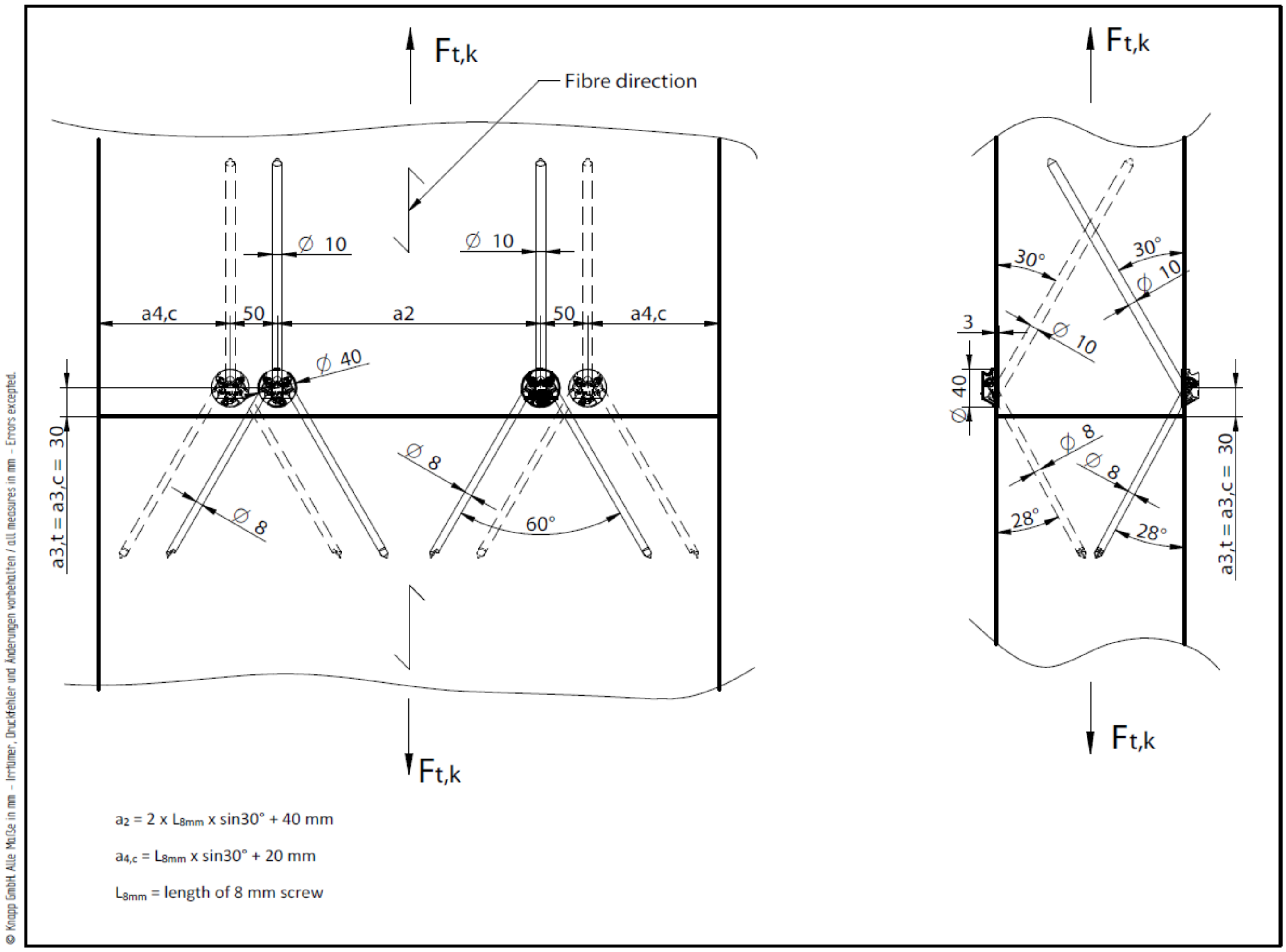
SCREW diameter [mm]	Length [mm]	Screw type
6.0 - 12.0	120 - 400	Self-tapping load-bearing screws according to EN 14592 or ETA
5.0 – 6.0	60 - 100	Fixing screws according to EN 14592 or ETA

Minimum spacings and edge and end distances for T-Joint connectors - see figures for legend.

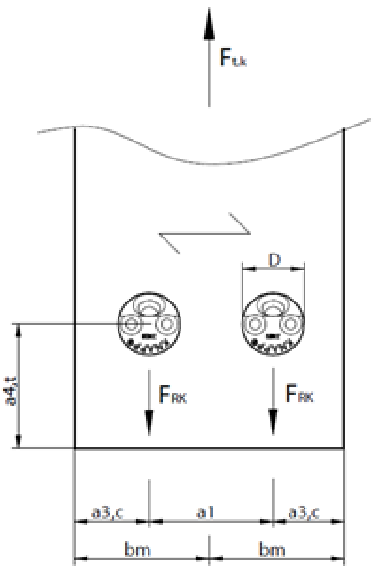
Spacing and edge/end distances (see EN 1995-1-1 Figure 8.7)	Angle to grain	Minimum spacings and edge/end distances	
		D35/W45, D35/W30, D30/W30 and D20/W45	D40 /W30
Distances parallel to grain			
a_1	$0^\circ \leq \alpha \leq 360^\circ$	2,0 D	$2 \cdot \ell_{8mm} \cdot \sin 30° + 40$ mm
$a_{3,t}$ (loaded end)	$-90^\circ \leq \alpha \leq 90^\circ$	2,0 D	30 mm
$a_{3,c}$ (unloaded end)	$90^\circ \leq \alpha < 270^\circ$	1,2 D	$\ell_{8mm} \cdot \sin 30° + 20$ mm
Distances perpendicular to grain			
a_2	$0^\circ \leq \alpha \leq 360^\circ$	2,0 D	$2 \cdot \ell_{8mm} \cdot \sin 30° + 40$ mm
$a_{4,t}$ (loaded edge)	$0^\circ \leq \alpha \leq 180^{0^\circ}$	2,0 D	30 mm
$a_{4,c}$ (unloaded edge)	$180^\circ \leq \alpha \leq 360^{0^\circ}$	1,2 D	$\ell_{8mm} \cdot \sin 30° + 20$ mm

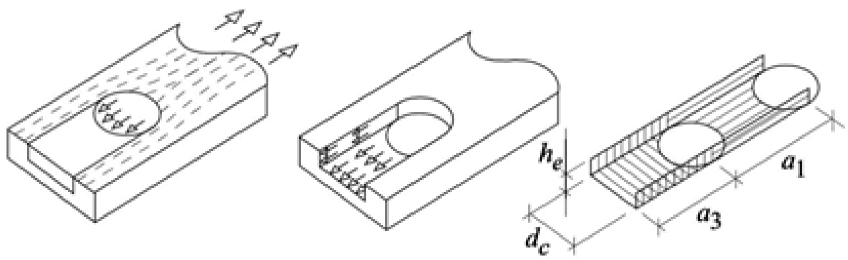


Legend for edge end distances for load perpendicular to the direction of the grain



Legend for edge end distances for load parallel to the direction of the grain





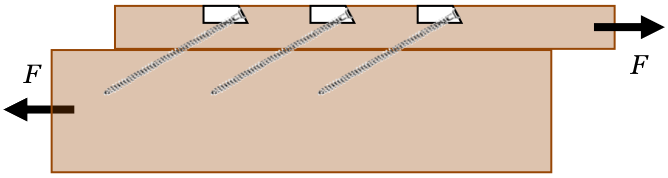
Legend for edge end distances

Shear areas in split ring connection

Annex B
Characteristic values of load-carrying-capacities and slip modulus

The forces are assumed to act parallel to the timber member surface. Only a full fastener pattern is specified, where there are screws in all the three holes of the connector except T-Joint D20/W45, where there is a single screw in the hole of the connector.

B.1 KNAPP T-JOINT connectors D35/W45, D35/W30, D30/W30 and D20/W45



Loading parallel to grain:

$$F_{Rk} = \min \begin{cases} F_{ax,Rk} \cdot \cos\alpha \\ \dfrac{f_{head,k} \cdot D^2}{\tan\alpha} \left(\dfrac{\rho_k}{350}\right)^{0,8} \\ 0,09 \cdot \rho_k \cdot D \cdot h_e \\ K \cdot A_s^{0,75} \end{cases} \quad \text{(B.1)}$$

Loading perpendicular to grain:

$$F_{Rk} = \min \begin{cases} F_{ax,Rk} \cdot \cos\alpha \\ \dfrac{f_{head,k} \cdot D^2}{\tan\alpha} \left(\dfrac{\rho_k}{350}\right)^{0,8} \\ 0,07 \cdot \rho_k \cdot D \cdot h_e \\ f_{vr,k} \cdot a_{4,t} \cdot b_m \end{cases} \quad \text{(B.2)}$$

Where:

α	Angle between screw axis and member surface, α = 30° or α = 45°;
$F_{ax,Rk}$	Characteristic tensile or withdrawal capacity of load-bearing screw in N, the lower value governs;
$f_{head,k}$	Characteristic pull-through parameter in N/mm², $f_{head,k}$ = 12 N/mm² ;
D	Outer diameter of T-Joint connector, D = 20 mm or D = 30 mm or D = 35 mm;
ρ_k	Characteristic density of timber member;
h_e	Thickness of T-Joint connector, h_e = 10,5 mm for D = 20 mm or h_e = 16 mm for D = 30 mm or D = 35 mm;
a_1	Spacing between T-Joints parallel to grain direction in mm;
$a_{3,t}$	Loaded end distance in mm;
$a_{4,t}$	Loaded edge distance in mm;
K	Factor; K = 20 N/mm^{1,5} for softwood solid timber, glued solid timber, glulam or CLT, K = 30 N/mm^{1,5} for softwood LVL, K = 40 N/mm^{1,5} for hardwood solid timber, glulam or CLT, K = 50 N/mm^{1,5} for hardwood LVL;
A_s	Shear area;

$$A_s = a_{3,t} \cdot (2 \cdot h_e + D) - \frac{\pi \cdot D^2}{8} \text{ for connections with one T-Joint in load direction}$$

$$A_s = a_1 \cdot (2 \cdot h_e + D) - \frac{\pi \cdot D^2}{2} \text{ for connections with more than one T-Joint in load direction}$$

$f_{vr,k}$	Characteristic rolling shear strength;
b_m	Width of rolling shear area; $b_m = 0,5 \cdot a_1 + a_{3,c}$ or $b_m = a_1$.

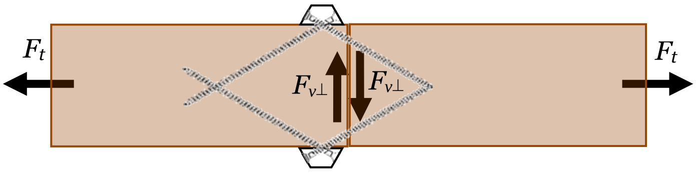
Slip modulus

$$K_{ser,T\text{-}Joint} = k_\alpha \cdot \left(\frac{1}{K_{ax,tip} \cdot \cos^2 \alpha} + \frac{1}{K_{ax,head} \cdot \cos^2 \alpha + \frac{n_{fixing} \cdot \rho_m^{1,5} \cdot d_{fixing}^{0,8}}{30} + 0,5 \cdot \rho_m \cdot d_{T-Joint}} \right)^{-1} \text{ N/mm} \qquad \text{(B.3)}$$

Where:

k_α = 0,50 for α = 30°
k_α = 0,34 for α = 45°
α is the angle between screw axis and load direction
α = 30° for T-Joint D35/W30 and D30/W30
α = 45° for T-Joint D35/W45 and D20/W45
$K_{ax,tip}$ is the axial slip modulus of the screw length embedded in the timber member close to the screw tip,
$K_{ax,tip} = 25 \cdot \ell_{ef,tip} \cdot d$ [N/mm] for softwood,
$K_{ax,tip} = 30 \cdot \ell_{ef,tip} \cdot d$ [N/mm] for hardwood
$K_{ax,head}$ is the axial slip modulus of the screw length embedded in the timber member close to the screw tip,
$K_{ax,head} = 25 \cdot \ell_{ef,head} \cdot d$ [N/mm] for softwood,
$K_{ax,head} = 30 \cdot \ell_{ef,head} \cdot d$ [N/mm] for hardwood
d is the diameter of the inclined screw [mm]
$\ell_{ef,tip}$ is the penetration length of the inclined screw in the point side timber member [mm]
$\ell_{ef,head}$ is the penetration length of the inclined screw in the point side timber member [mm]
n_{Fixing} is the number of fixing screws per T-Joint connector
n_{Fixing} = 2 for T-Joint D35/W45, D35/W30 and D30/W30
n_{Fixing} = 0 for T-Joint D20/W45
ρ_m is the mean density of the timber member on the screw's head side [kg/m³]
d_{Fixing} is the diameter of the fixing screws, d_{Fixing} = 5 mm or 6 mm
$d_{T-Joint}$ is the diameter of the T-Joint connector
$d_{T-Joint}$ = 35 mm for T-Joint D35/W45 and D35/W30
$d_{T-Joint}$ = 30 mm for T-Joint D30/W30
$d_{T-Joint}$ = 20 mm for T-Joint D20/W45

B.2 KNAPP T-JOINT connector D40/W30



$$F_{t,Rk} = \min \begin{cases} 0,866 \cdot F_{ax,10mm,Rk} \\ 1,58 \cdot F_{ax,8mm,Rk} \\ 26 \cdot \left(\frac{\rho_k}{400} \right)^{0,8} \ \text{kN} \end{cases} \tag{B.4}$$

$$F_{v\parallel,Rk} = \min \begin{cases} F_{ax,8mm,Rk} \cdot \cos 28° \cdot (\sin 30° + 0,25 \cdot \cos 30°) \\ F_{v,10mm,Rk} + \min\{F_{v,10mm,Rk}; 0,25 \cdot F_{ax,10mm,Rk} \cdot \cos 30°\} \end{cases} \tag{B.5}$$

$$F_{v\perp,Rk} = 0,25 \cdot F_{contact} + \min \begin{cases} \cos 30° \cdot \min\{F_{v,Rk,10mm}; 2 \cdot F_{ax,Rk,8mm} \cdot \sin 28°\} \\ \cos 28° \cdot \min\{2 \cdot F_{v,Rk,8mm}; F_{ax,Rk,10mm} \cdot \sin 30°\} \end{cases} \tag{B.6}$$

$$F_{contact} = \min \begin{cases} F_{v,10mm,Rk} \cdot \sin 30° \\ 2 \cdot F_{v,8mm,Rk} \cdot \sin 28° \\ F_{ax,10mm,Rk} \cdot \cos 30° \\ 2 \cdot F_{ax,8mm,Rk} \cdot \cos 28° \cdot \cos 30° \end{cases} \tag{B.7}$$

Where:

$F_{ax,10mm,Rk}$ Characteristic tensile or withdrawal capacity of 10 mm screw in N, the lower value governs, $\ell_{ef} = \ell_{screw} - 25$ mm;

$F_{ax,8mm,Rk}$ Characteristic tensile or withdrawal capacity of 8 mm screw in N, the lower value governs, $\ell_{ef} = \ell_{screw} - 45$ mm;

$F_{v,10mm,Rk}$ Characteristic lateral capacity of 10 mm screw without rope effect in N;
with $f_{h,10mm,k} = \frac{0,082 \cdot \rho_k \cdot 10^{-0,3}}{2,5 \cdot \cos^2 30° + \sin^2 30°}$

$F_{v,8mm,Rk}$ Characteristic lateral capacity of 8 mm screw without rope effect in N;
with $f_{h,8mm,k} = \frac{0,082 \cdot \rho_k \cdot 8^{-0,3}}{2,5 \cdot \cos^2 38° + \sin^2 38°}$

ρ_k Characteristic density of timber member in contact with KNAPP T-JOINT connector D40/W30;

Combined forces

If the forces F_t, $F_{v,\parallel}$ or $F_{v\perp}$ act at the same time, the following inequality shall be fulfilled:

$$\left(\frac{F_{t,Ed}}{F_{t,Rd}}\right)^2 + \left(\frac{F_{v\parallel,Ed}}{F_{v\parallel,Rd}}\right)^2 + \left(\frac{F_{v\perp,Ed}}{F_{v\perp,Rd}}\right)^2 \tag{B.8}$$

Slip modulus

$$K_{ser,t} = 13 \text{ kN/mm} \tag{B.9}$$
$$K_{ser,v\perp} = K_{ser,v\parallel} = 6 \text{ kN/mm} \tag{B.10}$$