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European Technical Assessment

ETA-24/0624
of 24 July 2024

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the European Technical Assessment:	Deutsches Institut für Bautechnik
Trade name of the construction product	HECO-WR (HWR)
Product family to which the construction product belongs	Self-tapping screws for use in timber constructions
Manufacturer	HECO-Schrauben GmbH & Co. KG Dr.-Kurt-Steim-Straße 28 78713 Schramberg GERMANY
Manufacturing plant	
This European Technical Assessment contains	17 pages including 4 annexes which form an integral part of this assessment
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of	EAD 130118-01-0603

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Specific Part

1 Technical description of the product

HECO-WR (HWR) in the versions "HWR-T-9,0 and HWR-T-13,0" are self-tapping screws divided into a drill tip, a continuous threaded length, and head of the screw. They are made from special carbon steel and coated with a corrosion protection according to Annex A.2.6. The outer thread diameter is not less than 9.0 mm and not greater than 13.0 mm. The overall length of the screws is ranging from 50 mm to 1000 mm. Further dimensions are shown in Annex 4.

All HECO-WR (HWR) achieve a bending angle α of at least $45/d^{0.7} + 20$, where d is the outer thread diameter of the screws.

2 Specification of the intended use in accordance with the applicable European Assessment Document

The performances given in Section 3 are only valid if the HECO-WR (HWR) are used in compliance with the specifications and conditions given in Annex 1 and 2.

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the screws of at least 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, 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

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Dimensions	See Annex 4
Characteristic yield moment	See Annex 2
Bending angle	See Annex 2
Characteristic withdrawal parameter	See Annex 2
Characteristic head pull-through parameter	See Annex 2
Characteristic tensile strength	See Annex 2
Characteristic yield strength	See Annex 2
Characteristic torsional strength	See Annex 2
Insertion moment	See Annex 2
Spacings, end and edge distances of the screws and minimum thickness of the wood-based material	See Annex 2
Slip modulus for mainly axially loaded screws	See Annex 2
Durability against corrosion	See Annex 2

3.2   Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1

3.3   Safety and accessibility in use (BWR 4)

Same as BWR 1.

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

In accordance with EAD No. 130118-01-0603, the applicable European legal act is: 97/176/EC. The system to be applied is: 3

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 with Deutsches Institut für Bautechnik.

Issued in Berlin on 24 July 2024 by Deutsches Institut für Bautechnik

Anja Dewitt   *beglaubigt:*
Head of Section   Vössing

Annex 1   Specifications of intended use

A.1.1 Use of the HECO-WR (HWR) only for:

− static and quasi-static loads

A.1.2 Connection materials

The screws are used for connections in load-bearing timber structures between timber members or between timber members and steel members:

− Solid timber (softwood) in accordance with EN 14081-1[1],
− Solid timber of ash, beech or oak hardwood in accordance with EN 14081-1,
− Glued laminated timber (softwood) in accordance with EN 14080[2],
− Glued laminated timber made of ash, beech or oak hardwood in accordance with European Technical Assessments,
− Glued solid timber in accordance with EN 14080,
− Laminated veneer lumber LVL made of softwood or beech in accordance with EN 14374[3],
− Beam BauBuche GL75 in accordance with ETA-14/0354,
− Cross laminated timber (softwood) in accordance with European Technical Assessments.

The screws are used for connecting the following wood-based panels to the timber members mentioned above:

− Oriented strand boards (OSB) in accordance with EN 300[4] and EN 13986,
− Plywood in accordance with EN 636[5] and EN 13986[6],
− Particleboards in accordance with EN 312[7] and EN 13986,
− Cement-bonded particleboards in accordance with EN 634-2[8] and EN 13986,
− Fibreboards in accordance with EN 622-2[9], EN 622-3[10] and EN 13986,
− Solid wood panels (SWP) in accordance with EN 13353[11] and EN 13986.

Wood-based panels are only arranged on the side of the screw head.

HECO-WR (HWR) may be used for reinforcing of timber structures perpendicular to the grain.

[1]	EN 14081-1:2005+A1:2011	Timber structures – Strength graded structural timber with rectangular cross section – Part 1: General requirements
[2]	EN 14080:2013	Timber structures – Glued laminated timber and glued solid timber – Requirements
[3]	EN 14374:2004	Timber structures – Structural laminated veneer lumber – Requirements
[4]	EN 300:2006	Oriented strand boards (OSB) – Definition, classification and specifications
[5]	EN 636:2012+A1:2015	Plywood – Specifications
[6]	EN 13986:2004+A1:2015	Wood-based panels for use in construction – Characteristics, evaluation of conformity and marking
[7]	EN 312:2010	Particleboards – Specifications
[8]	EN 634-2:2007	Cement-bonded particleboards – Specifications – Part 2: Requirements for OPC bonded particleboards for use in dry, humid and external conditions
[9]	EN 622-2:2004/AC:2005	Fibreboards – Specifications – Part 2: Requirements for hardboards
[10]	EN 622-3:2004	Fibreboards – Specifications – Part 3: Requirements for medium boards
[11]	EN 13353:2008+A1:2011	Solid wood panels (SWP) – Requirements

HECO-WR (HWR)	
Specifications of intended use	Annex 1.1

A.1.3 Use conditions (environmental conditions)

The corrosion protection of the HECO-WR (HWR) is specified in Annex A.2.6.

A.1.4 Installation provisions

EN 1995-1-1[12] applies for the installation of HECO-WR (HWR).

A minimum of two screws is used for connections in load-bearing timber structures.

The screws are either driven into timber members made of softwood without pre-drilling or in pre-drilled holes with a diameter given in Table A.1.

The screws are driven into timber members made of ash, beech or oak with a maximum mean density of 750 kg/m³ and into timber members made of beech LVL or Beam BauBuche GL75 in accordance with ETA-14/0354 with a maximum mean density of 850 kg/m³ in pre-drilled holes with a diameter given in Table A.1.

Table A.1   Diameter of the pre-drilled holes

Screw type	Diameter of the pre-drilled hole with a tolerance of ± 0.1 mm [mm]	
	Softwood and LVL made of softwood	Ash, beech or oak hardwood, LVL made from beech or Beam BauBuche GL75 in accordance with ETA-14/0354
HWR-T-9,0	5.0	7.0
HWR-T-13,0	8.0	-

The screw holes in steel members are pre-drilled with an adequate diameter greater than the outer thread diameter.

If the screws with an outer thread diameter d ≥ 8 mm are driven into the timber member without pre-drilling, the solid timber, glued laminated timber, glued solid timber, laminated veneer lumber or cross laminated timber is from spruce, pine or fir.

By fastening screws in timber members, the head of the screws is flush with the surface of the timber member.

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[12] EN 1995-1-1:2004/AC2006 +A2:2014+A1:2008+A2:2014   Eurocode 5: Design of timber structures – Part 1-1: General – Common rules and rules for buildings

HECO-WR (HWR)	Annex 1.2
Installation provisions	

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Annex 2   Characteristic values of the load-carrying capacities

Table A.2.1   Characteristic load-carrying capacities of HECO-WR (HWR)

Outer thread diameter d [mm]	9.0	13.0
Characteristic yield moment $M_{y,k}$ [Nm]	30.0	80.0
Characteristic tensile strength $f_{tens,k}$ [kN]	25.0	55.0
Characteristic torsional strength $f_{tor,k}$ [Nm]	30.0	100.0

A.2.1 General

All HECO-WR (HWR) achieve a bending angle α of at least $45/d^{0.7} + 20$, where d is the outer thread diameter of the screws.

The minimum penetration length of the threaded part of the screw in the wood-based members l_{ef} is:

$$l_{ef} = \min \begin{cases} \dfrac{4 \cdot d}{\sin \alpha} \\[2mm] 20 \cdot d \end{cases} \tag{2.1}$$

Where

α angle between screw axis and grain direction [°],

d   outer thread diameter of the screw [mm].

The inner thread diameter d_1 of the screws is greater than the maximal width of the gaps in the layer of cross laminated timber.

A.2.2 Laterally loaded screws

A.2.2.1 General

The outer thread diameter d is used as effective diameter of the screw in accordance with EN 1995-1-1.

The embedding strength for the screws in timber members or in wood-based panels shall be taken from EN 1995-1-1.

A.2.2.2 Solid timber, glued laminated timber and glued solid timber

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

$$f_{h,k} = \frac{0.082 \cdot \rho_k \cdot d^{-0.3}}{2.5 \cdot \cos^2 \alpha + \sin^2 \alpha} \quad \text{[N/mm²]} \tag{2.2}$$

The embedding strength for screws in pre-drilled holes in softwood or in ash, beech or oak hardwood arranged at an angle between screw axis and grain direction, $0° \leq \alpha \leq 90°$ is:

$$f_{h,k} = \frac{0.082 \cdot \rho_k \cdot (1 - 0.01 \cdot d)}{2.5 \cdot \cos^2 \alpha + \sin^2 \alpha} \quad \text{[N/mm²]} \tag{2.3}$$

HECO-WR (HWR)	Annex 2.1
Characteristic values of the load-carrying capacities	

Where

ρ_k characteristic density of the timber member, for ash, beech and oak [kg/m³], $\rho_k \leq 590$ kg/m³,

d   outer thread diameter of the screw [mm],

α angle between screw axis and grain direction, $0° \leq \alpha \leq 90°$.

A.2.2.3 Laminated veneer lumber

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

$$f_{h,k} = \frac{0.082 \cdot \rho_k \cdot d^{-0.3}}{(2.5 \cdot \cos^2 \alpha + \sin^2 \alpha)(1.5 \cdot \cos^2 \beta + \sin^2 \beta)} \quad [\text{N/mm}^2] \tag{2.4}$$

and accordingly, for screws in pre-drilled holes in softwood LVL arranged at an angle between screw axis and grain direction, $0° \leq \alpha \leq 90°$:

$$f_{h,k} = \frac{0.082 \cdot \rho_k \cdot (1 - 0.01 \cdot d)}{(2.5 \cdot \cos^2 \alpha + \sin^2 \alpha)(1.5 \cdot \cos^2 \beta + \sin^2 \beta)} \quad [\text{N/mm}^2] \tag{2.5}$$

Where

ρ_k characteristic timber density of the softwood LVL [kg/m³], $\rho_k \leq 500$ kg/m³,

d   outer thread diameter of the screw [mm],

α angle between screw axis and grain direction ($0° \leq \alpha \leq 90°$),

β angle between screw axis and the LVL's wide face ($0° \leq \beta \leq 90°$).

The embedding strength for screws in pre-drilled or in non-pre-drilled holes in beech LVL in accordance with EN 14374 or in Beam BauBuche GL75 in accordance with ETA-14/0354 arranged at an angle between screw axis and grain direction, $0° \leq \alpha \leq 90°$ is:

$$f_{h,k} = \frac{0.082 \cdot \rho_k \cdot d^{-0.15}}{(2.5 \cdot \cos^2 \alpha + \sin^2 \alpha) \cdot k_\varepsilon \cdot k_\beta} \quad [\text{N/mm}^2] \tag{2.6}$$

Where

ρ_k characteristic density of beech LVL or Beam BauBuche GL75 [kg/m³], 590 kg/m³ $\leq \rho_k \leq$ 750 kg/m³

d   outer thread diameter of the screw [mm],

α angle between screw axis and grain direction, $0° \leq \alpha \leq 90°$,

k_ε $= (0.5 + 0.024 \cdot d) \cdot \sin^2 \varepsilon + \cos^2 \varepsilon$, $\tag{2.7}$

ε angle between load and grain direction, $0° \leq \varepsilon \leq 90°$,

k_β $= 1.2 \cdot \cos^2 \beta + \sin^2 \beta$, $\tag{2.8}$

β angle between screw axis and wide face of LVL or Beam BauBuche GL75 member, $0° \leq \beta \leq 90°$.

HECO-WR (HWR)	Annex 2.2
Characteristic values of the load-carrying capacities	

A.2.2.4 Cross laminated timber

The embedding strength for screws arranged in the narrow faces parallel to the plane of cross laminated timber may be assumed with equation (2.9) independent of the angle between screw axis and grain direction, $0° \leq \alpha \leq 90°$:

$$f_{h,k} = 20 \cdot d^{-0,5} \quad [N/mm^2] \tag{2.9}$$

unless otherwise specified in the technical specification of the cross laminated timber.
Where d is the outer thread diameter of the screws in mm.

Equation (2.9) is only valid for softwood layers. The provisions in the European Technical Assessment of the cross laminated timber apply.

The embedding strength for screws in the wide faces of cross laminated timber can be assumed as for solid timber based on the characteristic density of the outer layer. Where applicable, the angle between force and grain direction of the outer layer shall be considered. The direction of the lateral force shall be perpendicular to the screw axis and parallel to the wide faces of the cross laminated timber.

A.2.3 Axially loaded screws

A.2.3.1 Slip modulus for mainly axially loaded screws

The axial slip modulus K_{ser} of the threaded part of a screw for the serviceability limit state per side shall be taken independent of angle α to the grain as:

$$K_{ser} = 25 \cdot l_{ef} \cdot d \quad [N/mm] \qquad \text{for timber members made of softwood} \tag{2.10}$$

$$K_{ser} = 30 \cdot l_{ef} \cdot d \quad [N/mm] \qquad \text{for timber members made of ash, beech, oak or beech LVL} \tag{2.11}$$

Where

d   outer thread diameter of the screw [mm],
l_{ef} penetration length of the threaded part of the screw in the timber member [mm].

A.2.3.2 Axial withdrawal capacity – Characteristic withdrawal parameter

The characteristic withdrawal capacity of HECO-WR (HWR) in solid timber (softwood or hardwood species ash, beech and oak), glued laminated timber (softwood or hardwood species ash, beech and oak), cross laminated timber or laminated veneer lumber members or Beam BauBuche GL75 in accordance with ETA-14/0354 at an angle of $0° \leq \alpha \leq 90°$ to the grain shall be calculated as:

$$F_{ax,\alpha,Rk} = \frac{n_{ef} \cdot k_{ax} \cdot f_{ax,k} \cdot d \cdot l_{ef}}{k_\beta} \cdot \left(\frac{\rho_k}{\rho_a}\right)^{0.8} \tag{2.12}$$

Where

$F_{ax,\alpha,Rk}$ characteristic withdrawal capacity of a screw group at an angle α to the grain [N],

n_{ef} effective number of screws in accordance with EN 1995-1-1:2008, clause 8.7.2 (8),

k_{ax} factor, taking into account the angle α between screw axis and grain direction,

     $k_{ax} = 1.0$ for $45° \leq \alpha \leq 90°$

     $k_{ax} = a + \dfrac{b \cdot \alpha}{45°}$ for $0° \leq \alpha < 45°$ (2.13)

     $a = \begin{cases} 0.5 \text{ for LVL} \\ 0.3 \text{ for solid timber, glued solid timber, glued laminated timber and cross laminated timber} \end{cases}$

     $b = \begin{cases} 0.5 \text{ for LVL} \\ 0.7 \text{ for solid timber, glued solid timber, glued laminated timber and cross laminated timber} \end{cases}$

HECO-WR (HWR)	
Characteristic values of the load-carrying capacities	Annex 2.3

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Equation (2.12) may be used for angles α between screw axis and grain direction $0° \le \alpha < 15°$ if the following requirements are fulfilled:

1. The screws are inserted in solid timber, glued laminated timber, glued solid timber or laminated veneer lumber made from softwood or beech.

2. The penetration length of the threaded part of the screws is:

$$l_{ef,req} = \min \begin{cases} \dfrac{4 \cdot d}{\sin \alpha} \\ \\ 20 \cdot d \end{cases}$$

3. At least four screws are used in a connection.

k_β $k_\beta = 1.0$ for solid timber, glued solid timber and glued laminated timber

           $k_\beta = 1.5 \cdot \cos^2 \beta + \sin^2 \beta$ for laminated veneer lumber   (2.14)

$f_{ax,k}$ characteristic withdrawal parameter at an angle $\alpha = 90°$ for

- solid timber, glued solid timber, glued laminated timber, cross laminated timber and laminated veneer lumber made of softwood with $\rho_a = 350$ kg/m³:

  $f_{ax,k} = 12.8$ N/mm²

  The characteristic withdrawal parameter is also valid for softwood layers of cross laminated timber.

- beech LVL or Beam BauBuche GL75 (ETA-14/0354) members with $\rho_a = 730$ kg/m³:

  $f_{ax,k} = 35.0$ N/mm² for HECO screws HWR-T with d = 9.0 mm

d outer thread diameter of the screw [mm],

l_{ef} penetration length of the threaded part of the screw [mm],

α angle between grain and screw axis ($0° \le \alpha \le 90°$),

β angle between screw axis and the LVL's wide face ($0° \le \beta \le 90°$),

ρ_k characteristic density of the timber member [kg/m³], for softwood LVL $\rho_k \le 500$ kg/m³, for hardwood $\rho_k \le 590$ kg/m³, for beech LVL 590 kg/m³ $\le \rho_k \le 750$ 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. In the narrow faces of the cross laminated timber the screws are fully inserted in one layer of cross laminated timber.

HECO-WR (HWR)	
	Annex 2.4
Characteristic values of the load-carrying capacities	

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A.2.3.3 Head pull-through capacity – Characteristic head pull-through parameter

The characteristic value of the head pull-through parameter of HECO-WR (HWR) for solid timber (softwood or hardwood species ash, beech and oak), glued laminated timber (softwood or hardwood species ash, beech and oak), cross laminated timber, laminated veneer lumber members made of softwood or beech and wood-based panels like

- Oriented strand boards (OSB) in accordance with EN 300 and EN 13986,
- Plywood in accordance with EN 636 and EN 13986,
- Particleboards in accordance with EN 312 and EN 13986,
- Cement-bonded particleboards in accordance with EN 634-2 and EN 13986,
- Fibreboards in accordance with EN 622-2, EN 622-3 and EN 13986,
- Solid wood panels (SWP) in accordance with EN 13353 and EN 13986.

with a thickness of more than 20 mm and for ρ_a = 350 kg/m³ is

$f_{head,k}$ = 10.0 N/mm² for screws with countersunk head.

The characteristic head pull-through capacity in equation (8.40b) of EN 1995-1-1 for screws with alternative head geometry in accordance with Annex 4 is $F_{ax,\alpha,Rk}$ = 0.

For wood-based panels a maximum characteristic density of 380 kg/m³, for softwood LVL 500 kg/m³, for hardwood 590 kg/m³ and for beech LVL 730 kg/m³ shall be used in equation (8.40b) of EN 1995-1-1.

For wood-based panels with a thickness 12 mm ≤ t ≤ 20 mm the characteristic value of the head pull-through parameter for the HECO-WR (HWR) is:

$f_{head,k}$ = 8.0 N/mm².

For wood-based panels with a thickness of less than 12 mm the characteristic head pull-through capacity for HECO-WR (HWR) shall be based on a characteristic value of the head pull-through parameter of 8.0 N/mm². The characteristic head pull-through capacity shall be limited to 400 N. A minimum thickness of the wood-based panels of 1.2·d, with d as the outer thread diameter, and the values in Table A.2.2 shall be complied.

Table A.2.2 Minimum thickness of wood-based panels

Wood-based panel	Minimum thickness [mm]
Plywood	6
Fibreboards (hardboards and medium boards)	6
Oriented strand boards (OSB)	8
Particleboards	8
Cement-bonded particleboard	8
Solid wood panels (SWP)	12

For HECO-WR (HWR) the withdrawal capacity of the thread near the head in the timber member with the screw head may be taken into account instead of the head pull-through capacity.

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

HECO-WR (HWR)	Annex 2.5
Characteristic values of the load-carrying capacities	

A.2.3.4 Compressive capacity of HECO-WR (HWR) – Characteristic yield strength

The design axial capacity $F_{ax,Rd}$ of HECO-WR (HWR) embedded in solid timber, glued solid timber or glued laminated timber made from softwood with an angle between screw axis and grain direction of 30° ≤ α ≤ 90° is the minimum of the axial resistance against pushing-in and the buckling resistance of the screw.

$$F_{ax,Rd} = \min\left\{k_{ax} \cdot f_{ax,d} \cdot d \cdot \ell_{ef}; \kappa_c \cdot N_{pl,d}\right\} \tag{2.15}$$

k_{ax} factor, taking into account the angle α between screw axis and grain direction in accordance with clause A.2.3.2,

$f_{ax,d}$ design value of the axial withdrawal parameter of the threaded part of the screw [N/mm²],

d outer thread diameter of the screw [mm],

l_{ef} penetration length of the threaded part of the screw in the timber member [mm],

$$\kappa_c = 1 \qquad\qquad \text{for } \overline{\lambda}_k \leq 0{,}2 \tag{2.16}$$

$$\kappa_c = \frac{1}{k + \sqrt{k^2 - \overline{\lambda}_k^2}} \qquad \text{for } \overline{\lambda}_k > 0{,}2 \tag{2.17}$$

$$k = 0{,}5 \cdot \left[1 + 0{,}49 \cdot \left(\overline{\lambda}_k - 0{,}2\right) + \overline{\lambda}_k^2\right] \tag{2.18}$$

and a relative slenderness ratio $\overline{\lambda}_k = \sqrt{\dfrac{N_{pl,k}}{N_{ki,k}}}$ \tag{2.19}

Where

$N_{pl,k}$ characteristic plastic normal force related to the net cross-section of the inner thread diameter: : $N_{pl,k} = \pi \cdot$

$$\frac{d_1^2}{4} \cdot f_{y,k} \tag{2.20}$$

$f_{y,k}$ characteristic yield strength, $f_{y,k}$ = 800 N/mm² for HECO screws HWR,

d_1 inner thread diameter of the screw [mm],

$$N_{pl,d} = \frac{N_{pl,k}}{\gamma_{M1}} \tag{2.21}$$

γ_{M1} partial factor in accordance with EN 1993-1-1[13].

characteristic ideal elastic buckling load:

$$N_{ki,k} = \sqrt{c_h \cdot E_S \cdot I_S} \ \ [N] \tag{2.22}$$

elastic foundation of the screw:

$$c_h = \left(0.19 + 0.012 \cdot d\right) \cdot \rho_k \cdot \left(\frac{90° + \alpha}{180°}\right) \ \ [N/mm^2] \tag{2.23}$$

ρ_k characteristic density of the timber member [kg/m³],

α angle between screw axis and grain direction, 30° ≤ α ≤ 90°

modulus of elasticity: E_s = 210.000 N/mm², second moment of area: $I_s = \dfrac{\pi \cdot d_1^4}{64}$ [mm⁴] \tag{2.24}

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[13]   EN 1993-1-1:2005/AC:2009   Eurocode 3: Design of steel structures – Part 1-1: General rules and rules for buildings +A1:2014

HECO-WR (HWR)	
Compressive capacity – Characteristic yield strength	Annex 2.6

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A.2.4 Spacings, end and edge distances of the screws and minimum thickness of the wood-based material

A.2.4.1 Laterally or laterally *and* axially loaded screws

Screws in pre-drilled holes

For HECO-WR (HWR) in pre-drilled holes the minimum spacings, end and edge distances are given in EN 1995-1-1, clause 8.3.1.2 and Table 8.2 as for nails in pre-drilled holes. Here, the outer thread diameter d shall be considered.

Minimum thickness for structural timber members listed in Annex A.1.2 is t = 45 mm for screws with d = 9 mm. For screws with d = 13 mm the provisions in EN 1995-1-1 are valid.

Screws in non pre-drilled holes

For HECO-WR (HWR) in non-predrilled holes the minimum spacings, end and edge distances as well as the minimum member thicknesses are given in EN 1995-1-1, clause 8.3.1.2 and Table 8.2 as for nails in non-predrilled holes. Here, the outer thread diameter d shall be considered.

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

Minimum distances from loaded or unloaded ends parallel to the grain shall be at least 15·d for screws with outer thread diameter d > 8 mm and timber thickness t < 5·d.

Minimum distances from the unloaded edge perpendicular to the grain may be reduced to 3·d also for timber thickness t < 5·d, if the spacing parallel to the grain and the end distance is at least 25·d.

A.2.4.2 Only axially loaded screws

For HECO-WR (HWR) loaded only axially, the following minimum spacings, end and edge distances apply alternatively to paragraph A.2.4.1 for solid timber, glued laminated timber and glued solid timber made of softwood:

Spacing a_1 in a plane parallel to grain:	a_1	$= 5 \cdot d$
Spacing a_2 perpendicular to a plane parallel to grain:	a_2	$= 5 \cdot d$
End distance of the centre of gravity of the threaded part in the timber member:	$a_{1,CG}$	$= 5 \cdot d$
Edge distance of the centre of gravity of the threaded part in the timber member:	$a_{2,CG}$	$= 3 \cdot d$

For screws in non pre-drilled holes a minimum timber thickness of 10 · d is required.

For a crossed screw couple in solid timber, glued laminated timber and glued solid timber made of softwood the minimum spacing between the crossing screws may be reduced by the factor $(1 - \alpha_k/180°)$, with $0° \leq \alpha_k \leq 90°$. The minimum spacing shall be at least 1.5 d. Appropriate means have to ensure that the crossed screw threads do not touch each other when being screwed in the timber member.

Are the spacings, end and edge distances less than the distances and thicknesses given in EN 1995-1-1 the verification of resistance in accordance with EN 1995-1-1, clause 8.7.2 (1) the failure along the circumference of a group of screws has to be considered also for connections without steel plates.

HECO-WR (HWR)	
Spacings, end and edge distances, dimensions	Annex 2.7

A.2.5 Insertion moment

The ratio between the characteristic torsional strength $f_{tor,k}$ and the mean value of insertion moment $R_{tor,mean}$ fulfills the requirement for all screws.

A.2.6 Durability against corrosion

The screws are coated with the zinc flake system "Durocoat" or they are zinc-nickel coated (minimum thickness: 8 μ).

HECO-WR (HWR)	Annex 2.8
Insertion moment and durability against corrosion	

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Annex 3   Compression reinforcement perpendicular to the grain (informative)

A.3.1 General

HECO-WR (HWR) may be used for compression reinforcement perpendicular to the grain. The provisions are valid for reinforcing timber members made from solid timber, glued solid timber or glued laminated timber made from softwood.

The compression force shall be distributed evenly to the screws used as compression reinforcement.

The screws are driven into the timber member perpendicular to the contact surface under an angle between the screw axis and the grain direction of 45° to 90°. The screw heads are flush with the timber surface.

A.3.2 Design

For the design of reinforced contact areas, the following conditions must be met independent of the angle between the screw axis and the grain direction.

The design resistance of a reinforced contact area is:

$$R_{90,d} = min \begin{cases} k_{c,90} \cdot B \cdot l_{ef,1} \cdot f_{c,90,d} + n \cdot min \{R_{ax,d}; \kappa_c \cdot N_{pl,d}\} \\ B \cdot l_{ef,2} \cdot f_{c,90,d} \end{cases} \tag{3.1}$$

Where

$k_{c,90}$ parameter in accordance with EN 1995-1-1, clause 6.1.5,

B bearing width [mm],

$l_{ef,1}$ effective contact length in accordance with EN 1995-1-1, clause 6.1.5 [mm],

$f_{c,90,d}$ design compressive strength perpendicular to the grain [N/mm²],

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

n_0 number of reinforcing screws arranged in a row parallel to the grain,

n_{90} number of reinforcing screws arranged in a row perpendicular to the grain,

$$R_{ax,d} = f_{ax,d} \cdot d \cdot l_{ef} \quad [N] \tag{3.2}$$

$f_{ax,d}$ design value of the withdrawal parameter of the threaded part of the screw [N/mm²],

d outer thread diameter of the screw [mm]

κ_c in accordance with Annex A.2.3.3,

$N_{pl,d}$ in accordance with Annex A.2.3.3 [N],

$l_{ef,2}$ effective contact length in the plane of the screw tips (see Figure A.3.1) [mm],

   $l_{ef,2} = \{l_{ef} + (n_0 - 1) \cdot a_1 + min(l_{ef}; a_{1,CG})\}$ for end supports (see Figure A.3.1 left),

   $l_{ef,2} = \{2 \cdot l_{ef} + (n_0 - 1) \cdot a_1\}$ for intermediate supports (see Figure A.3.1 right),

l_{ef} penetration length of the threaded part of the screw in the timber member [mm],

a_1 spacing a_1 in a plane parallel to grain, see chapter A.2.4.2 [mm],

$a_{1,CG}$ end distance of the centre of gravity of the threaded part in the timber member, see chapter A.2.4.2 [mm].

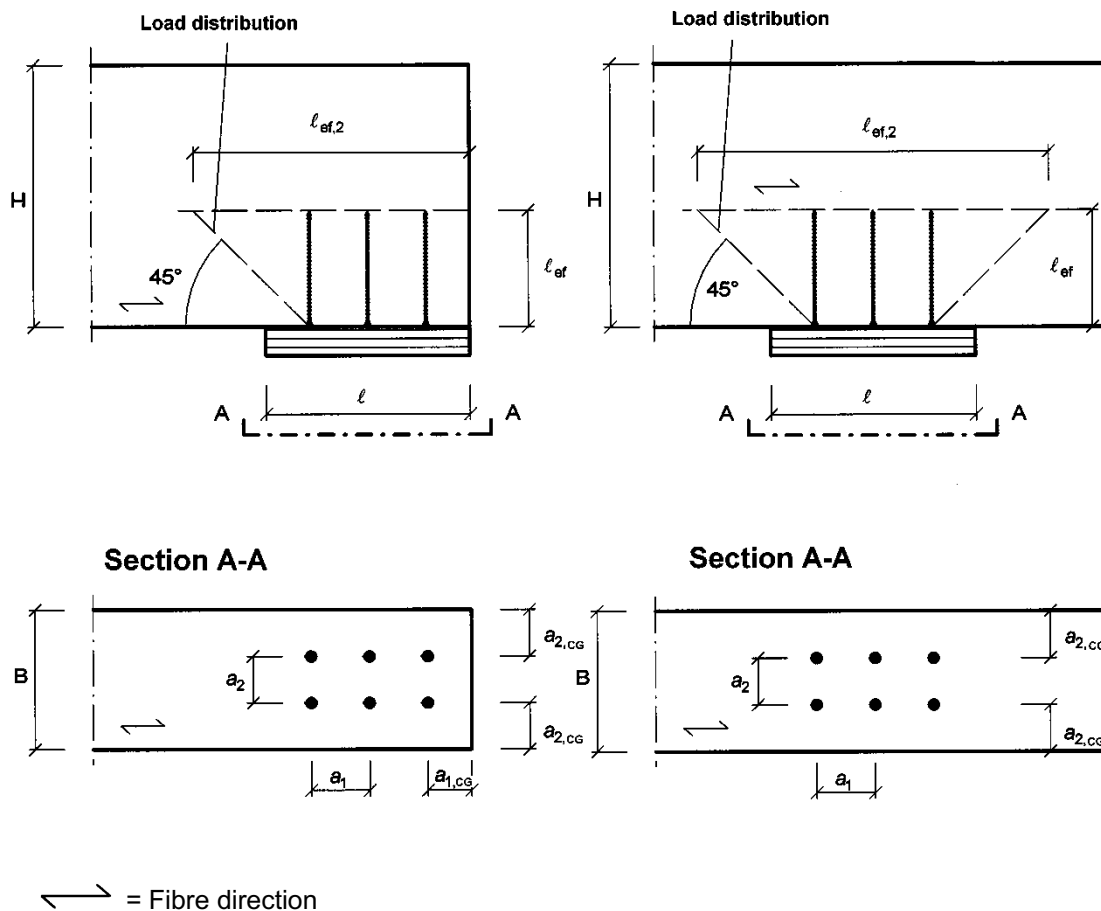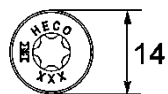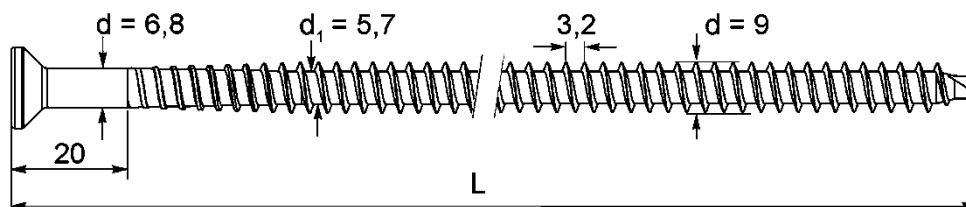| HECO-WR (HWR)	Annex 3.1
Compression reinforcement perpendicular to the grain	

Figure A.3.1: Reinforced end support (left) and reinforced intermediate support (right)

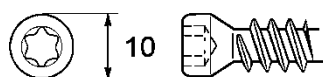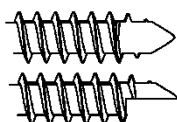| HECO-WR (HWR)	
Compression reinforcement perpendicular to the grain	Annex 3.2

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HWR-T-9 x L

14

Head types also possible without labelling

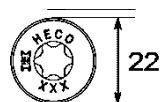d = 6,8 d_1 = 5,7   3,2   d = 9

20

L

alternative head geometry   alternative drill point

10

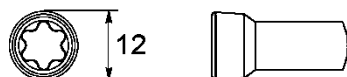50 mm ≤ L ≤ 500 mm

HWR-T-13 x L

22

Head types also possible without labelling

d = 10 d_1 = 8,5   5   d = 13

20

L

alternative head geometry

12
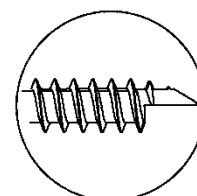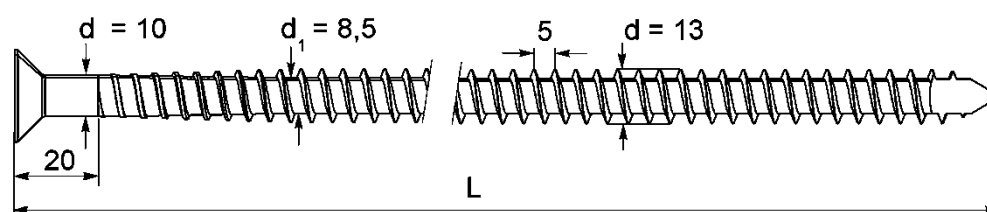
300 mm ≤ L ≤ 1000 mm

Tolerances	
Length	± 5%
Diameter	± 5%

HECO-WR (HWR)

Dimensions

Annex 4.1