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### European Technical Assessment ETA-14/0160 of 2024/05/23

**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:	IdeFix, IdeFix IFK, IdeFix AR, IdeFix DWD, ZaFix, bases
Product family to which the above construction product belongs:	Three-dimensional nailing plate (timber to timber connectors)
Manufacturer:	SIHGA GmbH Gewerbepark Kleinreith 4 A-4694 Ohlsdorf Tel. +49 7612 / 74370 - 0 Fax +49 7612 / 74370 - 10 Internet www.sihga.com
Manufacturing plant:	SIHGA GmbH Gewerbepark Kleinreith 4 A-4694 Ohlsdorf
This European Technical Assessment contains:	67 pages including 5 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:	EAD 130186-00-0603 for Three-dimensional nailing plates
This version replaces:	The ETA with the same number issued on 2022-05-17

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#### II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

#### **1** Technical description of product

IdeFix IF, IdeFix DWD connectors are used in timber to timber connections. IdeFix IFK connectors are used in timber to timber or steel to timber connections.

IdeFix AR connectors are used as support for hanging loads.

IdeFix IFS connector is used for a steel cable - timber connection, mainly for transportation.

IdeFix IF, IdeFix IFK, IdeFix DWD and IFS connectors are assembled of a cylindrical part made of steel 1.0715 according to EN 10087, IdeFix AR is made of carbon steel S235 and self-tapping screws GoFix HK with properties assessed in ETA-11/0425.

ZaFix are assembled of a threaded rod 1.0401 according to EN 10277 and a tube 1.0308 according to EN 10216 and EN 10305.

IdeFix IF and ZaFix connectors can be used as a kit assembled with a post-base.

Post-bases IdeFix STF and ZaFix STZ are assembled of steel parts made of 1.0038 according to EN 10025 (S235JR); washer nut DIN 6923, property class 8 according EN 20898; threaded rod of 1.0401 according to EN 10277 (C15); counter nut ISO 4035 (DIN 439), property class 4 according to EN 20898; special screw 1.0715 according to EN 10087; tube 1.0308 according to EN 10216 and EN 10305 (E235).

Dimensions and typical installations are shown in annex A to F.

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

The intended use of the connectors is for timber to timber connections as load-bearing elements, and for IdeFix IFK additionally for steel to timber connections, where requirements for mechanical resistance and stability and safety in use in the sense of the Basic Work Requirements 1 and 4 of the Regulation 305/2011 (EU) shall be fulfilled.

IdeFix IF and IFK is mainly used as header - joist connection. It might be used as beam – column connector too. The connector is loaded in tension or by shearing forces, compression loads are not transmitted by IdeFix IF and IFK but in contact between end-grain of joist and header's side-grain or column's end-grain and beam's side-grain respectively.

IdeFix AR is intended to be used as a support for hanging loads.

IdeFix IFS is intended to be used for bracing by ties. This connector is not applied in the end-grain. Properties of the eye bolt are not assessed within this ETA, verification has to be done according to Eurocode 3.

ZaFix connector is used only as assembled kit with post base.

IdeFix STF and ZaFix STZ are post bases. The post-base lower part to the upper steel plate, which works as support to the timber column, is identical for both products. The connection to the timber column is either done by IdeFix IF or by ZaFix.

The connectors are used for timber joints designed according to Eurocode 5; assembled with post-bases the joint to the column is designed according to Eurocode 5 in addition some verifications of the post base have to be done according to Eurocode 3. IdeFix IF connectors are used for joints of timber or wood-based products.

The connectors can be installed as joint between wood based members such as:

- Structural solid softwood timber according to EN 14081,
- Softwood glulam according to EN 14080,
- Glued solid timber according to EN 14080,

Header–joist or column-beam connections with IdeFix IF or IFK and joints with IdeFix IF, IFK might additionally be used with

1 Engineered wood products according to European Technical Approval if the ETA of the product includes provisions for the use of self-tapping screws and ring-connectors, the provisions of the ETA of the engineered wood product apply

IdeFix AR can be used additionally with CLT – products according to European Technical Assessments 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 annexes state the formulas for the characteristic loadcarrying capacities of the connections. The design of the connections shall be in accordance with Eurocode 3, Eurocode 5 or a similar national Code.

It is assumed that the forces acting on the connection are the following  $F_1$ ,  $F_c$ ,  $F_t$  and  $F_2$ ,  $F_3$ ,  $F_4$ ,  $F_5$ ,  $F_h$ . The force  $F_1$  or  $F_c$  or  $F_t$  acts parallel to the axis of joist or column,  $F_2$ ,  $F_3$ ,  $F_4$ ,  $F_5$ ,  $F_h$  act perpendicular to the axis of joist or column. It is assumed that the forces are acting right at the end of the joist. It is assumed that the header beam is prevented from rotating. If the header beam only has installed a connector on one side the eccentricity moment shall be considered where  $b_H$  is the header width. The same applies when the header has connections on both sides, but with vertical forces which differ more than 20%.

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

The use of IdeFix-connectors assembled with screws GoFix HK made of carbon steel according to ETA-11/0425 is limited to service class 1 and 2.

IdeFix-connectors and post-bases assembled with screws GoFix HK made of stainless steel according to ETA-11/0425 and post-bases with ZaFix can additionally be used in service-class 3.

The fasteners (bolts and washers) to be used shall be made from suitable material.

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 and in conjunction with the admissible service conditions according to EN 1995-1-1 and the admissible corrosivity category as described and defined in EN ISO 12944-2

#### Assumed working life

The assumed intended working life of the connectors for the intended use is 50 years, provided that they are subject to appropriate use and maintenance.

The information on the working life should not be regarded as a guarantee provided by the manufacturer or ETA Danmark. An "assumed intended working life" means that it is expected that, when this working life has elapsed, the real working life may be, in normal use conditions, considerably longer without major degradation affecting the essential requirements.

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

Cha	aracteristic	Assessment of characteristic
3.1	Mechanical resistance and stability (BWR 1)*)	
	Joint Strength - Characteristic load-carrying capacity	See Annex A to F
	Joint Stiffness	See Annex A to F
	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 (BWR 2)	
	Reaction to fire	The connectors are made from steel classified as <b>Euroclass A1</b> in 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 and post-bases have been assessed as having satisfactory durability and serviceability when used in timber structures using the soft-wood timber species described in Eurocode 5 and subject to the conditions defined by service class 1, 2 or 3 for IdeFix connections assembled with screws GoFix HK made of stainless steel according to ETA-11/0425. Kits using screws GoFix HK made of carbon steel according to ETA-11/0425 are limited to service class 1 and 2.
	Identification	See Annex A, B and C
3.2	Resistance to seismic actions   Resistance to corrosion and deterioration   Safety in case of fire (BWR 2)   Reaction to fire   Resistance to fire   General aspects related to the performance of the product	No performance assessed See section 3.6 The connectors are made from steel classified a <b>Euroclass A1</b> in in accordance with EN 13501-1 an Commission Delegated Regulation 2016/364 No performance assessed The connectors and post-bases have been assessed a having satisfactory durability and serviceability whe used in timber structures using the soft-wood timber species described in Eurocode 5 and subject to th conditions defined by service class 1, 2 or 3 for IdeFi connections assembled with screws GoFix HK made of stainless steel according to ETA-11/0425. Kits usin screws GoFix HK made of carbon steel according to ETA-11/0425 are limited to service class 1 and 2. See Annex A, B and C

\*) See additional information in section 3.4 - 3.7.

#### 3.4 Methods of verification

#### Safety principles and partial factors

The characteristic load-carrying capacities are based on the characteristic values of the connections with metal fasteners, the steel plates and the timber post.

In the case of timber failure or failure of the metal fasteners, the design values shall be calculated according to EN 1995-1-1 by dividing the characteristic values of the load-carrying capacities by different partial factors for the strength properties, and in addition multiplied with the coefficient  $k_{mod}$ .

In the case of steel failure, the design value shall be calculated according to EN 1993-1-1 by reducing the characteristic values of the load-carrying capacity with different partial factors.

The design value of the load-carrying capacity is the smaller value of all load-carrying capacities:

$$F_{Rd} = min \left\{ \frac{k_{mod} \cdot F_{Rk,T}}{\gamma_{M,T}}; \frac{F_{Rk,S}}{\gamma_{Mi,S}} \right\}$$

Therefore, for timber failure or failure of the metal fasteners the load duration class and the service class are included. The different partial factors  $\gamma_M$  for steel or timber failure, respectively, are also correctly taken into account.

#### 3.5 Mechanical resistance and stability

See Annex A to F for characteristic load-carrying capacities of the connectors and post-bases.

The characteristic capacities of the connectors are determined by calculation assisted by testing as described in the 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 to F.

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

See annex A to E for the joint's stiffness properties - to be used for the analysis of the serviceability limit state.

### **3.6** Aspects related to the performance of the product

Corrosion protection in service class 1, 2 and 3.

The use of IdeFix-connectors assembled with screws GoFix HK made of carbon steel according to ETA-11/0425 is limited to service class 1 and 2.

IdeFix-connectors and post-bases assembled with screws GoFix HK made of stainless steel according to ETA-11/0425 and post-bases with ZaFix can additionally be used in service-class 3.

The connectors and post-bases with three layered coating are assessed to be equivalent at least to class C4 EN ISO 12944-2. Details of the corrosion protection system are deposited at ETA-Danmark.

### **3.7** General aspects related to the use of the product

IdeFix IF, IdeFix IFK, IdeFix AR, IdeFix IFS and postbases IdeFix STF, ZaFix STZ are manufactured in accordance with the provisions of this European Technical Approval using the manufacturing processes as identified in the inspection of the plant by the notified inspection body and laid down in the technical documentation.

The following provisions concerning product performance apply:

#### IdeFix IF, IdeFix IFK, IdeFix DWD or IdeFix IFS Connector joints

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

1 The header beam shall be restrained against rotation and be free from wane under the connector.

If the header carries joists only on one side the eccentricity moment from the joists

$$M_{\rm ec} = R_{\rm joist} (b_{\rm H}/2)$$

shall be considered at the strength verification of the header.

 $R_{\text{joist}}$ Reaction force from the joists $b_{\text{H}}$ Width of header

- 2 For a header with joists from both sides but with different reaction forces a similar consideration applies.
- 3 Connectors are fastened to wood-based members by bolts.
- 4 The characteristic capacity of the connector joint is calculated according to the manufacturer's technical documentation.
- 5 The connector joint is designed in accordance with Eurocode 5 or an appropriate national code.
- 6 There is no gap between the end of the joist and header, beam column respectively.
- 7 The height and depth of the joist or header shall be so large that the minimum fastener end and edge distances are observed.

#### Post-bases IdeFix STF or ZaFix STZ

• The characteristic capacity of the connector joint is calculated according to

the manufacturer's technical documentation, dated 2013

- The connector joint is designed in accordance with Eurocode 5 or an appropriate national code.
- The post-bases is designed in accordance with Eurocode 3 or an appropriate national code.
- There is no gap between the end of the column and the column support plate of the post-base.
- The height and depth of the column shall be so large that the minimum fastener end and edge distances are observed.

The actual end bearing capacity of the timber member to be used in conjunction with the connector is checked by the designer of the structure to ensure it is not less than the connector capacity and, if necessary, the connector capacity reduced accordingly.

There are no specific requirements relating to preparation of the timber members.

#### 4 Assessment and verification of constancy of performance (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 2024-05-23 by

Thomas Bruun Managing Director, ETA-Danmark

#### Annex A: IdeFix IF, IFK

#### A) Characteristic values of load-carrying-capacities and stiffness

#### 1.1 Loading in tension of IdeFix IF, IFK



Figure A.1: IdeFix IF in tension loading

d: diameter of GoFix HK;

n: number of GoFix HK screws

#### Resistance:

$$F_{t,IdeFixIF,Rk} = n \cdot \left(F_{ax,\alpha,Rk} + F_{la,\alpha,Rk}\right) \cdot \cos(45^{\circ})$$

with  $F_{ax,\alpha,Rk}$ ,  $F_{la,\alpha,Rk}$  for screws GoFix HK, properties and design according to ETA-11/0425. Without taking in account the rodeffect for  $F_{la,\alpha,Rk}$ .

#### Stiffness:

$$\frac{n}{K_{IdeFix}} = \sqrt{\frac{1}{8} \cdot \left(\frac{1}{K_{ax}^2} + \frac{1}{K_{la}^2}\right)}$$

with 
$$K_{la} = \rho^{1,5} \cdot d/23$$
;  $K_{ax} = 780 \cdot d^{0.2} \cdot l_{ef}^{0.4}$ 

IdeFix® IF Ø	GoFix HK made of carbon steel according to ETA-11/0425	$F_{t,IdeFix,Rk}$ [kN], C24	<i>K<sub>ser</sub></i> [kN/mm], C24
30 mm	d=5,0 mm, l <sub>ef</sub> = 34 mm	17,00 kN	30,7 kN/mm
30 mm	d=5,0 mm, l <sub>ef</sub> = 54 mm	25,60 kN	31,1 kN/mm
30 mm	d=5,0 mm, l <sub>ef</sub> = 74 mm	32,40 kN	31,3 kN/mm
40 mm	d=6,0 mm, l <sub>ef</sub> = 53 mm	29,00 kN	36,9 kN/mm
40 mm	d=6,0 mm, l <sub>ef</sub> = 73 mm	37,90 kN	37,3 kN/mm
40 mm	d=6,0 mm, l <sub>ef</sub> = 93 mm	45,60 kN	37,5 kN/mm
50 mm	d=8,0 mm, l <sub>ef</sub> = 81 mm	56,00 kN	48,9 kN/mm
50 mm IFD	d=6,0 mm, l <sub>ef</sub> = 68 mm	71,90 kN	74,3 kN/mm
50 mm IFD	d=6,0 mm, l <sub>ef</sub> = 88 mm	87,30 kN	74,9 kN/mm

Table 1: characteristic withdrawal resistance of IdeFix IF or IFK in timber of grade C24

#### 1.2 Loading of IdeFix IF, IFK by shearing force

Three different failure modes must be verified.

Mode a) embedding of IdeFix in end grain

The resistance of IdeFix IF or IFK is calculated as proposed in EC 5 for ring-connector joints,

 $F_{Rk,IdeFix,endgrain} = \frac{k_h}{k_{90}} \cdot min\{\frac{k_1 \cdot k_2 \cdot k_3 \cdot k_4 \cdot 35 \cdot d_c^{1,5}}{k_1 \cdot k_3 \cdot l_e \cdot 31.5 \cdot d_c}\} \text{ with } d_c: IdeFix \text{ diameter},$ 

 $l_e$  depth of embedment of IdeFix in joist's end grain and  $k_1 = k_2 = k_4 = 1$ ,  $k_h = 0.65$ .

load-carrying capacity of self-tapping screws GoFix HK F<sub>v,Rk,GoFix</sub>

The load carrying capacity of GoFix HK  $F_{\nu,Rk,GoFix}$  self-tapping screws according to Johansen's equations EC5, 8.2.3 and ETA-11/0425 is added for a reduced number: n=5 screws are supposed to contribute (n=10 for IdeFix IFD with two rows of screws).

The rod effect  $F_{ax}/4$  in these equations is the minimum of either the pull out resistance of all screws or the compression strength of the washer at the side of the bolt:

 $F_{ax} = min\{n_{screw} \cdot F_{R,ax} \cdot \cos(45^\circ), F_{c,90,washer}\}$ 

The strength capacity for mode a) follows as

 $F_{v,Rk,modea} = F_{Rk,IdeFix,endgrain} + F_{v,Rk,GoFix}$ 

Mode b) embedding of bolt and IdeFix in header or column

The embedding of the bolt is taken into account.

 $F_{v,Rk,bolt} = f_{h,90,bolt} \cdot d_{bolt} \cdot (\sqrt{(e_{bolt}^2 + \frac{4 \cdot M_{y,bolt}}{d_{bolt} \cdot f_{h,90,bolt}})} - e_{bolt}) + F_{ax}/4 \text{ with } F_{ax} \text{ as defined in failure mode a}).$ 

For IdeFix IF the sunken part in the header or column is added

 $F_{Rk,IF,sidegrain} = \frac{1}{k_{90}} \cdot min\{\frac{k_1 \cdot k_2 \cdot k_3 \cdot k_4 \cdot 35 \cdot d_c^{1,5}}{k_1 \cdot k_3 \cdot l_{e,h} \cdot 31.5 \cdot d_c}\}$  with  $l_{e,h}$  embedding length of IdeFix IF in header or column

 $F_{v,Rk,mode\ b} = F_{Rk,IF,sidegrain} + F_{v,Rk,bolt}$ 

Table 2: embedding depth  $l_e$ ; distance  $e_{bolt}$ 

diameter IdeFix	embedding depth <i>l<sub>e</sub></i> in joist	embedding depth $l_{e,h}$ in header or column	e <sub>bolt</sub> IF	$e_{bolt} \mathrm{IFK}$
30 mm	20 mm	7 mm	15 mm	8 mm
40 mm	25 mm	10 mm	21 mm	11 mm
50 mm	30 mm	15 mm	32 mm	13 mm
diameter IdeFix, IFD				
50 mm	35 mm	10 mm	27 mm	

Mode c) tension perpendicular to grain for the joist or column according to EC 5



Figure A.2: Verification for stresses perp. to grain according EC5-1-1

The shearing force capacity of IdeFix IF or IFK in end-grain is the minimum value of these three modes. Slip modulus for IdeFix connections in end-grain:  $K_{ser} = 1,2 \cdot \rho_m^{\square} \cdot d_c/2$ 

#### 1.3 lateral capacity with IdeFix IF or IFK in side grain of a timber-to-timber joint

If IdeFix connectors are placed in the side-grain the models of paragraph A.1.2 might be applied, without  $k_h = 0,65$ . The parameters  $k_1$ ,  $k_2$  and  $k_{90}$  have to be adjusted accordingly EC 5-1-1, 8.9.

#### 1.4 lateral capacity with IdeFix IFK in a steel-to-timber joint

Instead of mode b, embedding of IdeFix and bolt in the header, the bending of the bolt is used as a criterion for the bearing capacity.

The lateral resistance of this failure mode is  $F_{mode \ b, Boltsteel} = \frac{M_{y, Rk}}{(t_s/2 + e_{bolt})}$ .



Additionally shear and bearing resistance are to be verified according EC3-1-8.

#### 1.5 Combined loading of IdeFix IF or IFK by shearing force and tension force

Clause 8.3.3, equ. (8.28) of EN 1995-1-1:2010 is applied:  $\left(\frac{F_{ax,Ed}}{F_{t,IdeFix,Rd}}\right)^2 + \left(\frac{F_{V,Ed}}{F_{V,IdeFix,Rd}}\right)^2 \le 1,0$ 

#### 1.6 Multiple IdeFix IF or IFK connectors per joint

For joints with more than one IdeFix IF or IFK connector the bearing capacity of the joint is found by multiplying the capacity for one IdeFix IF with the number of connectors  $n_{IdeFix}$ .

For joints loaded by shearing force mode c of Annexe A1.2 as a verification of tension perpendicular to grain shall not be multiplied by  $n_{IdeFix}$ .

Verification for wood members according to Eurocode 5 have to be done consciously.

#### B) IdeFix IF, product details, definitions and installation





#### Figure 2: IdeFix IF series 300



Figure 3: IdeFix IF series 400



Figure 4: IdeFix IF series 500

Cylindrical part made of steel 1.0715 according to EN 10087 and self-tapping screws GoFix HK with properties assessed in ETA-11/0425

#### 2.1 IdeFix IF series 300, details:

![](_page_13_Figure_2.jpeg)

#### 2.2 IdeFix IF series 400, details:

![](_page_14_Figure_2.jpeg)

#### 2.3 IdeFix IF series 500, details:

![](_page_15_Figure_2.jpeg)

![](_page_16_Figure_1.jpeg)

#### 2.4 IdeFix IF series 500 with two rows of screws, details:

#### 2.5 IdeFix IFK series, details:

![](_page_17_Picture_2.jpeg)

							IFK30		IFK40			IFK50			
			Schraubendurchmess er d [mm]			5,0		6,0			8,0				
SIHGA GmbH Schutzvermerke nach EN ISO 16016:2007			Schraubenlängen l [mm]		40,(	) / 60,0 / 8	30,0	60,0 / 80,0	/ 100,0		90,0				
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		rücklich gestattet.		teilung seines Inhalts rboten, soweit nicht ausdrücklich gestattet. rhandlungen		Durchmesser D	) [mm]		30,0		40,0			50,0	
		ו	Schraubenanzahl [Stk.]		8 8		8								
					Allaer	nein-	Maßstab	:		Fo	rmat:	A	4		
					Tolera	anz			Datum:		N	ame:			
					ISO 27		Gez.:	07	.11.2023						
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SIHGA® GmbH Gewerbepark Kleinreith 4 A-4694 Ohlsdorf bei Gmunden Tel: +43 7612-74370 0 info@sihga.com		erial:						Zeic	hnungs	Νг.:	Index:				
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<b>──</b>															

#### 2.6 IdeFix IF screws, GoFix HK, ETA -11 / 0425, geometry:

![](_page_18_Figure_2.jpeg)

GoFix HK 6,0

GoFix HK 8,0

![](_page_18_Figure_5.jpeg)

![](_page_18_Figure_6.jpeg)

![](_page_18_Figure_7.jpeg)

Figure 5: IdeFix IF screws

Table 4: Ider IX IF screws, det	tails
---------------------------------	-------

IdeFix			GoFix HK	
IF	Ø	d	1	lef
304	30	5,0	40	34
306	30	5,0	60	54
308	30	5,0	80	74
406	40	6,0	60	53
408	40	6,0	80	73
410	40	6,0	100	93
509	50	8,0	90	81
IdeFi	ix IFD		GoFix HK	
508	50	6,0	80	68
510	50	6,0	10	88

#### 2.7 IdeFix IF installation:

![](_page_19_Figure_2.jpeg)

Figure 6: Tension connection with anti-twist protection, bolted joint connection

![](_page_19_Figure_4.jpeg)

Figure 7: Column to main beam connection with anti-twist protection, bolted joint connection

![](_page_19_Figure_6.jpeg)

Figure 8: Header- joist connection with anti-twist protection, bolted joint connection

#### Side View

![](_page_20_Figure_2.jpeg)

Hexagon screw with shank or threaded bar M12, M16, M20 Washer – DIN 40 Idefix - Connector series IF300, IF400, IFS00

**Figure 9: Tension Connection, details** 

Anti-twist protection			
IF 300	3 mm		
IF 400	5 mm		
IF 500	5 mm		

![](_page_21_Figure_1.jpeg)

Figure 10: Bolted Joint Connection,

![](_page_22_Figure_1.jpeg)

Figure 11: Secondary beam to Mainbeam connection, details

![](_page_23_Figure_1.jpeg)

Fjgure 12:Subheam to Mainbeam connection-angle, details

![](_page_24_Figure_1.jpeg)

Figure 13: Multiple port connection

![](_page_25_Figure_1.jpeg)

IdeFix	subbeam	mainbeam
IF 300	20 mm	10 mm
IF 400	25 mm	15 mm
IF 500	30 mm	20 mm
IFD 500	25 mm	15 mm

IdeFix	edge distance [e <sub>d</sub> ]	center distance $[c_d]$		
IF 304	50 mm	50 mm		
IF 306	60 mm	60 mm		
IF 308	70 mm	70 mm		
IF 406	60 mm	60 mm		
IF 408	80 mm	80 mm		
IF 410	90 mm	90 mm		
IF 509	80 mm	80 mm		
IFD 508	80 mm	160 mm		
IFD 510	100 mm	200 mm		

Figure 14: Multiple port connection, details

#### **Annex B: IdeFix IFS**

#### 1. IdeFix IFS product details, definitions and installation

![](_page_26_Figure_3.jpeg)

Figure 15: IdeFix IFS

![](_page_26_Figure_5.jpeg)

Table 5: IdeFix IFS geometry, screws

IdeFix® IFS Ø	GoFix HK ETA-11/0425
70 mm	d=6,0 x 100 mm, $l_{ef}$ = 63 mm for screws with an angle of 45°
70 mm	d=6,0 x 100 mm, $l_{ef}$ = 72 mm for screws with an angle of 90°

Figure 16: IdeFix IFS loading

Properties of the eye bolt are not assessed within this ETA, verification has to be done according to Eurocode 3. This connector is not applied in the end-grain.

![](_page_27_Figure_1.jpeg)

Figure 17: IdeFix IFS, details

#### 2. IdeFix IFS Characteristic values of load-carrying-capacities and stiffness

![](_page_28_Figure_2.jpeg)

Figure 18: IdeFix IFS loading

Axial withdrawal resistance

 $F_{ax,IdeFixIFS} = 6 \cdot \left( F_{45^\circ,ax,Rk} + F_{45^\circ,la,Rk} \right) \cdot cos(45^\circ)$ 

with  $F_{45^\circ,ax,Rk}$ ,  $F_{45^\circ,la,Rk}$  for screws GoFix HK, properties and design according ETA-11/0425. Without taking in account the rod-effect for  $F_{la,\alpha,Rk}$ .

Load-carrying capacity for shearing forces

 $F_{la,IdeFixIFS} = 2 \cdot \left(F_{45^\circ,ax} + F_{45^\circ,la}\right) \cdot cos(45^\circ)$ 

Combined loading

$$\left(\frac{F_{ax,Ed}}{F_{ax,IdeFixIFS,Rd}}\right)^{2} + \left(\frac{F_{V,Ed}}{F_{V,IdeFixIFS,Rd}}\right)^{2} \leqslant 1,0$$

Characteristic values for IdeFix IFS made of carbon steel according to ETA-11/0425 and timber grade C24

 $F_{ax,IdeFixIFS,k} = F_{ax,Rk} = 25,5kN$  $F_{la,IdeFixIFS,k} = F_{v,Rk} = 8,5kN$  $F_{45^{\circ},Rk} = 11,4kN$ 

#### Annex C: ZaFix ZF

#### 1. Characteristic values of load-carrying-capacities and stiffness

#### 1.1 Loading in tension of ZaFix ZF

 $F_{ZaFix,\emptyset30mm,ax,Rk} = \frac{\rho_k}{350kg/m^3} \cdot 5,70kN; \qquad F_{ZaFix,\emptyset40mm,ax,Rk} = \frac{\rho_k}{350kg/m^3} \cdot 5,70kN$   $F_{ZaFix,\emptyset30mm,C24} = 5,70kN; \qquad F_{ZaFix,\emptyset40mm,C24} = 5,70kN$ 

 $K_{ser,ZaFix,\emptyset30mm} = \frac{\rho_k}{350kg/m^3} \cdot 23,0 \ kN/mm; \qquad K_{ser,ZaFix,\emptyset40mm} = \frac{\rho_k}{350kg/m^3} \cdot 23,0 \ kN/mm$ 

#### 1.2 Loading of ZaFix ZF by shearing force

•

Two different failure modes are taken into account:

Embedding in column of ZaFix cylinder  $F_{modea,ZaFix,V;Rk} = 0.65 \cdot 0.84 \cdot f_{h,EC5,dowel}/2 \cdot l_{ZaFix} \cdot d_{ZaFix}$ 

with  $f_{h,EC5,dowel} = 0.082 \cdot (1 - 0.01 \cdot d_{ZaFix}) \cdot \rho$ 

• tension perpendicular to grain for the column according to EC 5  $F_{modeb,ZaFix,V,Rk} = 14 \cdot b_{column} \cdot \sqrt{\frac{h_e}{(1-h_e/h_{column})}}$ 

Table 6: embedding depth of ZaFix *l*<sub>ZaFix</sub>

ø ZaFix ZF	embedding in column
30 mm	70 mm
40 mm	90 mm

Slip modulus:  $K_{ser} = 2/3 \cdot 1/2 \cdot \rho_m^{1,5} \cdot d_{ZaFix}/23$ 

Table 7: characteristic value of shear capacity C24

	F <sub>V,k,modela</sub>	K <sub>ser</sub>
ZaFix ø30 mm	11,5 kN	3,74 kN/mm
ZaFix ø40 mm	16,9 kN	5,0 kN/mm

#### 1.3 Combined loading of ZaFix ZF by shearing force and tension force

Clause 8.3.3, equ. (8.27) of EN 1995-1-1:2010 is applied:  $\frac{F_{ax,Ed}}{F_{ZaFix,L,Rd}} + \frac{F_{V,Ed}}{F_{ZaFix,V,Rd}} \le 1,0$ 

#### 2. ZaFix ZF product details, definitions and installation

ZaFix connector is used only as assembled kit with post base.

![](_page_30_Figure_3.jpeg)

Figure 19: ZaFix ZF d=30

Figure 20: ZaFix ZF d=40

Threaded rod made of 1.0401, EN 10277 (C15); the cone to force the profiled tube outward is formed of this rod. The tube is made from 1.0308, EN 10216, EN 10305 (E235) with t=2,5 mm for ZaFix  $\emptyset$ 30mm or t=2,0 mm for ZaFix  $\emptyset$ 40mm.

![](_page_31_Figure_1.jpeg)

Figure 22: ZaFix ZF d=40, details

#### **Annex D: Post-bases**

#### 1. Characteristic values of load-carrying-capacities and stiffness

For post-bases loaded in tension or by horizontal shearing forces the connector IdeFix IF or ZaFix have to be verified according to Annex A or Annex C respectively.

#### 1.1 Post-bases loaded in tension

IdeFix IF's or ZaFix's withdrawal capacity according to Annex A 1.1 or Annex C 1.1 is to be verified.

#### 1.2 Loading of post-bases by horizontal forces (shearing force)

The verification of the post-base subjected to bending has to be done according to EN 1993-1-1 and EN 1993-1-8. For the bending resistance of the threaded rod and the connection of rod to lower tube the characteristic resistance for bending according to Table 8 is used with  $\gamma_{M2} = 1,25$ .

#### Table 8: characteristic values threaded rod

STF	M <sub>k,rod</sub>
STF 300 series	163 kNmm
STF 400 series	318 kNmm
STF 700 series	549 kNmm

#### 1. Post-bases loaded in compression

First failure mode for the post base under compression load is yielding of rod

•  $F_{c,k,modea} \leq 0.9 \cdot f_{ub} \cdot A_s = F_{t,Rd}$  with  $\gamma_{M2} = 1.25$ 

Second failure mode for the post base under compression load is yielding of the tube

•  $F_{c,k,modeb} \leq f_y \cdot A_{tube}$  with  $\gamma_{M0} = 1,0$ 

Third failure mode is buckling of rod, with buckling length according to Figure 23.

If the column's foot is horizontally fixed, the buckling length might be reduced according to buckling scheme. For threaded rods of higher property class as 4.6 a simplifying approach of taking the complete length of the post base as buckling length for the rod or a more exact calculation according to Eurocode 3 of columns with different cross section is applied for all series.

•  $F_{c,k,postbase} = \chi \cdot A \cdot f_y$  with  $\gamma_{M1} = 1,1$  mode c) is only to be applied if  $\overline{\lambda} > 0,2$ 

mode d finally takes account of timber's compressive strength.

• IdeFix:  $\begin{aligned} F_{c,k} &= f_{c,0} \cdot \pi/4 \cdot d_a^2 \\ \text{ZaFix:} & F_{c,k} &= f_{c,0} \cdot \pi/4 \cdot (d_a^2 - d_{ZaFix}^2) \end{aligned}$ 

 $\gamma_M$  for stresses parallel to grain according to EC5

Verification is done with  $F_{post-base,c,Rd} = min\{F_{c,d,modea}; F_{c,d,modeb}; F_{c,d,modec}; F_{c,d,moded}; \}$ 

 $\frac{N_{Ed}}{F_{post-base,c,Rd}} \leqslant 1$ 

#### 1.4 Combined loading of post-bases by horizontal force and tension force

The verification has to done for IdeFix IF or ZaFix according annex to A 1.3. or annex C 1.3

#### 1.5 Combined loading of post-bases by horizontal force and compression force

 $\frac{N_{Ed}}{F_{post-base,c,Rd}} + \frac{M_{Ed}}{M_{c,Rd}} \leq 1 \text{ with } F_{post-base,c,Rd} \text{ according to annex D 1.3 and } M_{c,Rd} \text{ according to 1.2}$ 

![](_page_33_Figure_5.jpeg)

Figure 23: post bases IdeFix STF and ZaFix STZ 300, 400,700, buckling length and compressive stresses

#### 2. Post bases product details, definitions and installation

![](_page_34_Figure_2.jpeg)

- → IdeFix IF 304, GoFix HK 5,0 x 40 mm
- → Washer Ø 80 x 6,0 mm
- $\rightarrow$  Shouldered nut M16 with O-ring
- $\rightarrow$  Stainless cap
- $\rightarrow$  O –ring
- $\rightarrow$  Threaded rot M16
- $\rightarrow$  Counter nut M16
- $\rightarrow$  Pre tensioned nut
- $\rightarrow$  Stand tube Ø 32 mm (wall thickness 5,0 mm)
- $\rightarrow$  Support plate

![](_page_34_Figure_13.jpeg)

Figure 24: STF / STZ 300 series with IdeFix IF or ZaFix ZF

![](_page_35_Figure_1.jpeg)

- → IdeFix IF 406, GoFix HK 6,0 x 60 mm
- → Washer Ø 95 x 8,0 mm
- $\rightarrow$  Shouldered nut M20 with O-ring
- $\rightarrow$  Stainless cap
- $\rightarrow$  O –ring
- $\rightarrow$  Threaded rot M20
- $\rightarrow$  Counter nut M20
- $\rightarrow$  Pre tensioned nut
- $\rightarrow$  Stand tube Ø 33,7 mm (wall thickness 3,25 mm)
- $\rightarrow$  Support plate

![](_page_35_Figure_12.jpeg)

Figure 25: STF / STZ 400 series with IdeFix IF or ZaFix ZF

![](_page_36_Figure_1.jpeg)

- → IdeFix IF 408, GoFix HK 6,0 x 80 mm
- $\rightarrow$  Washer Ø 95 x 8,0 mm
- $\rightarrow$  Shouldered nut M24 with O-ring
- $\rightarrow$  Stainless cap
- $\rightarrow$  O –ring
- $\rightarrow$  Threaded rot M24
- $\rightarrow$  Counter nut M24
- $\rightarrow$  Pre tensioned nut
- $\rightarrow$  Stand tube Ø 38 mm (wall thickness 3,25 mm)
- $\rightarrow$  Support plate

![](_page_36_Figure_12.jpeg)

Figure 26: STF / STZ 700 series with IdeFix IF or ZaFix ZF

![](_page_37_Figure_1.jpeg)

- → IdeFix IF 304, GoFix HK 5,0 x 40 mm
- → Washer Ø 80 x 6,0 mm
- $\rightarrow$  Shouldered nut M16 with O-ring
- $\rightarrow$  Stainless cap
- $\rightarrow$  O –ring
- $\rightarrow$  Threaded rot M16
- $\rightarrow$  Counter nut M16
- $\rightarrow$  Stand tube Ø 32 mm (wall thickness 5,0 mm)
- $\rightarrow$  Support plate

![](_page_37_Figure_11.jpeg)

Figure 27: STF 337 with IdeFix IF

![](_page_38_Figure_1.jpeg)

Figure 28: STF /STZ 338 with IdeFix IF or ZaFix ZF

![](_page_39_Figure_1.jpeg)

Figure 29: STF/STZ 336 with IdeFix IF or ZaFix ZF

![](_page_40_Figure_1.jpeg)

Figure 30: STF/STZ 446 with IdeFix IF or ZaFix ZF

![](_page_41_Figure_1.jpeg)

Figure 31: STF/STZ 746 with IdeFix IF or ZaFix ZF

![](_page_42_Figure_1.jpeg)

Figure 32: STF 448 with IdeFix IF

![](_page_43_Figure_1.jpeg)

Figure 33: STF 748 with IdeFix IF

![](_page_44_Figure_1.jpeg)

Figure 34: STF 952 with IdeFix

![](_page_45_Figure_1.jpeg)

![](_page_45_Figure_2.jpeg)

#### E.1 Definitions and notations for the calculation models

![](_page_46_Figure_2.jpeg)

![](_page_47_Figure_1.jpeg)

Figure 35: Possible arrangements of the IdeFix-DWD Connector and notations

Note: Due to the M12;M16 screw (C) (see figure 35) in the center of the DWD box (A) the GoFix HK screws (B) are able to transfer both, tension and compression loads in axial direction. Buckling of the screws in compression must not be considered up to available length given in the ETA-11/0425, 2017.

Abbreviations and parameters for the following calculation in Annex B

- (1) Timber element 1, see Figure 35
- (2) Timber element 2, see Figure 35
- (3) Grain direction, see Figure 35
- d Nominal diameter of the GoFix HK screw [mm]
- *d*<sub>DWD</sub> Diameter of the IdeFix-DWD Connector [mm]
- $f_{h,a,k}$  Characteristic embedment strength, considering load-grain direction [N/mm<sup>2</sup>]
- $f_{h,b,1,k}$  Characteristic embedment strength, considering load-grain direction,
- timber part 1 [N/mm<sup>2</sup>]
- $f_{h,b,2,k}$  Characteristic embedment strength, considering load-grain direction, timber part 2 [N/mm<sup>2</sup>]
- $f_{ax,k}$  Characteristic withdrawal capacity with

d [mm]	GoFix HK ETA-11/0425
4,0	$f_{ax,k} = 12,9 N / mm^2$
5,0	$f_{ax,k} = 12, 1 N / mm^2$
6,0	$f_{ax,k} = 11, 4 N / mm^2$
8,0	$f_{ax,k} = 11, 1 N / mm^2$

- *L* Length of the the fully threaded *GoFix HK* screw [mm]
- $h_{\text{DWD}}$  Penetration depth of the cylindrical steel part of the IdeFix-DWD [mm]
- $R_{v,0,cen,k}$  Characteristic value of the shear strength of the cylindrical part of the IdeFix-DWD Connector with load direction parallel to the joint [N]
- $R_{qx,cen,k}$  Characteristic withdrawal-capacity of the screws [N]
- $R_{\nu,cen,k}$  Characteristic shear strength parallel to the joint of the IdeFix-DWD with centric assembling to the joint of the timber parts [N]
- $\alpha_{la}$  Angle between screw and timber joint, see Figure 35
- $\alpha_{lb}$  Angle between screw and timber joint, see Figure 35
- $\alpha_{2a}$  Angle between load and screw axis, see Figure 35
- $\alpha_{2b}$  Angle between load and screw axis, see Figure 35
- $\beta_1$  Timber grain direction to the joint, timber part 1 [°]
- $\beta_2$  Timber grain direction to the joint, timber part 2 [°]
- $\rho_{l,k}$  Characteristic gross density, timber part 1 [kg/m<sup>3</sup>]
- $\rho_{2k}$  Characteristic gross density, timber part 1 [kg/m<sup>3</sup>]

#### E.2 Applications in Solid Timber (EN 338, EN 15497), Softwood

#### E.2.1 Characteristic shear strength parallel to the joint of the timber parts, with centric arrangement

The characteristic shear strength parallel to the joint of the timber parts, with centric assembling,  $R_{v,cen,k}$  can be calculated with the help of equation (1).

![](_page_49_Figure_4.jpeg)

### Figure 36: Centric arrangement of the IdeFix-DWD Connector, shear strength parallel to the timber joint Solid Timber

Hereby the amount of the embedment strength of the IdeFix-DWD Connector, by considering the load-grain direction for the embedment strength, should be calculated with equation (2).

$$R_{v,0,cen,k} = \frac{1}{2} \cdot d_{DWD} \cdot h_{DWD} \cdot \min(f_{h,\beta,1,k}; f_{h,\beta,2,k})$$
(2)

With

$$f_{h,\beta,1,k} = \frac{0,082 \cdot (1-0,01 \cdot d_{DWD}) \cdot \rho_{1,k}}{(1,35+0,015 \cdot d_{DWD}) \cdot \sin(\beta_1)^2 + \cos(\beta_1)^2}$$
(3)

$$f_{h,\beta,2,k} = \frac{0,082 \cdot (1 - 0,01 \cdot d_{DWD}) \cdot \rho_{k,2}}{(1,35 + 0,015 \cdot d_{DWD}) \cdot \sin(\beta_2)^2 + \cos(\beta_2)^2}$$
(4)

The axial capacity of the screws can be calculated with equation

$$R_{v,ax,k} = 2 \cdot \cos(\alpha_{1a}) \cdot \frac{F_{ax,a,Rk}}{\sqrt{2}} + 2 \cdot \cos(\alpha_{1b}) \cdot \frac{F_{ax,b,Rk}}{\sqrt{2}}$$

With the characteristic withdrawal capacity Fax, Rk for GoFix HK screws according to ETA-11/0425

$$F_{ax,a,Rk} = f_{ax,k} \cdot d \cdot l_{ef,a} \cdot \left(\frac{\min(\rho_{1,k}, \rho_{1,k})}{350}\right)^{0,8}$$
(5)

$$F_{ax,b,Rk} = f_{ax,k} \cdot d \cdot l_{ef,b} \cdot \left(\frac{\min(\rho_{1,k}, \rho_{1,k})}{350}\right)^{0,8}$$

(6)

Angle	Effective length L <sub>ef</sub> [mm]
$\alpha_{1a}$	$d_{DWD}$ 40; $L_{ef,a} = L - 7$
$\alpha_{1a}$	$d_{DWD}$ 30; $L_{ef,a} = L - 6$
$\alpha_{1b}$	$d_{DWD}$ 40; $L_{ef,b} = L - 7$
$\alpha_{1b}$	$d_{DWD}$ 30; $L_{ef,b} = L - 6$

#### E.2.2 Characteristic shear strength parallel to the joint of the timber parts, with eccentric arrangement

The characteristic shear strength parallel to the joint of the timber parts, with eccentric arrangement, can be calculated with equation (8).

![](_page_50_Figure_5.jpeg)

### Figure37: Eccentric arrangement of the IdeFix DWD Connector, shear strength parallel to the timber joint Solid Timber

With

$$R_{v,ax,k} = 2 \cdot \cos\left(\alpha_{load} - \alpha_{1a}\right) \cdot \frac{F_{ax,a,Rk}}{\sqrt{2}} + 2 \cdot \cos\left(\alpha_{load} - \alpha_{1b}\right) \cdot \frac{F_{ax,b,Rk}}{\sqrt{2}}$$
(8)

and the equations in accordance to ETA-11/0425 for GoFix HK screws.

$$F_{ax,a,k} = k_{ax} \cdot f_{ax,k} \cdot d \cdot l_{ef,a} \cdot \left(\frac{\rho_k}{350}\right)^{0,8}$$

$$F_{ax,b,k} = k_{ax} \cdot f_{ax,k} \cdot d \cdot l_{ef,b} \cdot \left(\frac{\rho_k}{350}\right)^{0,8}$$
(10)

Note: Due to the use of the M12;M16 screw in the center of the DWD box the GoFix HK screws are able to transfer both, tension in compression loads. Buckling of the screws in compression must not be considered.

Where

d	Nominal diameter of the GoFix HK screw [mm]
$d_{DWD}$	Diameter of the IdeFix-DWD Connector [mm]
$f_{h,\alpha,k}$	Characteristic embedment strength, considering load-grain direction [N/mm <sup>2</sup> ]
<i>k</i> <sub>ax</sub>	Coefficient to consider the angel between crew axis and grain-direction [-]

#### Page 50 of 67 of European Technical Assessment no. ETA-14/0160, issued on

Effective length of the threaded part of the screw in the timber part [mm]

Angle	<i>Effective length L<sub>ef</sub> [mm]</i> eccentric arrangement
$\alpha_{1a}$	$d_{DWD}$ 40; $L_{ef 45^{\circ}} = L - 24 > 0$
$\alpha_{1a}$	$d_{DWD}$ 30; $L_{ef45^{\circ}} = L - 19 > 0$
$\alpha_{1a}$	$d_{DWD}$ 40; $L_{efa} = L - 57 > 0$
$\alpha_{1a}$	$d_{DWD}$ 30; $L_{ef,a} = L - 43 > 0$
$\alpha_{1b}$	$d_{\rm DWD}$ 40; $L_{\rm ef,b} = L - 7$
α <sub>1b</sub>	$d_{\rm DWD}$ 30; $L_{\rm ef,b} = L - 6$

$d_{DWD}$	Diameter of the IdeFix-DWD Connector [mm]
$f_{h,\alpha,k}$	Characteristic embedment strength, considering load-grain direction [N/mm <sup>2</sup> ]
$h_{DWD}$	Penetration depth of the IdeFix-DWD Connector [mm]
$R_{\nu,ax,k}$	Characteristic withdrawal-capacity of the screws [N]
$R_{v,cen,k}$	Characteristic shear strength of the IdeFix-DWD Connector with centric assembling to the joint of the
	timber parts [N]
$R_{\nu,0,k}$	Characteristic value of the embedment strength of the IdeFix-DWD Connector with
	$\alpha_{\text{load}}=0^{\circ}$ [N]
<i>k</i> <sub>ax</sub>	Coefficient to consider the angel between crew axis and grain-direction [-]
$\alpha_{\rm load}$	Angle load grain-direction [°]
$\alpha_{1a}$	Angle between screw and timber joint $\alpha_{1a}=22,5^{\circ}$
$\alpha_{2b}$	Angle between screw and timber joint $\alpha_{1b}=67,5^{\circ}$
$ ho_k$	Characteristic gross density [kg/m <sup>3</sup> ]

### E.2.3 Characteristic tension strength perpendicular to the timber joint of the timber parts, with centric arrangement

The characteristic tension strength perpendicular to joint of the timber parts, with centric arrangement can be calculated with equation (11).

![](_page_52_Figure_3.jpeg)

### Figure 38: Centric arrangement of the IdeFix DWD Connector, tension strength perpendicular to the timber joint

#### Solid Timber

With

$$R_{v,ax,k} = 2 \cdot \left( \frac{F_{ax,\alpha 1a,k} \cdot F_{v,la,\alpha 1a,k}}{F_{ax,\alpha 1a,k} \cdot \sin^2 \alpha 2a + F_{v,la,\alpha 1a,k} \cdot \cos^2 \alpha 2a} + \frac{F_{ax,\alpha 1b,k} \cdot F_{v,la,\alpha 1b,k}}{F_{ax,\alpha 1b,k} \cdot \sin^2 \alpha 2b + F_{v,la,\alpha 1b,k} \cdot \cos^2 \alpha 2b} \right) (12)$$

$$F_{ax,\alpha 1a,k} = \frac{f_{ax,k} \cdot L_{ef} \cdot d}{\sqrt{2}} \cdot \sin(\alpha 1a)$$
(13)

$$F_{ax,\alpha 1b,k} = \frac{\int_{-ax,k} L_{ef} \cdot u}{\sqrt{2}} \cdot \sin(\alpha 1b)$$
(14)

$$F_{v,la,\alpha 1a,k} = 2, 3 \cdot \sqrt{M_{y,Rk} \cdot f_{h,45^\circ,k} \cdot d}$$
(16)

$$F_{y,la,a1b,k} = 2,3 \cdot \sqrt{M_{y,Rk} \cdot f_{h,45^{\circ},k} \cdot d}$$
(17)

and the equations in accordance to ETA-11/0425 for GoFix HK screws.

#### Page 52 of 67 of European Technical Assessment no. ETA-14/0160, issued on

Additionally, the proof for tension perpendicular to the grain direction has to be done according to the table below.

$\frac{a}{h} > 0,7$	$0,2 \le \frac{a}{h} \le 0,7$	$a < 0, 2 \cdot h$
Proof for tension perpendicular to the grain is not necessary	$R_{t,90,d} = \frac{k_{mod}}{\gamma_M} \cdot k_s \cdot k_r \cdot \left(6, 5 + \frac{18 \cdot a^2}{h^2}\right) \cdot \left(t_{ef} \cdot h\right)^{0,8} \cdot f_{t,90,k}$ with	Only allowed for applications with short-term loads, e.g. wind loads
	$k_s = \max \begin{cases} 1\\ 0, 7 + \frac{1, 4 \cdot a_r}{h} \end{cases}$	
	and $k_r = \frac{6}{\sum_{i=1}^n \left(\frac{h_1}{h_i}\right)^2}$	
	Connections with $a_t > h$ and $F_{t,90,d} > 0, 5 \cdot R_{t,90,d}$ must be reinforced.	

IdeFix DWD d <sub>DWD</sub> [mm]	a [mm]	a <sub>r</sub> [mm]	h1 [mm]
30; 40	$\left(\frac{d_{DWD}}{3} + \frac{L_{ef}}{\sqrt{2}}\right) \cdot \cos\left(22,5\right)$	$2 \cdot \left(\frac{d_{DWD}}{3} + \frac{L_{ef}}{\sqrt{2}}\right) \cdot \sin(22,5)$	$h - \left(\frac{d_{DWD}}{3} + \frac{L_{ef}}{\sqrt{2}}\right) \cdot \cos(22, 5)$

Where

 $F_{t,90,d}$  Acting load on the IdeFix DWD Connector [N]

 $R_{t,90,d}$  Load bearing capacity of the Idefix-DWD Connector [N]

*a* Distance of the screw with the greatest distance to the loaded edge [mm]

*h* Height of the timber element [mm]

*b* Width of the timber element [mm]

$$\min\left\{b; \frac{L_{ef}}{\sqrt{2}}; 6 \cdot d\right\}$$

 $t_{ef}$  Effective depth of the connection, with uni-laterally connection

 $f_{t,90,k}$  Characteristic value of tension strength perpendicular to the grain direction [N/mm<sup>2</sup>]

*a<sub>r</sub>* Distance to the screws with greatest spacings perpendicular to the load direction [mm]

 $h_1$  Distance of the nearest screw to the unloaded edge of the timber element [mm]

 $h_i$  Distances to the unloaded edge of the circular i<sup>th</sup> arranged screw pair

#### E.3 Applications with Cross-Laminated Timber (CLT)

#### E.3.1 Characteristic shear strength parallel to the panel joint of the CLT elements, with centric arrangement

The characteristic shear strength parallel to the panel joint of the CLT elements, with centric arrangement, can be calculated with the help of equation (18).

![](_page_54_Figure_4.jpeg)

#### Figure 39: Centric arrangement of the IdeFix DWD Connector, shear strength parallel to the CLT panel-joint

The amount of the embedment strength of the IdeFix-DWD Connector, by considering the load-grain direction, should be calculated with equation (19).

$$R_{\nu,0,k} = \frac{1}{2} \cdot d_{DWD} \cdot h_{DWD} \cdot f_{h,\alpha,k}$$
(19)

with

$$f_{h,\alpha,k} = \frac{0,082 \cdot (1 - 0,01 \cdot d_{DWD}) \cdot \rho_k}{(1,35 + 0,015 \cdot d_{DWD}) \cdot \sin(\alpha)^2 + \cos(\alpha)^2}$$
(20)

and

$$R_{v,ax,k} = 2 \cdot \cos\left(\alpha_{load} - \alpha_{1a}\right) \cdot \frac{F_{ax,a,Rk}}{\sqrt{2}} + 2 \cdot \cos\left(\alpha_{load} - \alpha_{1b}\right) \cdot \frac{F_{ax,b,Rk}}{\sqrt{2}}$$
(21)

For the characteristic withdrawal parameter for GoFix HK screws made of carbon steel according to ETA-11/0425 has to be considered with the equations below.

$$F_{ax,a,Rk} = k_{ax} \cdot f_{ax,k} \cdot d \cdot l_{ef,a} \cdot \left(\frac{\rho_k}{350}\right)^{0,8}$$

$$F_{ax,b,Rk} = k_{ax} \cdot f_{ax,k} \cdot d \cdot l_{ef,b} \cdot \left(\frac{\rho_k}{350}\right)^{0,8}$$

$$(22)$$

Note: Due to the use of the M12;M16 screw in the center of the DWD box the GoFix HK screws are able to transfer both, tension and compression loads. Buckling of the screws in compression must not be considered.

Where	
d	Nominal diameter of the GoFix HK screw [mm]
$d_{DWD}$	Diameter of the IdeFix-DWD Connector [mm]
$f_{h,lpha,k}$	Characteristic embedment strength, considering load-grain direction [N/mm <sup>2</sup> ]
$h_{DWD}$	Penetration depth of the IdeFix-DWD Connector [mm]
$R_{v,ax,k}$	Characteristic withdrawal-capacity of the screws [N]
$R_{v,cen,k}$	Characteristic shear strength of the IdeFix-DWD Connector with centric assembling to the joint of the

timber parts [N]

- $R_{\nu,0,k}$  Characteristic value of the embedment strength of the IdeFix-DWD Connector with  $\alpha_{load} = 0^{\circ}$
- *k<sub>ax</sub>* Coefficient to consider the angel between crew axis and grain-direction [-]

Lef

Angle	Effective length L <sub>ef</sub> [mm]
$\alpha_{1a}$	$d_{DWD}$ 40; $L_{ef,a} = L - 7$
$\alpha_{1a}$	$d_{DWD}$ 30; $L_{ef,a} = L - 6$
$\alpha_{1b}$	$d_{DWD}$ 40; $L_{ef,b} = L - 7$
α <sub>1b</sub>	$d_{DWD}$ 30; $L_{ef,b} = L - 6$

- $\alpha_{\text{load}}$  Angle load grain-direction [°]
- $\alpha_{Ia}$  Angle between screw and timber joint  $\alpha_{1a}=22,5^{\circ}$
- $\alpha_{2b}$  Angle between screw and timber joint  $\alpha_{1b}=67,5^{\circ}$
- $\rho_k$  Density of the CLT panels, for inhomogeneous assembling the density of the outer layer should be taken into account [kg/m<sup>3</sup>]

#### E.3.2 Characteristic shear strength parallel to the panel joint of the CLT elements, with eccentric arrangement

The characteristic shear strength parallel to the panel joint of the CLT elements, with eccentric arrangement, can be calculated with the help of equation (24).

![](_page_56_Figure_3.jpeg)

Figure 41: Centric arrangement of the IdeFix-DWD Connector, shear strength parallel to the CLT panel-joint

With

$$R_{v,ax,k} = 2 \cdot \cos\left(\alpha_{load} - \alpha_{1a}\right) \cdot \frac{F_{ax,\alpha,Rk}}{\sqrt{2}} + 2 \cdot \cos\left(\alpha_{load} - \alpha_{1b}\right) \cdot \frac{F_{ax,b,Rk}}{\sqrt{2}}$$
(25)

For the characteristic withdrawal parameter for GoFix HK screws made of carbon steel according to ETA-11/0425 has to be considered with the equations below.

$$F_{ax,a,Rk} = k_{ax} \cdot f_{ax,k} \cdot d \cdot l_{ef,a} \cdot \left(\frac{\rho_k}{350}\right)^{0,8}$$

$$F_{ax,b,Rk} = k_{ax} \cdot f_{ax,k} \cdot d \cdot l_{ef,b} \cdot \left(\frac{\rho_k}{350}\right)^{0,8}$$

$$(26)$$

Note: Due to the use of the M12;M16 screw in the center of the DWD box the GoFix HK screws are able to transfer both, tension and compression loads. Buckling of the screws in compression must not be considered.

#### Page 56 of 67 of European Technical Assessment no. ETA-14/0160, issued on

Where	
d	Nominal diameter of the GoFix HK screw [mm]
$d_{DWD}$	Diameter of the IdeFix-DWD Connector [mm]
$f_{h,\alpha,k}$	Characteristic embedment strength, considering load-grain direction [N/mm <sup>2</sup> ]
$h_{DWD}$	Penetration depth of the IdeFix-DWD Connector [mm]
$R_{v,ax,k}$	Characteristic withdrawal-capacity of the screws [N]
$R_{v,cen,k}$	Characteristic shear strength of the IdeFix-DWD Connector with centric assembling to the joint of the
	timber parts [N]
$R_{v,0,k}$	Characteristic value of the embedment strength of the IdeFix-DWD Connector with
	$\alpha_{\text{load}}=0^{\circ}$
<i>k</i> <sub>ax</sub>	Coefficient to consider the angel between crew axis and grain-direction [-]
L <sub>ef</sub>	Effective length of the threaded part of the screw in the timber part [mm]

Angle	<i>Effective length L<sub>ef</sub> [mm]</i> eccentric arrangement
$\alpha_{1a}$	$d_{DWD}$ 40; $L_{ef 45^{\circ}} = L - 24 > 0$
$\alpha_{1a}$	$d_{DWD}$ 30; $L_{ef45^{\circ}} = L - 19 > 0$
$\alpha_{1a}$	$d_{DWD}$ 40; $L_{efa} = L - 57 > 0$
$\alpha_{1a}$	$d_{DWD}$ 30; $L_{ef,a} = L - 43 > 0$
$\alpha_{1b}$	$d_{\rm DWD}$ 40; $L_{\rm ef,b} = L - 7$
$\alpha_{1b}$	$d_{DWD}$ 30; $L_{ef,b} = L - 6$

 $\alpha_{\text{load}}$  Angle load grain-direction [°]

 $\alpha_{1a}$  Angle between screw and timber joint  $\alpha_{1a}=22,5^{\circ}$ 

 $\alpha_{lb}$  Angle between screw and timber joint  $\alpha_{1b}$ =67,5°

 $\rho_k$  Density of the CLT panels, for inhomogeneous assembling the density of the outer layer should be taken into account [kg/m<sup>3</sup>]

### E.3.3 Characteristic tension strength perpendicular to the panel joint of CLT elements, with centric arrangement

The characteristic tension strength perpendicular to the panel joint of the CLT panels, with centric arrangement can be calculated with equation (28).

![](_page_58_Figure_3.jpeg)

# Figure 42: Centric arrangement of the IdeFix-DWD Connector, tension strength perpendicular to the CLT panel-joint

With

$$R_{v,ax,k} = 2 \cdot \cos\left(\alpha_{load} - \alpha_{1a}\right) \cdot \frac{F_{ax,\alpha,Rk}}{\sqrt{2}} + 2 \cdot \cos\left(\alpha_{load} - \alpha_{1b}\right) \cdot \frac{F_{ax,b,Rk}}{\sqrt{2}}$$
(29)

and the equations in accordance to ETA-11/0425 for GoFix HK screws.

$$F_{ax,a,Rk} = k_{ax} \cdot f_{ax,k} \cdot d \cdot l_{ef,a} \cdot \left(\frac{\rho_k}{350}\right)^{0,8}$$

$$F_{ax,b,k} = k_{ax} \cdot f_{ax,k} \cdot d \cdot l_{ef,b} \cdot \left(\frac{\rho_k}{350}\right)^{0,8}$$
(30)
(31)

### E.3.4 Characteristic tension strength parallel to the axis of the IdeFix DWD Connector, arranged in the narrow surface of CLT panels

The characteristic tension strength parallel to the axis of the IdeFix DWD Connector in the edge surface of CLT panels, can be calculated with equation (32).

![](_page_59_Figure_3.jpeg)

### Figure 43: Centric arrangement of the IdeFix DWD Connector, tension strength parallel to the axis of the DWD box in the edge surface of CLT

With the equations of ETA-11/0425

$$F_{ax,Rk} = k_{ax} \cdot f_{ax,k} \cdot d \cdot l_{ef} \cdot \left(\frac{\rho_k}{350}\right)^{0.8}$$
(33)

Where	
d	Nominal diameter of the GoFix HK screws [mm]
$f_{ax,k}$	Characteristic withdrawal parameter of GoFix HK screws [N/mm <sup>2</sup> ]
kax	Coefficient to consider the angel between crew axis and grain-direction [-]
Lef	Effective length of the threaded part of the screw in the timber part [mm]
$F_{ax,Rk}$	Characteristic withdrawal capacity of GoFix HK screws [N]
$\rho_k$	Density of the CLT panels, for inhomogeneous assembling the density of the outer layer should be
	taken into account [kg/m <sup>3</sup> ]

#### E.3.5 Characteristic shear strength parallel to the panel joint of the CLT elements, with centric arrangement

The characteristic shear strength parallel to panel joint of the CLT elements, with centric arrangement, can be calculated with the help of equation (34).

![](_page_60_Figure_3.jpeg)

Figure 44: Centric arrangement of the IdeFix-DWD Connector, shear strength parallel to the CLT corner panel-joint

The amount of the embedment strength of the IdeFix-DWD Connector, by considering the load-grain direction, should be calculated with equation **Fejl! Henvisningskilde ikke fundet.** 

$$R_{\nu,0,k} = \frac{1}{2} \cdot d_{DWD} \cdot h_{DWD} \cdot f_{h,\alpha,k}$$
(35)

With

$$f_{h,\alpha,k} = \frac{0,082 \cdot (1 - 0,01 \cdot d_{DWD}) \cdot \rho_k}{(1,35 + 0,015 \cdot d_{DWD}) \cdot \sin(\alpha)^2 + \cos(\alpha)^2}$$
(36)

and

$$R_{\nu,ax,k} = 2 \cdot \cos\left(\alpha_{load} - \alpha_{1a}\right) \cdot \frac{F_{ax,a,k}}{\sqrt{2}} + 2 \cdot \cos\left(\alpha_{load} - \alpha_{1b}\right) \cdot \frac{F_{ax,b,k}}{\sqrt{2}}$$
(37)

The characteristic withdrawal parameter for GoFix HK screws according to ETA-11/0425 has to be considered with the equations below.

$$F_{ax,a,k} = k_{ax} \cdot f_{ax,k} \cdot d \cdot l_{ef,a} \cdot \left(\frac{\rho_k}{350}\right)^{0.8}$$

$$F_{ax,b,k} = k_{ax} \cdot f_{ax,k} \cdot d \cdot l_{ef,b} \cdot \left(\frac{\rho_k}{350}\right)^{0.8}$$

$$(38)$$

Note: Due to the use of the M12;M16 screw in the center of the DWD box the GoFix HK screws are able to transfer both, tension and compression loads. Buckling of the screws in compression must not be considered.

#### Page 60 of 67 of European Technical Assessment no. ETA-14/0160, issued on

### E.3.6 Characteristic shear strength parallel to the panel joint of the CLT elements, with eccentric arrangement

The characteristic shear strength parallel to panel joint of the CLT elements, with eccentric arrangement, can be calculated with the help of equation (40).

![](_page_61_Figure_3.jpeg)

$$R_{\nu,ex,k} = 2.5 \cdot \frac{F_{ax,a,k}}{\sqrt{2}} \tag{40}$$

# Figure 45: Eccentric arrangement of the IdeFix-DWD Connector, shear strength parallel to the CLT corner panel-joint

With the equation in accordance to ETA-11/0425.

$$F_{ax,a,k} = k_{ax} \cdot f_{ax,k} \cdot d \cdot l_{ef,a} \cdot \left(\frac{\rho_k}{350}\right)^{0,8}$$
(41)

Where

d	Nominal diameter of the GoFix HK screws [mm]
f <sub>ax,k</sub>	Characteristic withdrawal parameter of GoFix HK screws [N/mm <sup>2</sup> ]
kax	Coefficient to consider the angel between crew axis and grain-direction [-]
l <sub>ef,a</sub>	Effective length of the threaded part of the screw in the timber part
-	with $l_{ef} = 22 \text{ mm} \text{[mm]}$
$F_{ax,Rk}$	Characteristic withdrawal capacity of GoFix HK screws [N]
$ ho_k$	Density of the CLT panels, for inhomogeneous assembling the density of the outer layer should be taken into account [kg/m <sup>3</sup> ]

#### Page 61 of 67 of European Technical Assessment no. ETA-14/0160, issued on

### E.3.7 Characteristic shear strength perpendicular to the panel joint of the CLT elements, with centric arrangement

The characteristic shear strength perpendicular to panel joint of the CLT elements, with centric arrangement, can be calculated with the help of equation (42).

![](_page_62_Figure_3.jpeg)

Figure 46: Centric arrangement of the IdeFix-DWD Connector, shear strength parallel to the axis of the DWD box

#### CLT corner panel-joint

With the equation in accordance to ETA-11/0425.

$$F_{ax,k} = k_{ax} \cdot f_{ax,k} \cdot d \cdot l_{ef} \cdot \left(\frac{\rho_k}{350}\right)^{0.8}$$
(43)

Where

d	Nominal diameter of the GoFix HK screws [mm]
$f_{ax,k}$	Characteristic withdrawal parameter of GoFix HK screws [N/mm <sup>2</sup> ]
<i>k</i> <sub>ax</sub>	Coefficient to consider the angle between crew axis and grain-direction [-]
l <sub>ef,a</sub>	Effective length of the threaded part of the screw in the timber part [mm]
$F_{ax,Rk}$	Characteristic withdrawal capacity of GoFix HK screws [N]
$ ho_k$	Density of the CLT panels, for inhomogeneous assembling the density of the outer layer should be
	taken into account [kg/m <sup>3</sup> ]

#### Page 62 of 67 of European Technical Assessment no. ETA-14/0160, issued on

### E.3.8 Characteristic shear strength parallel to the panel joint of the CLT elements, with centric and inclined arrangement

The characteristic shear strength parallel to panel joint of the CLT elements, with centric and inclined arrangement, can be calculated with the help of equation (44).

![](_page_63_Figure_3.jpeg)

Figure 47 : Centric inclined arrangement of the IdeFix DWD Connector, shear strength parallel to the CLT corner panel-joint

$$R_{\nu,ax,k} = 2 \cdot \frac{F_{ax,a,k}}{\sqrt{2}} \tag{45}$$

With the equation in accordance to ETA-11/0425.

$$F_{ax,k} = k_{ax} \cdot f_{ax,k} \cdot d \cdot l_{ef} \cdot \left(\frac{\rho_k}{350}\right)^{0,8}$$

(46)

Where

d	Nominal diameter of the GoFix HK screws [mm]
$f_{ax,k}$	Characteristic withdrawal parameter of GoFix HK screws [N/mm <sup>2</sup> ]
<i>k</i> <sub>ax</sub>	Coefficient to consider the angle between crew axis and grain-direction [-]
l <sub>ef,a</sub>	Effective length of the threaded part of the screw in the timber part [mm]
$F_{ax,Rk}$	Characteristic withdrawal capacity of GoFix HK screws [N]
$\rho_k$	Density of the CLT panels, for inhomogeneous assembling the density of the outer layer should be
	taken into account [kg/m <sup>3</sup> ]

Note: Due to the use of the M12; M16 screw in the center of the DWD box the GoFix HK screws are able to transfer both, tension and compression loads. Buckling of the screws in compression must not be considered.

#### Annex F: IdeFix AR

#### F) Characteristic values of load-carrying-capacities and stiffness

#### F.1 Loading by forces perpendicular to side grain

The screws under  $\alpha = 61^{\circ}$  of IdeFix AR in the timber member are loaded by axial  $F_{ax}$  and lateral forces  $F_{la}$ . The resulting force equals the proportional tensile force  $F_t/n$  for n screws at  $\alpha = 61^{\circ}$  and a force  $F_{ho}$  acting at the screw's head and the IdeFix AR connector, see figure 48.

![](_page_64_Figure_5.jpeg)

Figure 48: loading of IdeFix AR by tensile forces

The loading of IdeFix ARs fixed with inclined screws at  $\alpha = 61^{\circ}$  results:  $F_t/n = F_{ax} \cdot cos(29^{\circ}) + F_{la} \cdot sin(29^{\circ})$ . And for IdeFix AR fixed exclusively with 2 screws under  $\alpha = 90^{\circ}$ :  $F_t/2 = F_{ax}$ . In the section of screws' tips tensile stresses perpendicular to the grain  $\sigma_{t,90}$  act.

The bearing strength for IdeFix AR connectors loaded by a tensile force with n screws under an angle of  $\alpha = 61^{\circ}$  is:  $F_{ax,Adapter,Rk} = \left(n^{0,9} \cdot F_{ax,screw,Rk} \cdot cos(29^{\circ}) + n \cdot F_{la,screw,Rk} \cdot sin(29^{\circ})\right)$  and for connectors fixed with 2 screws perpendicular to side-grain  $F_{ax,Adapter,Rk} = 2^{0,9} \cdot F_{ax,screw,Rk}$ The axial resistance  $F_{ax,screw,Rk}$  of the screws GoFix HK is determined according to ETA-11/0025.

The lateral load-carrying capacity  $F_{la,screw,Rk}$  for screws with  $l_{ef,\alpha=61^{\circ}}$  is found with the parameters according to ETA-11/0425 and Johansen's model for steel-timber joints with thin steel plates according EC5-1-1, 8.2.3.

For IdeFix AR connectors applied with screws under  $\alpha = 90^{\circ}$  and  $\alpha = 61^{\circ}$  the bearing capacities are not to be added.

The splitting capacity for connection forces perpendicular to grain should be verified according to EC5-1-1, the pull out of bolts M12 or M16 according to EN 1993-1-8.

#### F.2 Loading by forces parallel to side grain

The load bearing capacity for lateral forces follows as:

 $F_{la,Adapter,Rk} = \left(n_V \cdot F_{ax,screw,RK} \cdot cos(61^\circ) + n_V \cdot F_{la,screw,RK} \cdot cos(29^\circ)\right)$ And for IdeFix AR fixed with 2 GoFix HK at 90°:  $F_{la,Adapter,Rk} = 2 \cdot F_{la,screw,RK}$ With  $n_V$  given in table F.1

Srew pattern	$n_V$
2 x 90°	2
3 x 61°	1
6 x 61°	2

![](_page_65_Figure_6.jpeg)

Figure 49: loading of IdeFix AR by shear forces  $F_V$ 

F.3 Loading under an arbitrary angle to side grain

The model according annex B.2 for IdeFix IFS is applied to IdeFix AR:

 $\left(\frac{F_{t,Ed}}{F_{ax,Adapter,Rd}}\right)^2 + \left(\frac{F_{V,Ed}}{F_{la,Adapter,Rd}}\right)^2$ 

#### F.4 Loading by a moment

No model is assessed for a loading of IdeFix AR by moments. The load bearing capacities of IdeFix IFS according to annex B are based on tests with small eccentricities of loads due to an eye bolt.

If the bolts M12 or M16 are loaded by greater bending moments, e.g. due to forces acting in larger distances from the contact area between IdeFix AR and timber, this would produce additional axial loading of screws and stresses perpendicular to side grain. For this kind of loading a verification according to EC 5-1-1 for the in-site realisation has to be done and the bolts M12 or M16 are to be verified for bending moments.

![](_page_66_Figure_4.jpeg)

Figure 50: IdeFix AR and bolt loaded by bending moment due to eccentricity

IdeFix AR, product details, definitions and installation

![](_page_67_Figure_2.jpeg)

ETA-11/0025 specifies for screws subjected exclusively to axial forces a minimum distance from the centre of the penetration length to the unloaded edge of  $a_{4,c} = 4 \cdot d = 24 \text{ mm}$ . Lateral embedding stresses are not considered as these stresses are equalised within the joint area.

For IdeFix AR fixed with GoFix HK l = 60 mm in solid timber, glued laminated timber or glued solid timber the minimum width is  $b_{min} = 43 + 2 \cdot (13 + 24) = 117mm$  and for fixing without inclined screws  $b_{min} = 47 + 2 \cdot 24 = 95mm$ .

![](_page_68_Figure_3.jpeg)

![](_page_68_Figure_4.jpeg)

figure 51: minimum distance  $a_{4,c}$  for IdeFix AR loaded exclusively by forces  $F_t$  perpendicular to the side.

figure 52: minimum distance  $a_{4,c}$  for IdeFix AR loaded exclusively by forces  $F_t$  perpendicular to the side.