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1459\_Experts Report\_SWG\_ASSY\_BauBuche

## **Expert's report – Evaluation report**

### **Extension of ETA-11/0190 for ASSY Screws in Beech LVL**

#### **1 General**

The following European technical assessment exists for self-tapping screws produced by Adolf Würth GmbH & Co. KG for use in timber constructions:

- ETA-11/0190 Würth selbstbohrende Schrauben dated 23.07.2017

Adolf Würth GmbH & Co. KG has applied for an extension of ETA-11/0190 based on EAD 130118-00-0603 for ASSY screws for use in timber constructions.

The screws are used for connections in load bearing timber structures between members made of solid timber (softwood), glued laminated timber, cross-laminated timber, and laminated veneer lumber, similar glued members, wood-based panels or steel members. ASSY screws with a diameter of at least 6 mm may also be used for the fixing of thermal insulation material on rafters and ASSY screws with full thread are used as tensile and compression reinforcements perpendicular to the grain.

The extension of ETA-11/0190 comprises the following topic:

- Use of ASSY screws in predrilled Beech LVL members with increased predrilling diameter for screws with  $d = 6 \text{ mm}$  to  $d = 14 \text{ mm}$ ;

This expert report assesses the load-carrying capacity of ASSY screws according to EAD 130118-00-0603 with a view to a European Technical Assessment.

This expert's report is mainly based on the following documents:

- GUTACHTERLICHE STELLUNGNAHME NR. GU18-470-1-01: „Beurteilung des Einflusses des Vorbohrdurchmessers auf die Tragfähigkeit und Steifigkeit ausgewählter, axial beanspruchter Holzbauschrauben“, Lignum Test Center (LTC), Institut für Holzbau und Holztechnologie, TU Graz, 27.06.2018
- Comparative withdrawal tests with ASSY screws 12x300 with different predrilling diameter, Versuchsanstalt für Stahl, Holz und Steine des Karlsruher Instituts für Technologie, 11.12.2018
- ETA-11/0190 Würth selbstbohrende Schrauben, 23.07.2017 issued by DIBt;
- EAD 130118-00-0603 “Screws for use in timber constructions”, October 2016;
- Eurocode 5 (EN 1995-1-1:2008-09): Design of timber structures - Part 1-1: General - Common rules and rules for buildings.

## 2 Test Results

### 2.1 Characteristic withdrawal parameter

The characteristic withdrawal parameter was determined according to EAD 130118-00-0603, 2.2.4 Method 1. The withdrawal parameter shall be determined by testing according to the test method given in EN 1382. At least 20 tests for every influencing parameter such as the outer thread diameter, drill tip, secondary rough thread and the angle between screw-axis and grain are required.

The number of specimens was 90 for diameters 6 mm, 10 mm and 14 mm and 10 for diameter 12 mm. For diameters 6 mm, 10 mm and 14 mm 10 screws each were tested without predrilling, with predrilling according to ETA-11/0190 and with an increased predrilling diameter. These variations in predrilling were applied for screws arranged parallel to grain and perpendicular to grain, the latter both in the edge and wide face of the Beech LVL. The tests were hence performed at an angle of 90° or 0° between screw axis and grain direction. The penetration length excluding the drill tip was 6 d for diameters 6 mm, 10 mm and 14 mm and including the drill tip for diameter 12 mm. The withdrawal parameter of each test was corrected with a factor  $k_p = (\rho_k/\rho)^{0.8}$  according to EAD 130118-00-0603, 2.2.1.4 Method 1. The characteristic density was uniformly chosen as 730 kg/m<sup>3</sup>.

From the corrected withdrawal parameters, the characteristic value of the withdrawal parameter was calculated according to EN 14358 (Tables 1 to 3) for each combination of diameter, predrilling and screw orientation. This characteristic withdrawal parameter corresponds to the chosen characteristic density of the timber.

Table 1: Characteristic withdrawal parameter of ASSY screws in Beech LVL

Diameter d [mm]	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0
Angle screw axis – grain [°]	0	0	0	90	90	90	90	90	90	90
Screw axis in LVL's	End grain			Edge face			Wide face			
Pre-drilling diameter [mm]	0	4,0	4,5	0	4,0	4,5	0	4,0	4,5	
Mean density [kg/m <sup>3</sup> ]	805	810	812	802	802	803	799	803	799	
Minimum [N/mm <sup>2</sup> ]	31,1	32,1	33,4	38,5	38,4	40,3	40,7	42,8	42,0	
Mean value [N/mm <sup>2</sup> ]	38,9	38,6	36,7	45,6	44,8	44,2	47,3	46,9	46,0	
Maximum [N/mm <sup>2</sup> ]	45,4	47,6	43,9	52,6	50,5	48,9	51,0	51,9	50,0	
f <sub>ax,k</sub> [N/mm <sup>2</sup> ]	30,9	28,8	31,0	37,3	37,9	38,8	41,4	41,4	41,4	

Table 2: Characteristic withdrawal parameter of ASSY screws in Beech LVL

Diameter d [mm]	10,0	10,0	10,0	10,0	10,0	10,0	10,0	10,0	10,0	10,0
Angle screw axis – grain [°]	0	0	0	90	90	90	90	90	90	90
Screw axis in LVL's	End grain			Edge face			Wide face			
Pre-drilling diameter [mm]	0	7,0	8,0	0	7,0	8,0	0	7,0	8,0	
Mean density [kg/m <sup>3</sup> ]	803	819	819	776	791	799	784	800	802	
Minimum [N/mm <sup>2</sup> ]	28,8	25,1	24,3	36,3	41,1	42,4	36,8	41,9	41,1	
Mean value [N/mm <sup>2</sup> ]	30,9	27,9	27,6	40,4	45,5	45,0	41,2	44,2	43,2	
Maximum [N/mm <sup>2</sup> ]	32,1	29,5	30,6	46,4	51,5	50,7	44,9	46,6	46,6	
f <sub>ax,k</sub> [N/mm <sup>2</sup> ]	27,7	25,1	23,6	34,4	39,5	40,5	36,4	39,8	38,8	

Table 3: Characteristic withdrawal parameter of ASSY screws in Beech LVL

Diameter d [mm]	14,0	14,0	14,0	12,0	12,0	14,0	14,0	14,0	14,0	14,0	14,0
Angle screw axis – grain [°]	0	0	0	90	90	90	90	90	90	90	90
Screw axis in LVL's	End grain			Edge face			Wide face				
Pre-drilling diameter [mm]	0	9,0	11,0	8,0	9,0	0	9,0	11,0	0	9,0	11,0
Mean density [kg/m <sup>3</sup> ]	791	793	794	827	827	812	801	811	788	794	801
Minimum [N/mm <sup>2</sup> ]	29,4	26,5	26,3	31,2	31,4	32,8	36,4	33,4	34,1	37,3	36,4
Mean value [N/mm <sup>2</sup> ]	32,2	30,7	32,4	34,2	33,1	35,8	38,3	36,3	37,1	39,1	39,0
Maximum [N/mm <sup>2</sup> ]	34,6	34,8	36,7	36,2	35,1	38,3	41,0	40,4	39,6	41,3	41,2
f <sub>ax,k</sub> [N/mm <sup>2</sup> ]	28,7	25,8	26,5	29,5	29,5	31,9	34,5	32,2	33,4	35,2	35,1

Comparing the results of the withdrawal tests in Beech LVL for different predrilling diameters, the ratio of the **mean** withdrawal capacity of screws with an increased predrilling diameter to the **mean** withdrawal capacity of screws with a predrilling diameter according to ETA-11/0190 is between 0,946 and 1,054 with an average ratio of 0,984. The ratio of the **characteristic** withdrawal capacity of screws with an increased predrilling diameter to the **characteristic** withdrawal capacity of screws with a predrilling diameter according to ETA-11/0190 is between 0,932 and 1,076 with an average ratio of 1,000. Hence, the characteristic withdrawal capacity of ASSY screws in predrilled holes is not influenced by an increased predrilling diameter. The different ratios are all within the expected variation of withdrawal test results.

### 3 Proposal for the extension of ETA-11/0190

In order to enable larger predrilling diameters in Beech LVL, the following changes marked in green in section A.1.4 of ETA-11/0190 are proposed:

Table A.1.1 Diameter of the pre-drilled holes in softwood and in beech, ash, oak or LVL made from beech according to EN14374 or FST according to ETA-14/0354

Outer thread diameter [mm]	Drill hole diameter [mm]		
	Softwood	Hardwood	Beech LVL or FST
3,0/3,4	1,5	2,0	2,5/2,5
3,5/3,9	2,0	2,5	2,5/3,0
4,0/4,4	2,5	3,0	3,0/3,5
4,5	2,5	3,5	3,5
5,0	3,0	3,5	4,0
5,5/6,0/6,3	4,0	4,0	4,5/4,5/5,0
6,5/7,0	4,0	5,0	5,0/5,5
7,5/8,0	5,0	6,0	6,0/6,5
10,0	6,0	7,0	8,0
12,0	7,0	8,0	9,0
14,0	8,0	9,0	11,0

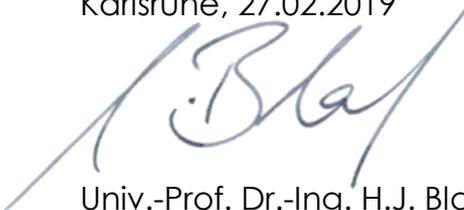
### 4 Summary

ASSY screws are self-tapping screws for use in connections in load-bearing timber structures between members made of solid timber (softwood or hardwood), glued laminated timber (softwood or hardwood), cross-laminated timber, laminated veneer lumber, and wood-based panels or steel. The screws are driven into softwood either without pre-drilling or in pre-drilled holes with a diameter not exceeding the inner thread diameter. In hardwood LVL, the holes are non-pre-drilled for limited penetration lengths or predrilled with a diameter generally exceeding the inner thread diameter.

In this expert's report recommendations are made for the extension of the content of the European Technical Assessment ETA-11/0190 based on tests by the notified body 0769 Versuchsanstalt für Stahl, Holz und Steine, Karlsruhe Institute of Technology and by Graz University of Technology.

There are no objections in my opinion to extending ETA-11/0190 for ASSY screws by the predrilling diameters given in section 3.

Karlsruhe, 27.02.2019



Univ.-Prof. Dr.-Ing. H.J. Blaß

VA-KA Holzbau und Baukonstruktionen - LABOR

# Prüfprotokoll

Maschine	Inspekt 150kN
Nennwert	150000 N

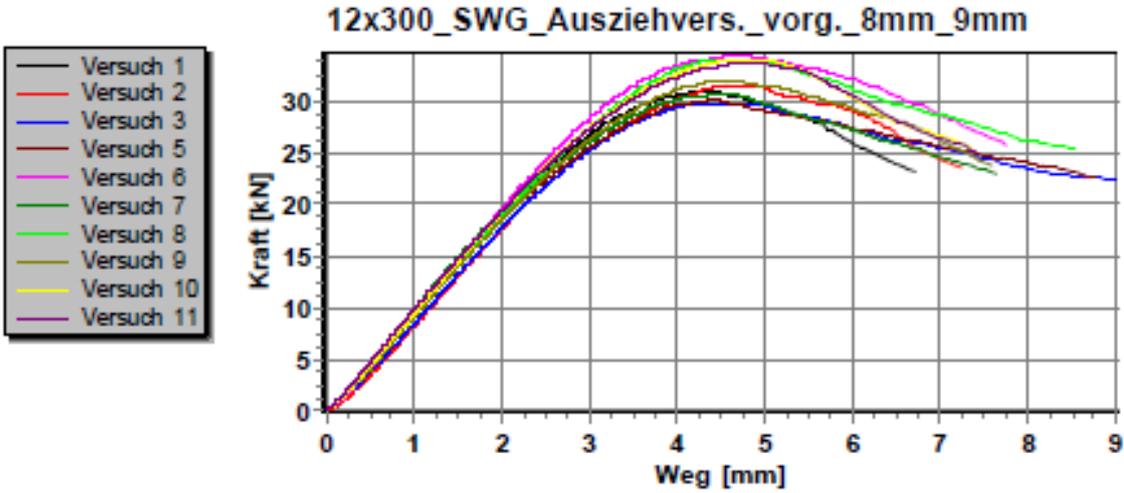
Kurzbezeichnung	Name	Kurzbezeichnung	Name
Rohd.	Rohdichte	Fmax	Maximalkraft (global)
Jrl	Jahringlage	Kom.	Kommentar
ET	Einschraubtiefe		

Resultate 12x300\_SWG\_Ausziehvers.\_vorg.\_8mm\_9mm:

Name	Rohd.	Jrl	ET [mm]	Fmax [kN]	Kom.
Versuch 1	813	tangential	72	30,963	Vorg. 8mm
Versuch 2	813	tangential	72	31,536	Vorg. 9mm
Versuch 3	831	tangential	72	29,874	Vorg. 8mm
Versuch 5	831	tangential	72	30,136	Vorg. 9mm
Versuch 6	825	tangential	72	34,471	Vorg. 8mm
Versuch 7	825	tangential	72	30,832	Vorg. 9mm
Versuch 8	835	tangential	72	34,065	Vorg. 8mm
Versuch 9	835	tangential	72	31,982	Vorg. 9mm
Versuch 10	833	tangential	72	34,102	Vorg. 8mm
Versuch 11	833	tangential	72	33,740	Vorg. 9mm

Statistik 12x300\_SWG\_Ausziehvers.\_vorg.\_8mm\_9mm:

Name	ET [mm]	Fmax [kN]
MW	72	32,170
MINI	72	29,874
MAXI	72	34,471
s	0	1,769
V	0	5,500
ANZ	10	10



Das Protokoll ist auch ohne Unterschrift gültig!