EUROPEAN ASSESSMENT DOCUMENT

EAD 130019-00-0603

September 2016

DOWEL-TYPE FASTENERS WITH RESIN COATING

www.eota.eu

The reference title and language for this EAD is English. The applicable rules of copyright refer to the document elaborated in and published by EOTA.

This European Assessment Document (EAD) has been developed taking into account up-to-date technical and scientific knowledge at the time of issue and is published in accordance with the relevant provisions of Regulation No (EU) 305/2011 as a basis for the preparation and issuing of European Technical Assessments (ETA).

Contents

1 SCOPE OF THE EAD

1.1 Description of the construction product

The EAD regarding "Dowel-type fasteners with resin coating" covers staples in timber structures.

In terms of geometry and materials the staples are in accordance with EN 14592:2008+A1:2012 “Timber structures – Dowel-type fasteners – Requirements” for the following requirements:

Staples have legs with a round, deformed circular or rectangular cross-section and will be delivered in loose or collated form.

They are produced from non-alloy steel rods in accordance with EN ISO 16120 or from stainless steel or drawn from austenitic steel rods in accordance with EN 10088.

Staples are different to EN 14592 for the following requirements:

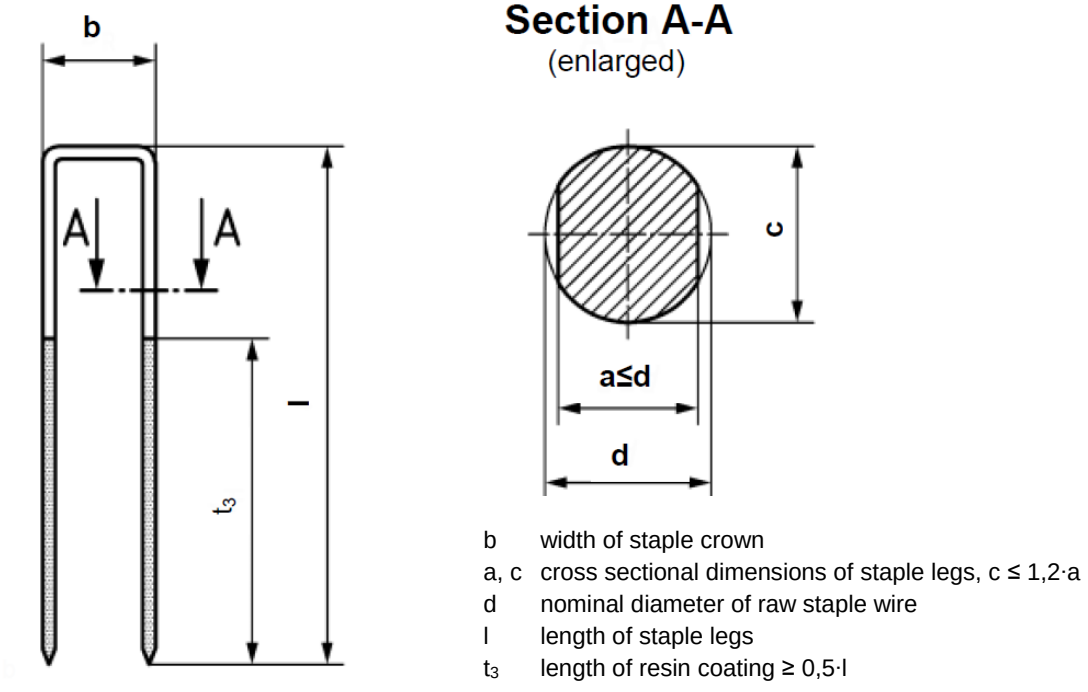
The tensile strength f_u of the raw wire is at least 900 N/mm^2.

For staples with rectangular or circular or deformed-circular cross-section the diameter of the staple leg d is at least 1,5 mm and not more than 3,0 mm (d ≤ 2,00 mm for connections of gypsum boards and cement bonded boards). Legs have a minimum cross-sectional area A_s of 1,7 mm^2 and a maximum cross-sectional area of 7,1 mm^2. The leg diameter d is taken as d = $\sqrt{4 \cdot A / \pi}$ provided that largest cross-sectional dimension measured about the perimeter is not larger than 1,2 times the value of the smallest dimension.

The crown has a minimum width b of 5,8·d.

In accordance with EN 14592 the maximum length l of the leg is 65·d.

If wood fibre insulation material is connected to timber constructions the maximum length l of the leg is 85·d.



b width of staple crown
a, c cross sectional dimensions of staple legs, c ≤ 1,2·a
d nominal diameter of raw staple wire
l length of staple legs
t_3 length of resin coating ≥ 0,5·l

Figure 1 – Staple dimensions

Staples according to this EAD have a special resin coating for which criteria are determined in clause 2.2.9.

The resin coating has a minimum length of 50 % of the legs.

The characteristics of staples with resin coating enable its long term and permanent load duration withdrawal capacity.

The application of this EAD implies that tests according to clause 2.2.3 and 2.2.4 are obligatory and the conditions of equation (1) to (3) are met.

The product is not fully covered by the following harmonised technical specification EN 14592:2008+A1:2012.

Concerning product packaging, transport, storage, maintenance, replacement and repair it is the responsibility of the manufacturer to undertake the appropriate measures and to advise his clients on the transport, storage, maintenance, replacement and repair of the product as he considers necessary.

It is assumed that the product will be installed according to the manufacturer's instructions or (in absence of such instructions) according to the usual practice of the building professionals.

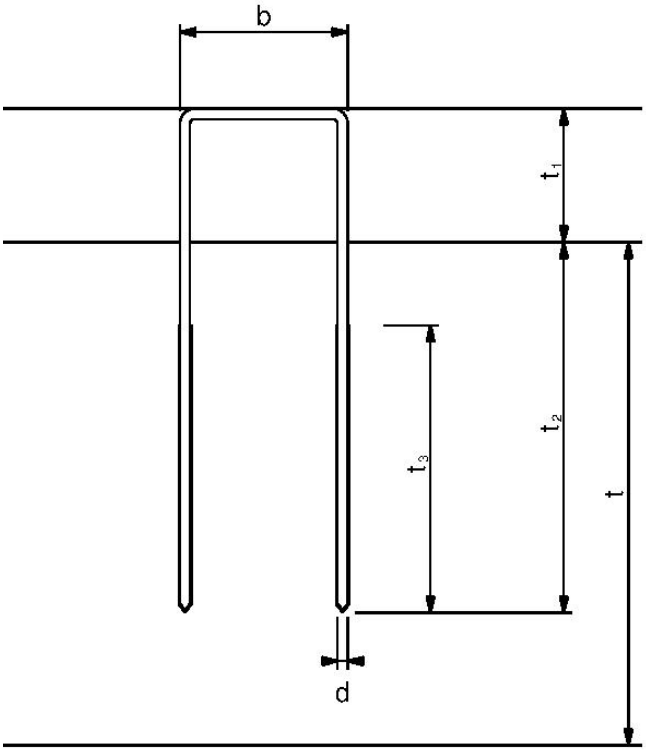
Relevant manufacturer's stipulations having influence on the performance of the product covered by this European Assessment Document shall be considered for the determination of the performance and detailed in the ETA.

1.2 Information on the intended use(s) of the construction product

1.2.1 Intended use(s)

The staples with resin coating are intended to be used for short term and medium term as well as long term and permanent load duration withdrawal capacity according to the definition of EN 1995-1-1. They are intended to be used for load bearing connections in timber to timber or timber to glued laminated timber, as well as to glued laminated solid timber or to laminated veneer lumber (LVL) or to cross laminated timber.

Connected components also may be wood-based panels as OSB, plywood, cement bonded particle boards, fibre boards or laminated veneer lumber (LVL) or solid wood panels. Besides those products the connection of gypsum boards, cement bonded boards, wood fibre boards and wood fibre insulation material with staples are also intended to be used.



b	width of the staple crown
d	nominal diameter of raw staple wire
t	thickness of the supporting structure
t_1	thickness of the connected component
t_2	length of the staple in the supporting system
(l)	length of the staple leg $l = t_1 + t_2$
t_3	length of resin coating

Figure 2 Connection with staple

1.2.2 Working life/Durability

The assessment methods included or referred to in this EAD have been written based on the manufacturer's request to take into account a working life of the Dowel-type fasteners with resin coating for the intended use of 50 years when installed in the works (provided that the Dowel-type fasteners with resin coating is subject to appropriate installation (see 1.1). These provisions are based upon the current state of the art and the available knowledge and experience.

When assessing the product, the intended use as foreseen by the manufacturer shall be taken into account. The real working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for works[1].

The indications given as to the working life of the construction product cannot be interpreted as a guarantee neither given by the product manufacturer or his representative nor by EOTA when drafting this EAD nor by the Technical Assessment Body issuing an ETA based on this EAD, but are regarded only as a means for expressing the expected economically reasonable working life of the product.

[1] The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works is subject, as well as on the particular conditions of the design, execution, use and maintenance of that works. Therefore, it cannot be excluded that in certain cases the real working life of the product may also be shorter than the working life referred to above.

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

Table 1 shows how the performance of dowel-type fasteners with resin coating is assessed in relation to the essential characteristics.

Table 1 Essential characteristics of the product and methods and criteria for assessing the performance of the product in relation to those essential characteristics

No	Essential characteristic	Assessment method	Type of expression of product performance
Basic Works Requirement 1: Mechanical resistance and stability			
1	Dimensions	2.2.1	Levels
2	Characteristic yield moment	2.2.2	Level
3	Withdrawal capacity for short-term and medium-term loads	2.2.3	Level
4	Withdrawal capacity for long term and permanent loads	2.2.4	Level
5	Characteristic head pull-through parameter	2.2.5	Level
6	Minimum tensile strength of the wire	2.2.6	Level
7	Minimum and maximum thickness of the connected material	2.2.7	Level
8	Durability against corrosion	2.2.8	Description and/or level
9	Durability of the resin coating	2.2.9	Description
Basic Works Requirement 2: Safety in case of fire			
10	Reaction to fire	2.2.10	Class
Basic Works Requirement 4: Safety and accessibility in use			
12	Same as BWR 1		

2.2 Methods and criteria for assessing the performance of the product in relation to essential characteristics of the product

2.2.1 Dimensions

The dimensions of the dowel-type fasteners with resin coating are to be determined by measuring the relevant dimensions using a calibrated device capable of achieving an accuracy of ± 1 % of the measurement.

The dimensions of the staples shall be documented in the test report. Length (l) of staple leg and nominal diameter (d) shall be within ± 2,5 % of the stated value. Length of the cross-sectional area (A_s) and crown-width (b) shall be within ± 5 % of the stated value. Length of the resin coating (t_3) shall be at least in accordance with the stated minimum value.

2.2.2 Characteristic yield moment

The characteristic yield moment of the staples shall be determined by tests according to EN 409. The tests shall be carried out with a free length of the staple t_2 of 3·d.

The minimum number of specimens is 10 for every nominal diameter.

The yield moment is the value at the plastic bending angle α = 45°. No cracks are allowed at a bending angle α of less than 45°. The characteristic value of the yield moment shall be calculated according to EN 14358.

2.2.3 Withdrawal capacity for short-term and medium-term loads

The characteristic withdrawal parameter $f_{ax,k}$ shall be determined by tests according to the test method given in EN 1382. Standard for the selection of timber specimens is EN ISO 8970. Tests shall be made with solid timber of softwood according to EN 338/ EN 14081-1 and a characteristic density ρ_k = 350 kg/m^3 for the supporting material.

At least 20 tests for each different diameter and type of steel of the raw wire as well as each different kind of resin are required.

The test specimen shall be manufactured with the timber at an equilibrium moisture content corresponding to (20 ± 2) °C and (85 ± 5) % relative humidity.

The insertion of dowel-type fasteners shall follow normal preparation and practice. Staples shall be driven into the test specimen with fasteners axis perpendicular to grain (not parallel) to a penetration of at least 14·d or 20 mm, but not more than 20·d and not more than the stated minimum of the length of the resin coating (t_3).

After manufacture the test pieces shall be stored for at least one week at (20 ± 2) °C and (65 ± 5) % relative humidity.

The characteristic withdrawal parameter for the tested Staple shall be calculated according to EN 1382[2] and it has to be:

$$f_{ax,k} \geq 40 \cdot 10^{-6} \cdot \rho_k^2 \geq 4{,}9 \text{ N/mm}^2 \quad (1)$$

with:
ρ_k: characteristic density

[2] The withdrawal parameter of each test has to be corrected with: $k_\rho = \rho_k / \rho$.
ρ : density of test specimen

2.2.4 Withdrawal capacity for long term and permanent loads

2.2.4.1 Complementary tests for long term and permanent loads

With the following complementary tests the suitability of the dowel type fasteners and the used resin coating for long term and permanent loads shall be proved.

Beside the complementary tests the dowel type fasteners have to meet the requirements for short-term and medium-term loads described in clause 2.2.3.

1. Tests under the Conditioning 60 °C/75 % relative humidity

The withdrawal parameter $f_{ax,k}$ shall be determined by tests according to the test method given in EN 1382[2]. Standard for the selection of timber specimens is EN ISO 8970.

Tests shall be made with solid timber of softwood according to EN 338/ EN 14081-1 and a characteristic density ρ_k = 350 kg/m^3 for the supporting material.

At least 20 tests for each kind of resin are required. The tests may be carried out on only one diameter and on only one type of steel.

The test specimen shall be manufactured with the timber at an equilibrium moisture content corresponding to (20 ± 5) °C and (65 ± 5) % relative humidity.

The insertion of dowel-type fasteners shall follow normal preparation and practice. Staples shall be driven into the test specimen with fasteners axis perpendicular to grain (not parallel) to a penetration of at least - 14·d or 20 mm, but not more than 20·d.

After manufacture the test pieces shall be stored for at least one week at (60 ± 5) °C and (75 ± 5) % relative humidity.

The withdrawal parameter $f_{ax,k,}$ of the test has to be:

$$f_{ax,k,} \geq 40 \cdot 10^{-6} \cdot \rho_k^2 \geq 4{,}9 \text{ N/mm}^2 \quad (2)$$

2. Tests after driving the staples through a connected material

The characteristic withdrawal parameter $f_{ax,k}$ shall be determined by tests according to the test method given in EN 1382[2]. Standard for the selection of timber specimens is EN ISO 8970.

Tests shall be made with solid timber of softwood according to EN 338/ EN 14081-1 and a characteristic density ρ_k = 350 kg/m^3 for the supporting material and a mean density $\rho_m \geq$ 420 kg/m^3 for the connected material.

At least 20 tests for each kind of resin are required. The tests may be carried out on only one diameter and on only one type of steel.

The test specimen shall be manufactured with the timber at an equilibrium moisture content corresponding to (20 ± 2) °C and (85 ± 5) % relative humidity.

The insertion of dowel-type fasteners shall follow normal preparation and practice. Staples shall be driven through the connected material with a thickness t_1 of at least 40·d into the test specimen with fasteners axis perpendicular to grain (not parallel) to a penetration of at least 14·d or 20 mm, but not more than 20·d and not more than the stated minimum of the length of the resin coating (t_3).

If the shanks of the staples are not long enough to be driven through a connected material with a thickness t_1 of 40 · d, the thickness of the connected material may be reduced up to a minimum thickness of 20 · d. The thickness t_1 of the connected material as described in 2.2.4.2 has to be reduced in proportion to the reduced thickness of the connected material used in the tests (e.g.: connected material in the tests with a thickness of 20 · d / 30 · d instead of 40 · d leads to a 50%-reduction / 25%-reduction of the thickness t_1 of the connected material as described in 2.2.4.2).

After manufacture the test pieces shall be stored for at least one week at (20 ± 2) °C and (65 ± 5) % relative humidity.

The characteristic of the withdrawal parameter for the tested Staple shall be calculated according to EN 1382[2] and it has to be:

$$f_{ax,k} \geq 40 \cdot 10^{-6} \cdot \rho_k^2 \geq 4{,}9 \text{ N/mm}^2 \quad (3)$$

with:

ρ_k: characteristic density

2.2.4.2 Withdrawal capacity for long term and permanent loads

In case the withdrawal parameter $f_{ax,k}$ meets the requirements of clause 2.2.3 equation 1 and clause 2.2.4.1 equation 2 and 3, the design withdrawal capacity for service class 1 and 2 for long term and permanent loads may be taken to

$$R_{ax,d} = 70 \text{ N (with } \gamma_M = 1{,}3)$$

The penetration (effective anchoring length) of fasteners shall be at least 14 · d. In order to reduce abrasion of resin coating while the staple penetrates the connected material, its thickness t_1 has to be limited depending on the density of the connected material.

The afore mentioned design withdrawal capacity $R_{ax,d}$ = 70 N for long term and permanent loads can be applied if the following requirements on the thickness t_1 of the connected material are met. Otherwise, tests with the wanted connected material and wanted thickness t_1 in accordance with the test method given in clause 2.2.4.1 (2) shall be made.

If the thickness of the connected material in the tests described in 2.2.4.1 (2) is less than 40 · d, the thickness t_1 of the connected material as described below has to be reduced in proportion to the reduced thickness of the connected material used in the tests (e.g: connected material in the tests with a thickness of 20 · d / 30 · d instead of 40 · d leads to a 50%-reduction / 25%-reduction of the thickness t_1 of the connected material as described below).

$\rho_k \leq 400$ kg/m³ $t_1 \leq 80$ mm (e.g. solid timber of softwood)

400 kg/m³ < $\rho_k \leq 650$ kg/m³ $t_1 \leq 60$ mm (e.g. wood-based panels and solid timber of hardwood)

650 kg/m³ < $\rho_k \leq 900$ kg/m³ $t_1 \leq 40$ mm (e.g. wood-based panels and gypsum boards)

900 kg/m³ < $\rho_k \leq 1200$ kg/m³ $t_1 \leq 25$ mm (e.g. hardboards, gypsum fibreboards, cement-bonded particleboards)

1200 kg/m³ < $\rho_k \leq 1600$ kg/m³ $t_1 \leq 20$ mm (e.g. highly compressed gypsum fibreboards)

with

ρ_k = characteristic density of the connected material

Wood fibre insulation material

$t_1 \leq 70 \cdot d$ mm

with

d = nominal diameter of raw staple wire

2.2.5 Characteristic head pull-through parameter

The characteristic head pull-through parameter $f_{head,k}$ shall be determined by tests according to the test method given in EN 1383[2].

For staples -flush with the surface-, a cross sectional area within 1,7 mm² and 3,5 mm², a maximum anchoring length t_2 of 20·d, a characteristic withdrawal parameter $f_{ax,k} = 40 \cdot 10^{-6} \cdot \rho_k^2$ and a minimum thickness t_1 of the connected material according to Table 2 tests are not required, because this failure mechanism is not significant.

Table 2 Minimum thickness of wood and wood-based panels

Wood or wood-based panel	Minimum thickness in mm
Solid timber	24
Solid wood panels	7d*
Plywood	6*
Oriented Strand Boards OSB	8*
Resin-bonded particleboards	8*
Cement-bonded particleboards	8*

* shall be increased by 2 mm if staple crown is countersunk.

The characteristic head pull-through parameter for material regulated in technical approvals may be taken out of it.

Head pull-through parameters (which were) determined by tests shall be stated in accordance with the characteristic density of the connected material.

The withdrawal resistance does not only depend on the withdrawal capacity of the supporting elements, it also depends on the head pull-through strength of the staple crown through the connected material.

The characteristic head pull-through capacity may be calculated

$$R_{ax,2,k} = f_{head,k} \cdot b \cdot d \quad N \qquad (4)$$

with $f_{head,k}$: characteristic head pull-through parameter in N/mm^2

b: width of staple crown in mm

d: nominal diameter of raw staple wire in mm

2.2.6 Minimum tensile strength of the wire

The minimum tensile strength of the wire shall be determined by tests according to EN 10218-1.

2.2.7 Minimum and maximum thickness of the connected material

2.2.7.1 For minimum thickness of the connected material see clause 2.2.5 with Table 2.

2.2.7.2 For maximum thickness of the connected material see clause 2.2.4

2.2.8 Durability against corrosion

The corrosion protection shall be determined in conjunction with the admissible service conditions according to EN 1995-1-1 and the admissible corrosive category according to EN°ISO°-9223.

The product specification shall be examined and an assessment or appropriate test and evaluation shall be carried out to determine the thickness of corrosion protection or the material specification.

If a hot dip galvanized zinc coating according to EN ISO 1461 is used its thickness shall be determined by EN ISO 1460 – gravimetric method – or by EN ISO 2178 – non-destructive magnetic method –.

In case of using electroplated zinc coating according to EN ISO 2081 its thickness shall be determined by EN ISO 2081 or by EN ISO 2177.

If stainless steel is used, it shall be classified according to EN 10088-1.

The materials' specification or minimum corrosion protection for different service classes shall be in accordance with EN 1995-1-1 and the admissible corrosive category according to EN°ISO°-9223.

In case of acidic (or corrosive) timber species, e.g. hardwood (oak) or impregnated timber the use of the corrosion protection of service class 3 (stainless steel) shall be verified. It shall be considered that under certain service conditions some type of hardwood cause corrosion on staples.

Staples intended to be used in service class 3 have to be made of stainless steel (e.g. steel grade 1.4301, 1.4401, 1.4529).

The grade of the parent material and the thickness of the coating shall be stated.

Contact between staples and other components of the joint made from metal shall not result in corrosion in the intended use. Any risk of bimetallic corrosion shall be excluded.

Contact between staples and timber preservative treated against biological attack or fire retardants shall not result in corrosion in the intended use. If staples are used in preservative treated timber the compatibility has to be verified.

2.2.9 Durability of resin coating

2.2.9.1 Requirements for the resin coating

Organic polymers shall be the basis of resin.

The surface of the staple has to be without impurities (e.g. grease, oil or dust) to ensure the best possible adhesion of resin.

The viscosity of the resin shall adjust to the conditions of the application as to allow an acceptable moistening on the surface of the staples as basis for good adhesion.

The drying of resin coat (temperature and time) shall be done in accordance with the requirements of the resin producer.

The quality of the chemical composition of the used resin shall provide a good connection between steel and timber (e.g. suitable thermoplastic activity) and guarantee a maximum durability of the coating.

Data sheets of chemical compositions for resin coatings shall be deposited at TAB.

2.2.9.2 Methods of assessment

The resin specification shall be in accordance with the requirements of clause 2.2.9.1 and the withdrawal parameter in accordance with the requirements of clause 2.2.4.1, number 2.

2.2.10 Reaction to fire

The staples with resin coating are considered to satisfy the requirements for performance class A1 of the characteristic reaction to fire, in accordance with the provisions of EC Decision 96/603/EC (as amended) without the need for testing on the basis of its listing in that Decision.

Due to the fact that a resin coating on the staples for use in timber constructions is very thin, it may be assumed that it does not make any contribution to fire growth or the fully developed fire and has no influence to the smoke hazard. Thus staples for use in timber constructions with resin coating do not need to be tested.

3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

3.1 System(s) of assessment and verification of constancy of performance to be applied

For the product covered by this EAD the applicable European legal act is: Decision 97/176/EC.

The system is: 3.

3.2 Tasks of the manufacturer

The corner stones of the actions to be undertaken by the manufacturer of dowel-type fastener with resin coating in the procedure of assessment and verification of constancy of performance are laid down in Table 3.

Table 3 Control plan for the manufacturer; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Factory production control (FPC) [including testing of samples taken at the factory in accordance with a prescribed test plan]*					
1	Raw material specification	Supplier's declaration [a]	Specification of the manufacturer	Each steel consignment	Each delivery
2	Dimensions of the staples	See 2.2.1	Drawings in the ETA including tolerances	5	Daily
3	Length of resin coating	See 2.2.1	Stated ≥ ½ l	5	Daily
4	Characteristic yield moment	See 2.2.2	Stated ≤ characteristic tested	Each steel consignment	At least every six months
5	Minimum tensile strength of the raw wire	Supplier's declaration [a]	Stated ≤ minimum tested	Each steel consignment	Every six months
6	Durability against corrosion	Supplier's declaration [a]	See 2.2.8	Each steel- or coating consignment	Daily
7	Durability of the resin coating	Supplier's declaration	See 2.2.9	Each steel- or coating consignment	Daily

[a] supplier's certificate of compliance (EN 10204 Designation 2.1 or higher) and reference to the manufacturer's declaration of the coating

4 REFERENCE DOCUMENTS

As far as no edition date is given in the list of standards thereafter, the standard in its current version at the time of issuing the European Technical Assessment is of relevance.

EN 300:2006	Oriented strand boards (OSB) – Definition, classification and specifications
EN 312:2003	Particleboards – Specifications
EN 316:2009	Wood fibreboards – Definition, classification and symbols
EN 338:2009	Structural timber – Strength classes
EN 409:2009	Timber structures – Test methods – Determination of the yield moment of dowel type fasteners
EN 520:2004+A1:2009	Gypsum plasterboards – Definitions, requirements and test methods
EN 636:2012	Plywood – Specifications
EN 1382:1999	Timber structures – Test methods – Withdrawal capacity of timber fasteners
EN 1383:1999	Timber structures – Test methods – Pull through resistance of timber fasteners
EN 1995-1-1:2010	Design of timber structures – Part 1-1: General – Common rules and rules for buildings
EN 10088:2005	Stainless steels (all parts) Part 1: List of stainless steels Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes
EN 10218-1:2012	Steel wire and wire products – General – Part 1: Test methods
EN 13171:2012	Thermal insulating products for buildings – Factory made wood fibre (WF) products - Specification
EN 13986:2004	Wood-based panels for use in construction - Characteristics, evaluation of conformity and marking
EN 14080:2013	Timber structures - Glued laminated timber and glued solid timber – Requirements
EN 14081-1:2011	Timber structures – Strength graded structural timber with rectangular cross section – Part 1: General requirements
EN 14358:2006	Timber structures – Calculation of characteristic 5-percentile s and acceptance criteria for a sample
EN 14374:2005	Timber structures - Structural laminated veneer lumber – Requirements
EN 14592:2008+A1:2012	Timber structures – Dowel-type fasteners – Requirements
EN 15283-1:2008+A1:2009	Gypsum boards with fibrous reinforcement – Definitions, requirements and test methods Part 1: Gypsums boards with mat reinforcement
EN 15283-2:2008+A1:2009	Gypsum boards with fibrous reinforcement – Definitions, requirements and test methods Part 2: Gypsums fibre boards
EN 26891:1991	Timber structures; Joints made with mechanical fasteners; General principles for the determination of strength and deformation characteristics
EN ISO 1460:1994	Metallic coatings – Hot dip galvanized coatings on ferrous materials – Gravimetric determination of the mass per unit area
EN ISO 1461:2009	Hot dip galvanized coatings on fabricated iron and steel articles – Specifications and test methods
EN ISO 2081:2008	Metallic and other inorganic coatings - Electroplated coatings of zinc with supplementary treatments on iron or steel
EN ISO 2177:2004	Metallic coatings - Measurement of coating thickness - Coulometric method by anodic dissolution
EN ISO 2178:1995	Non-magnetic coatings on magnetic substrates – Measurement of coating thickness – Magnetic method
EN ISO 6892-1:2009	Metallic materials - Tensile testing - Part 1: Method of test at room temperature
EN ISO 8970:2010	Timber structures – Testing of joints made with mechanical fasteners – Requirements for wood density (ISO 8970:2010)
EN ISO 9223:2012	Corrosion of metals and alloys -- Corrosivity of atmospheres -- Classification, determination and estimation
EN ISO 16120:2011	Non-alloy steel wire rod for conversation to wire (all parts)