

BS EN 1382:2016



BSI Standards Publication

# Timber Structures — Test methods — Withdrawal capacity of timber fasteners

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**National foreword**

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A list of organizations represented on this committee can be obtained on request to its secretary.

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English Version

## Timber Structures - Test methods - Withdrawal capacity of timber fasteners

Structures en bois - Méthodes d'essai - Résistance à  
l'arrachement dans le bois d'éléments de fixation

Holzbauwerke - Prüfverfahren - Ausziehtragfähigkeit  
von Holzverbindungsmitteln

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## European foreword

This document (EN 1382:2016) has been prepared by Technical Committee CEN/TC 124 “Timber Structures”, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 2016, and conflicting national standards shall be withdrawn at the latest by August 2016.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document will supersede EN 1382:1999.

Compared to EN 1382:1999, the following changes have been made:

- replacement of EN 28970 by EN ISO 8970;
- improvement to figures and to definitions.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

## 1 Scope

This European Standard specifies the test method for determining the withdrawal capacity of fasteners which have been inserted into timber (solid timber, LVL, CLT and glued laminated timber).

The test method applies to all types of nails, screws and staples.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 14592, *Timber structures - Dowel-type fasteners - Requirements*

EN 26891:1991, *Timber structures - Joints made with mechanical fasteners - General principles for the determination of strength and deformation characteristics (ISO 6891:1983)*

EN ISO 8970:2010, *Timber structures - Testing of joints made with mechanical fasteners - Requirements for wood density (ISO 8970:2010)*

ISO 13061-1, *Physical and mechanical properties of wood — Test methods for small clear wood specimens — Part 1: Determination of moisture content for physical and mechanical tests*

ISO 13061-2, *Physical and mechanical properties of wood — Test methods for small clear wood specimens — Part 2: Determination of density for physical and mechanical tests*

## 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

- 3.1  
staple**  
double-bent, u-shaped piece of round, square, rectangular or oval wire with pointed legs
- 3.2  
staple crown**  
connection between the two staple legs
- 3.3  
staple leg diameter**  
nominal value of the diameter of a round staple leg, the side length of a rectangular leg, or the diameter of an oval cross section as defined in EN 14592
- 3.4  
staple length**  
length of each staple leg, including point
- 3.5  
staple crown width**  
width across the staple legs

### 3.6 withdrawal parameter

parameter measuring the resistance of a timber test piece to the withdrawal of a timber fastener

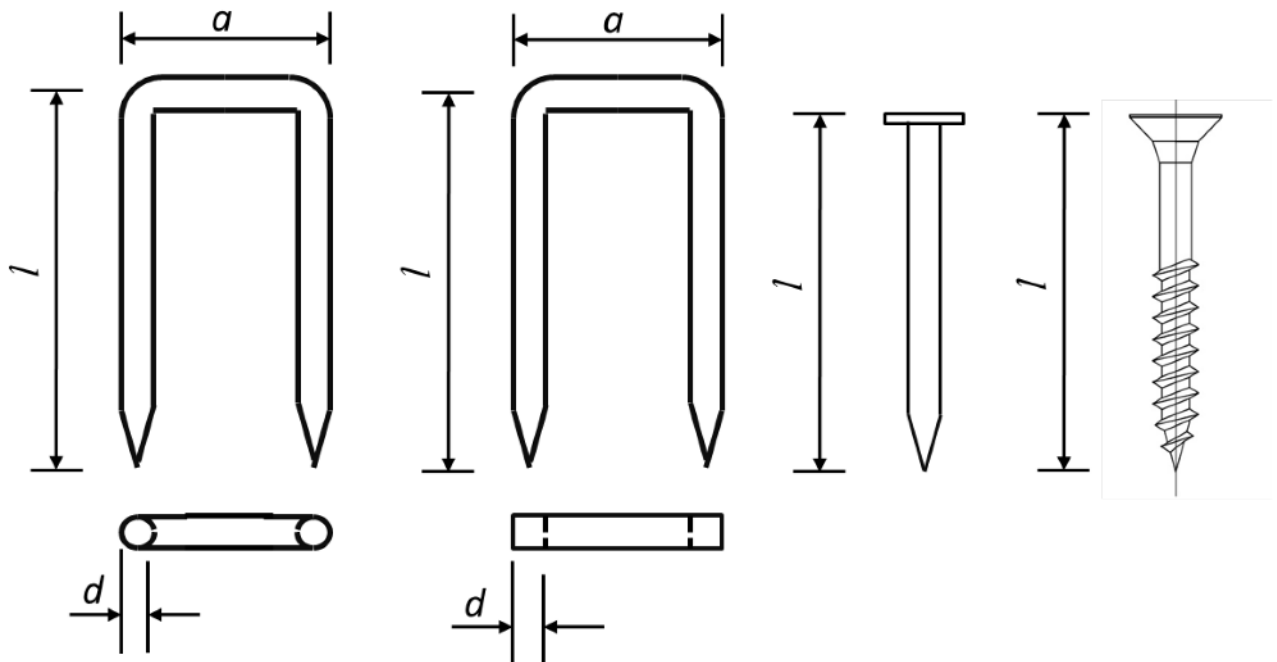
Note 1 to entry Figure 1 is given for clarification purposes.

## 4 Symbols and abbreviations

For the purposes of this document, the following symbols and abbreviations apply.

For symbols relating to staples.

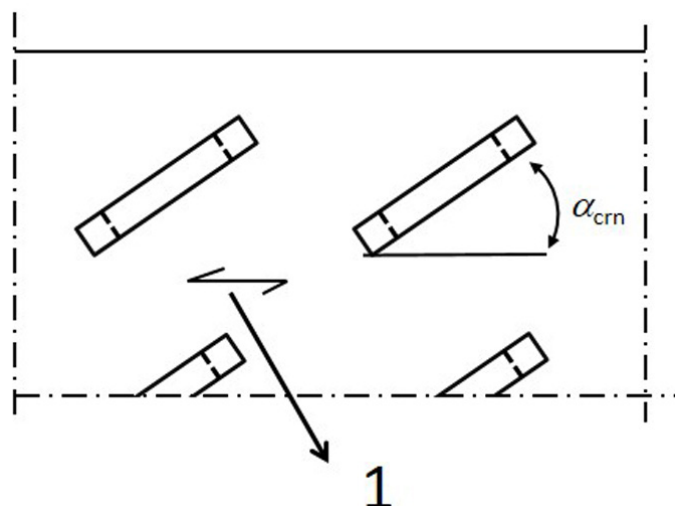
- $a$  staple crown width, see Figure 1, in millimetres
- $d$  is the outer thread diameter for screws, the diameter of the smooth plain part of a round nail or for staples the diameter of the wire (transformed to around cross-section), see EN 14592
- $F_{\max}$  maximum withdrawal load, in newtons
- $l$  is the fastener length, or leg length of the staple
- $f_{ax}$  withdrawal parameter, in newtons per square millimetres
- $l_d$  the effective depth of penetration of the fastener, in millimetres. For smooth nails and staples this includes the point. For profiled nails only the penetration depth of the profiled, for screws only the penetration depth of the profiled. In the case of partly or completely resin coated fasteners only the penetration depth of the coated part
- $\alpha_{crn}$  angle between the direction of a staple crown and the grain direction, respectively, see Figure 2, in degrees.



#### Key

- $l$  is fastener length
- $d$  is diameter
- $a$  is staple crown width

Figure 1 — Staple nail and screw dimensions



**Key**

1 grain direction

**Figure 2 — Angle between the staple direction and the grain direction**

## 5 Materials

### 5.1 Timber

The solid timber shall be selected in accordance with the method given in EN ISO 8970:2010.

The specification of the LVL, CLT and glued laminated timber shall be established. The products used for the individual test pieces shall be representative of the class or range of product to which they belong and the relevant properties shall be declared.

### 5.2 Fasteners

The specification of nails, screws or staples shall be established.

## 6 Test methods

### 6.1 General

The moisture content and density of the timber at test shall be determined as specified in ISO 13061-1 and ISO 13061-2 as appropriate.

### 6.2 Conditioning

For smooth fasteners the test pieces shall be manufactured with the timber or wood-based products at an equilibrium moisture content corresponding to  $(20 \pm 2) ^\circ\text{C}$  and  $(85 \pm 5) \%$  relative humidity.

After manufacture the test pieces shall be stored for at least one week at  $(20 \pm 2) ^\circ\text{C}$  and  $(65 \pm 5) \%$  relative humidity.

For all other fasteners the test pieces shall be manufactured with the timber or wood-based products at an equilibrium moisture content corresponding to  $(20 \pm 2) ^\circ\text{C}$  and  $(65 \pm 5) \%$  relative humidity.

After manufacture the test pieces shall be stored at  $(20 \pm 2) ^\circ\text{C}$  and  $(65 \pm 5) \%$  relative humidity until it is conditioned.



The material is conditioned when it attains constant mass. Constant mass is considered to be attained when, the results of two successive weightings, carried out at an interval of 6 h, do not differ by more than 0,1 % of the mass of the material.

For certain investigations other moisture conditioning may be appropriate, and shall be reported.

NOTE For some deciduous wood species a much longer storing period may be necessary.

## 6.3 Fabrication of the specimens

### 6.3.1 Fastener axis perpendicular to the grain

The axis of the fastener shall be perpendicular to the timber surface. The insertion of fasteners shall follow normal preparation (e.g. pre-boring) and practice. The width and depth of the test piece in the direction of insertion of the fastener shall be at least  $(l + 5d)$ , see Figure 3. Where the test pieces are of solid timber the insertion shall be at random with respect to the growth rings. For LVL the direction can be taken as perpendicular to the laminated veneer sheets. For staples, the tests shall be carried out with an angle of  $\alpha_{crn} = 30^\circ$ .

The other dimensions of the test piece shall comply with Figure 3. The fasteners shall be driven to a penetration of between  $8d$  and  $20d$  and shall be positioned as shown.

NOTE The range of depth penetration is given so that the depth of penetration used in the test can be decided depending on the withdrawal resistance and the tensile capacity of the fastener. A depth of penetration of at least  $12d$  is appropriate to fasteners of  $d$  less than 2 mm.

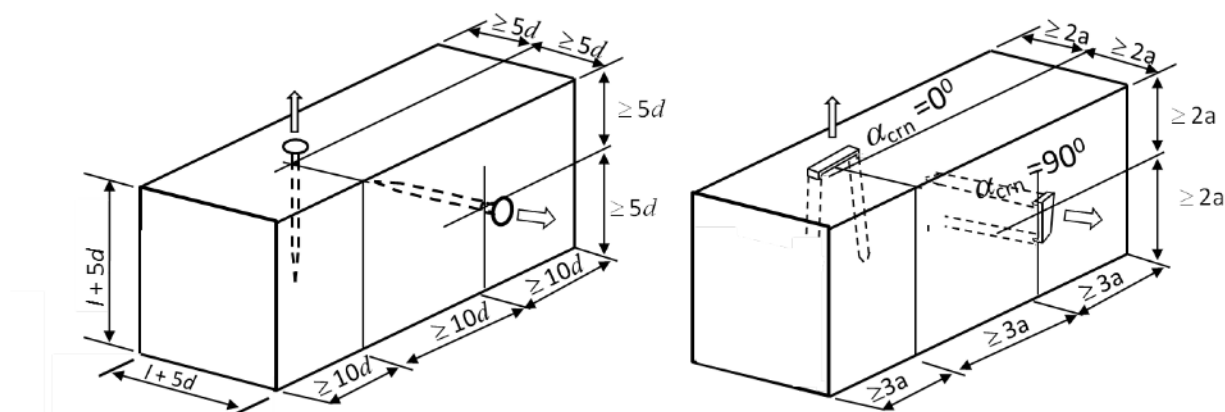


Figure 3 — Withdrawal timber test pieces - load perpendicular to grain

### 6.3.2 Fastener axis parallel to the grain

The axis of the fastener shall be perpendicular to the timber surface. The insertion of fasteners shall follow normal preparation (e.g. pre-boring) and practice. The length of the test piece in the direction of insertion of the fastener shall be at least  $(2l + 5d)$ , see Figure 4.

NOTE 1 This test method can also be used with the fasteners inserted into the timber at angles of between  $0^\circ$  and  $90^\circ$  to the grain direction.

The other dimensions of the test piece shall comply with Figure 4. The fasteners shall be driven into the end grain to a penetration of between  $8d$  and  $20d$  and shall be positioned as shown.

NOTE 2 A depth of penetration of at least  $12d$  is appropriate to fasteners of  $d$  less than 2 mm.

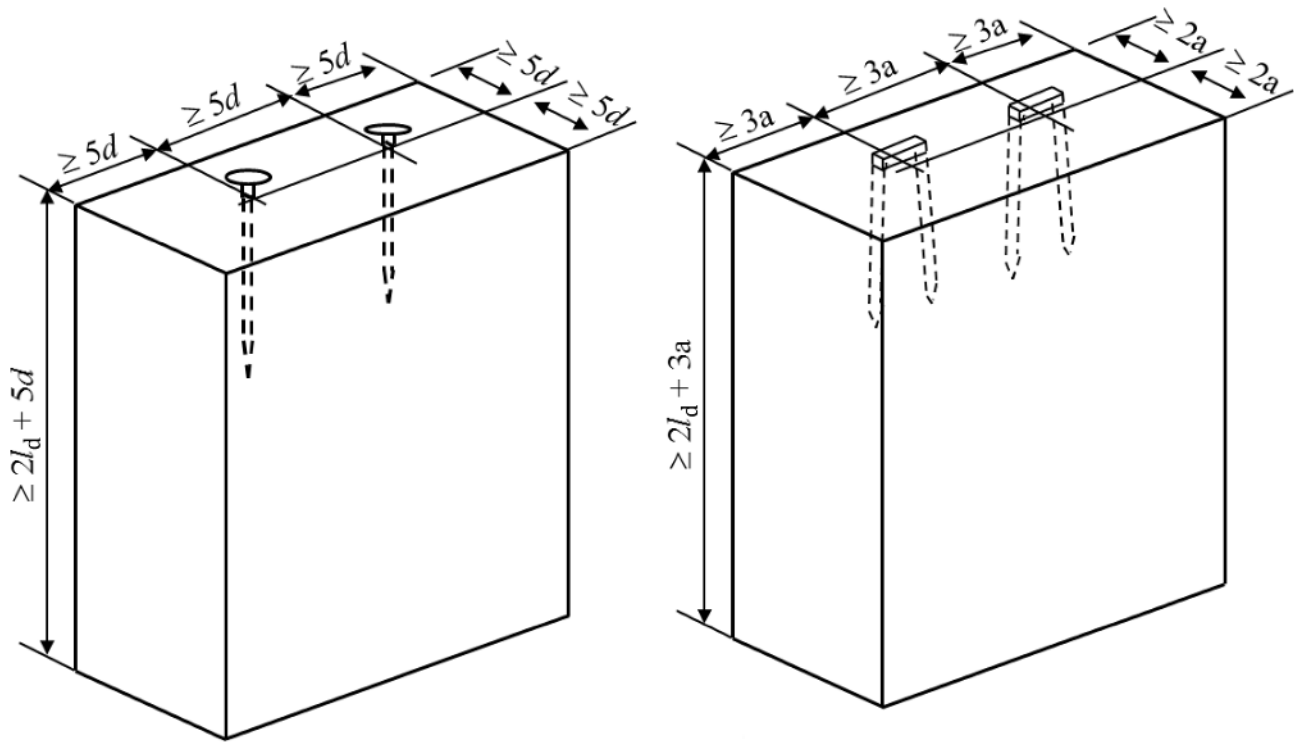


Figure 4 — Withdrawal test pieces - load parallel to grain

## 6.4 Test procedure

The apparatus used shall be as required in Clause 7 of EN 26891:1991. Determine the depth of the fastener penetration  $l_d$ . Place the test piece in a device ensuring the application of the withdrawal force along the axis of the fastener or the axes of the staple legs. Any part of the supports shall be not closer to the axis of the fastener than  $3d$  for nails and screws and  $a$  for staples.

The withdrawal test shall be performed with a constant rate of loading. When determining the withdrawal parameter  $f_{ax}$ , the rate of loading shall be such that the time taken to reach  $F_{max}$  is  $(60 \pm 15)$  s. Determine  $F_{max}$  to an accuracy of 1 %.

## 6.5 Test results

The withdrawal capacity is equal to the withdrawal load  $F_{max}$ .

The withdrawal parameter,  $f_{ax}$ , shall be determined from the equations:

$$f_{ax} = \frac{F_{max}}{d \times l_d}, \text{ for nails or screws}$$

Or

$$f_{ax} = \frac{F_{max}}{d \times 2l_d}, \text{ for staples}$$

The symbols are as given in Clause 4.

## 6.6 Test report

The test report shall contain the following information:

- a) sampling procedure;
- b) specification of the timber;
- c) dimensions, density, moisture content and conditioning history of the test pieces, fissures if any;
- d) diagram showing the layout of the fasteners and the method of insertion used in the test pieces;
- e) angle,  $\alpha_{\text{crn}}$ , between staple crown and grain as used in the test;
- f) number of test pieces used;
- g) specification and number of fasteners tested (type, sizes, material, surface coating or condition and other particulars);
- h) time to failure;
- i) individual test results for the withdrawal parameter  $f_{\text{ax}}$  and the withdrawal capacity  $F_{\text{max}}$ , mean values and standard deviations, and description of the mode of failure.

NOTE Characteristic values can be determined using EN 14358.

## Bibliography

- [1] EN 1381, *Timber structures - Test methods - Load bearing stapled joints*
- [2] EN 14358, *Timber structures - Calculation of characteristic 5-percentile values and acceptance criteria for a sample*



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