INTERNATIONAL STANDARD

ISO 12122-5

First edition
2018-11

Timber structures — Determination of characteristic values —

Part 5: Mechanical connections

Structures en bois — Détermination des valeurs caractéristiques —

Partie 5: Assemblages

Reference number
ISO 12122-5:2018(E)

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Published in Switzerland

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 165, *Timber structures*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

A list of all parts in the ISO 12122 series can be found on the ISO website.

Introduction

This document sets out a framework for establishing characteristic values from test results on a sample drawn from a clearly defined reference population of connections. The characteristic value is an estimate of the property of the reference population with a consistent level of confidence prescribed in this document.

This document is intended to be used in conjunction with ISO 12122-1.

This document permits the evaluation of characteristic values from testing on connections made with commercial components.

In some cases, characteristic values determined in accordance with this document may be modified to become a design value.

Timber structures — Determination of characteristic values —

Part 5: Mechanical connections

1 Scope

This document gives methods of determination of characteristic values for a defined population of mechanical connections between timber components, calculated from full scale test values.

It presents methods for the determination of:

a) slip modulus of mechanical connections;

b) characteristic strength of connections subjected to either monotonic or cyclic loads.

Glued connections are excluded from the scope of this document.

NOTE 1 It is assumed that the failure mode is the same for all specimens in the sample.

NOTE 2 When a small number of test results is available, ISO 12122-6 is used for the determination of the mean and the 5th percentile values.

NOTE 3 Informative commentary to the clauses of this document can be found in Annex A.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 6891, *Timber structures — Joints made with mechanical fasteners — General principles for the determination of strength and deformation characteristics*

ISO 12122-1, *Timber structures — Determination of characteristic values — Part 1: Basic requirements*

ISO 16670, *Timber structures — Joints made with mechanical fasteners — Quasi-static reversed-cyclic test method*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
mechanical connection
assembly of one or more timber components connected directly together or connected together with components made from other materials

Note 1 to entry: Other materials include steel dowels, bolts, nails, screws, shear connectors and plates.

3.2
test load
peak load achieved for each test specimen for both monotonic and cyclic tests

3.3
ultimate displacement
displacement associated with the maximum load or peak load or ultimate load, F_{max}, determined in accordance with ISO 16670

4 Symbols

F_{est} estimated maximum load, in newtons

F_{max} maximum load or peak load or ultimate load, in newtons

v_y yield displacement (determined only if a clear yield point can be established)

5 Reference population

In addition to the requirements for definition of the reference population in ISO 12122-1, the following attributes of connections shall be described:

a) the material of the connecting components;

b) the dimensions of the connecting components;

c) the method of assembly;

d) the dimensions of the assembly, in particular end distances, edge distances and connector spacings;

e) the species and density range of timber used in the connections;

f) the presence or exclusion of specified features (e.g. knots or finger joints) in or near the connection;

g) the moisture exposure conditions (before and after specimen preparation);

h) the moisture conditions when the specimen is installed and tested (e.g. installed dry and tested dry, installed wet and tested wet, installed dry and tested wet, installed wet and tested dry).

NOTE Where the densities of timber components comply with ISO 8970, this can be declared as part of the reference population.

6 Sampling

6.1 Sampling method

The sampling method shall comply with the performance objective of sampling defined in ISO 12122-1.

Representation of each of the variants in the sample shall approximate the representation of the same variants in the reference population.

Where the reference population includes a range of end distances, edge distances and connector spacings, the sampling method shall ensure that the range of densities is covered in each variation of dimensions.

NOTE A major variation is the range in individual properties of the timber components that make up the connection.

6.2 Sample size

The sample size shall comply with the requirements of ISO 12122-1 and shall take into account the coefficient of variation expected for the timber components in the reference population.

NOTE ISO 12122-1 gives some guidance on selecting the sample size.

7 Sample conditioning

The sample storage and testing environment shall reflect conditioning in accordance with the definition of the reference population as indicated in ISO 12122-1.

For specimens that are constructed by forcing the connecting component into the timber (e.g. nails and toothed plates), a minimum period of seven days shall elapse between assembly and testing of the test specimens to allow for fibre relaxation.

NOTE 1 A case can be made for an allowance of shorter conditioning periods if all timber components are dry at the time of fabrication and testing.

For reference populations in which the connections are constructed in a wet state but are dry during service, appropriate conditioning shall be required for the test specimens to simulate these conditions.

NOTE 2 Such conditioning requires an appropriate time delay between connection construction and testing to ensure that the service condition is replicated (this can be days or weeks).

8 Test data

8.1 General

This document uses data obtained from testing undertaken to relevant testing standards for mechanical connections. Test loading of connections is undertaken either in a linear form (i.e. load versus displacement) or an angular form (i.e. moment versus rotation). For the purposes of this document, moment and rotation may be substituted for load and displacement respectively.

8.2 Test method

8.2.1 Monotonic loading of connections

The test data shall be obtained from:

a) tests that follow the principles of ISO 6891;

b) tests in accordance with the ISO document relevant to the connection; or

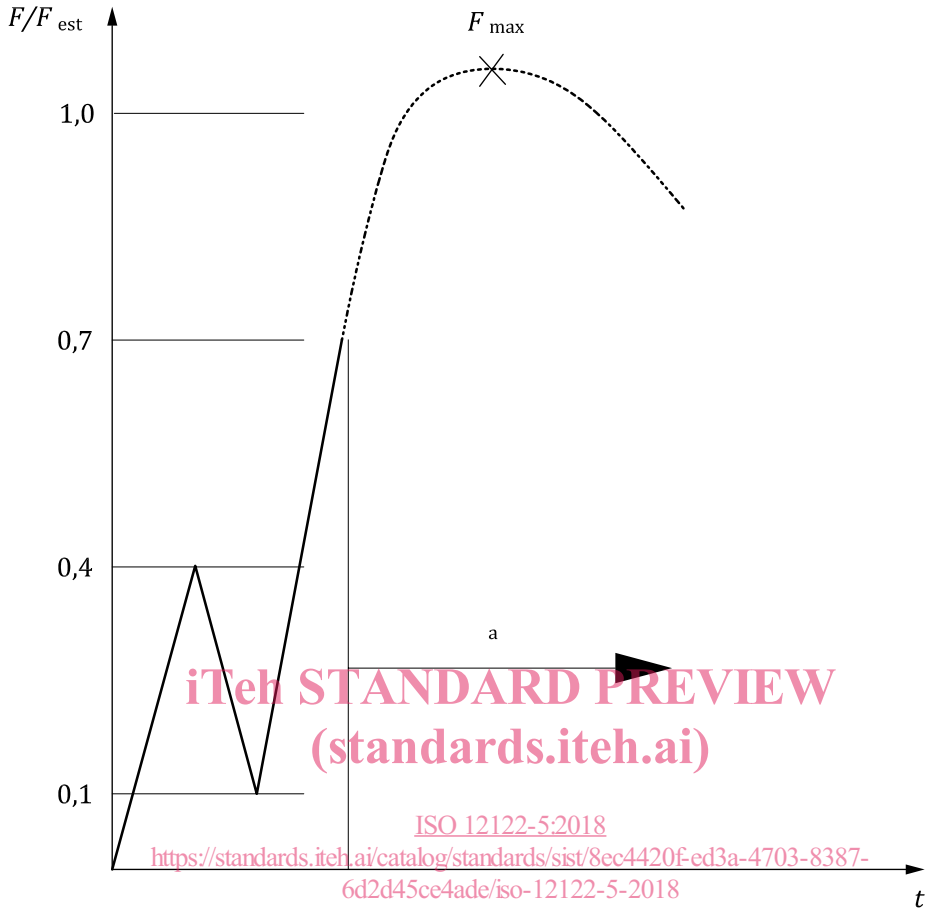
c) a standard test method appropriate for the reference population provided equivalency factors with the relevant ISO document can be established.

The selection of test variables shall be appropriate to the objectives of the testing, and can require some adjustments specified in 8.3.

NOTE 1 Test methods involve many variables that affect results including loading configuration and rates, specimen positioning and measurement methods.

The peak load for each test specimen in a monotonic test, F_{max}, shall be recorded (see Figure 1).

NOTE 2 If a clear yield point can be obtained, then the yield can also be recorded.



Key

F/F_{est}	load divided by estimated maximum load
F_{max}	specimen peak load, expressed in newtons
t	time
a	Displacement controlled.

Figure 1 — Monotonic test sequence

8.2.2 Cyclic loading of connections

The test data shall be obtained from:

a) tests that follow the principles of ISO 16670;

b) tests in accordance with the ISO document relevant to the connection; or

c) a standard test method appropriate for the reference population provided equivalency factors with the relevant ISO document can be established.

8.3 Test data compatible with product description

Where the characteristic value is applicable to a standard configuration and size or moisture content of the connection components, adjustments to the test data can be required. Any adjustment shall be in accordance with ISO 12122-1 and shall be detailed in the report.

8.4 Failure modes

The failure modes obtained in the tests shall be recorded.

The data shall only be included in the analysis if it comes from a test in which the failure mode appropriate to the property was obtained.

NOTE The same test method can produce different failure modes on different products. The characteristic value can be under-estimated or over-estimated by tests that produce failure modes that are completely different to ones that the test method was intended to produce.

9 Evaluation of characteristic values for structural properties

9.1 Structural properties

For connections, the determination of the characteristic values for the structural properties shall be in accordance with 9.2, 9.3 and 9.4.

The properties shown in Table 1 shall be calculated from the test data.

Table 1 — Characteristic values to be calculated

Characteristic value	Mean	5th percentile	95th percentile
Stiffness	✓[a]	✓	✓
Yield load[b]	✓	✓	
Max load or ultimate load		✓[a]	✓
Ultimate displacement	✓[a]		
Yield displacement[b]	✓	✓	

[a] Mandatory characteristic to be calculated.

[b] To be reported only if a clear yield point is established.

The characteristic value based on the 95th percentile value is the upper single-sided 75 % confidence limit on a 95th percentile property and can be found by fitting data to a distribution using Formula (1).

$$X_{0,95;0,75} = X_{0,95}\left(1 - \frac{k_{0,95;0,75}\,V}{\sqrt{n}}\right) \tag{1}$$

where

$X_{0,95;0,75}$ is the 95th percentile value with 75 % confidence;

$X_{0,95}$ is the 95th percentile of the test data from a fitted distribution;

$k_{0,95;0,75}$ is a multiplier to give the 95th percentile value with 75 % confidence and defined in Formula (2);

V is the coefficient of variation of the test data found by dividing the standard deviation of the test data by the average of the test data;

n is the number of test values.

$$k_{0,95;0,75} = -k_{0,05;0,75} \tag{2}$$

where $k_{0,05;0,75}$ is a multiplier to give the 5th percentile value with 75 % confidence, and defined in ISO 12122-1:2014, A.2.3.