INTERNATIONAL STANDARD

ISO 13061-4

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Physical and mechanical properties of wood — Test methods for small clear wood specimens —

Part 4: Determination of modulus of elasticity in static bending

Propriétés physiques et mécaniques du bois — Méthodes d'essais sur échantillons de bois sans défauts —

Partie 4: Détermination du module d'élasticité en flexion statique

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
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Contents

Page

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword — Supplementary information.

The committee responsible for this document is ISO/TC 218, *Timber*.

This first edition of ISO 13061-4 cancels and replaces ISO 3349:1975, which has been technically revised with regards to the sizes, grain orientation and moisture content of test pieces, and adjustment for moisture content.

ISO 13061 consists of the following parts, under the general title *Physical and mechanical properties of wood — Test methods for small clear specimens:*

— *Part 1: Determination of moisture content for physical and mechanical tests*

— *Part 2: Determination of density for physical and mechanical tests*

— *Part 3: Determination of ultimate strength in static bending*

— *Part 4: Determination of modulus of elasticity in static bending*

— *Part 6: Determination of ultimate tensile stress parallel to grain*

— *Part 7: Determination of ultimate tensile stress perpendicular to grain*

The following are under preparation:

— *Part 5: Determination of strength in compression perpendicular to grain*

— *Part 10: Determination of impact bending strength*

— *Part 11: Determination of resistance to impact indentation*

— *Part 12: Determination of static hardness*

— *Part 13: Determination of radial and tangential shrinkage*

— *Part 14: Determination of volumetric shrinkage*

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— *Part 15: Determination of radial and tangential swelling*

— *Part 16: Determination of volumetric swelling*

— *Part 17: Determination of strength in compression parallel to grain*

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Introduction

The main purpose of this International Standard is to establish the common international point of member countries of international organization for standardization (ISO), concerning testing methods for small clear wood specimens and general requirements for determining physical and mechanical properties of wood.

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Physical and mechanical properties of wood — Test methods for small clear wood specimens —

Part 4: Determination of modulus of elasticity in static bending

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1 Scope

This part of ISO 13061 specifies a method for determining the modulus of elasticity of wood in static bending by measuring the deflection in the mid-span of a simply supported beam.

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.

ISO 3129, *Wood — Sampling methods and general requirements for physical and mechanical testing of small clear wood specimens*

ISO 13061-1, *Physical and mechanical properties of wood — Test methods for small clear specimen — 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 specimen — Part 2: Determination of density for physical and mechanical tests*

ISO 24294, *Timber — Round and sawn timber — Vocabulary*

3 Terms and definitions

For the purpose of this document, the terms and definitions given in ISO 24294 apply.

4 Principle

The modulus of elasticity is determined by measuring the deflection in the mid-span of a simply supported beam during the application of a gradually increasing transverse load within the region of proportionality of the load and deflection.

5 Apparatus

5.1 Testing machine, providing (1) a rigid frame to support the test piece yet permit its deflection without restraint, (2) a loading head through which the force is applied without high stress concentrations in the test piece, (3) a constant rate of loading of the test piece or of movement of the loading head, and (4) a force-measuring device that is calibrated to ensure accuracy of 1 %.

5.2 Support apparatus, to provide support of the test piece at the specified span.

5.2.1 Reaction bearing plates or metal bearing plates, to prevent damage of the test piece at the point of contact between the test piece and reaction support. The plates shall be of sufficient length,

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thickness and width to provide a firm bearing surface and ensure a uniform bearing stress across the width of the test piece.

NOTE Usually, the length of the bearing plate that is twice the height of the test piece is sufficient.

5.2.2 Reaction supports. The bearing plates shall be supported by devices that provide unrestricted longitudinal deformation and rotation of the test piece at the reactions due to loading. Provisions shall be made to allow for initial twist in the length of the test piece.

NOTE Laterally adjustable knife edges and bearing plates with rollers at both supports are normally used.

5.3 Load bearing block, having a radius of curvature of at least 30 mm shall be used for applying the load to the test piece.

If significant deformation by indentation from the load bearing block occurs, the radius of curvature shall be increased.

5.4 Measuring instrument capable of determining the cross sectional dimensions of the test pieces to an accuracy of 0,1 mm.

5.5 Deflection measuring device, to measure linear deflection at the mid-span of the beam relative to the supports to an accuracy of at least 0,02 mm.

5.6 Equipment for the determination of moisture content in accordance with ISO 13061-1.

6 Preparation of test pieces

6.1 General

6.1.1 The sampling and preparation of test pieces shall be in accordance with ISO 3129.

6.1.2 Test pieces shall be prepared in the form of rectangular prisms having a square cross-section not less than 20 mm × 20 mm and length along the grain allowing the span (distance between the centres of the supports) of 14 times the height of the test pieces and sufficient bearing length. Test pieces shall be cut so that one of the faces is parallel to the radial grain direction.

6.2 Moisture content of test pieces

6.2.1 Test pieces can be prepared and tested in green or air-dry condition.

6.2.2 The moisture content of test pieces tested in green condition shall be equal or exceed fibre saturation point (FSP).

6.2.3 Test pieces tested in air-dry condition shall be conditioned to a constant mass in an atmosphere with a relative humidity of (65 ±5) % and a temperature of (20 ±2) °C.

NOTE Constant mass is considered to be reached when the results of two successive weighing operations, carried out at an interval of 8 h, do not differ by more than 0,2 % of the mass of the test piece.

6.2.4 After preparation, the test pieces shall be stored under conditions, which ensure that their moisture content remains unchanged before testing.

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7 Procedure

7.1 Measure the breadth and the height of the cross-section of test piece at the mid-span to the nearest 0,1 mm.

7.2 Carry out the test with the ratio of the span and the height of the test piece of 14. Apply the transverse load to the radial or tangential surface at the mid-span of the test piece. Measure the distances to the nearest 1 mm.

7.3 The load shall be applied continuously at a constant rate of loading or constant rate of movement of the loading head.

NOTE Mechanical properties of wood depend on the speed of testing. Therefore, it is important to select the speed of testing appropriate for the purpose of the test program and include it in the report.

7.4 Deflections of the neutral plane at the mid-span shall be measured with respect to points in the neutral plane above the supports. Alternatively, it is permitted to measure the deflection relative to the tension surface mid-way between the supports. However, take care to ensure that vertical displacements, which may occur at the reactions, are accounted for.

7.5 The upper and lower limits of loading for determination of the modulus of elasticity shall be established within the linear portion of the load-deflection curve.

NOTE 1 Normally, the lower and the upper limits of loading are found between 0,1 and 0,4 of the estimated breaking load.

NOTE 2 In some countries, the loading between the upper and lower limits is carried out repeatedly.

NOTE 3 If the test is combined with the determination of the ultimate strength in static bending, the loading is continued until rupture of the test piece according to ISO 13061-3.

7.6 As soon as the test has been completed, take sample(s) from the undamaged portion(s) of the test piece near the centre for the determination of moisture content and density according to ISO 13061-1 and ISO 13061-2, respectively.

8 Calculation and expression of results

8.1 The modulus of elasticity in static bending, E_W, of each test piece at the moisture content W at the time of test shall be calculated, in N/mm^2 (MPa), using Formula (1).

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$$E_w = \frac{Pl^3}{4bh^3 f} \quad (1)$$

where

P is the load equal to the difference between the upper and lower limits of loading, in N;

l is the span (distance between the centres of the supports), in mm;

b is the breadth of the test piece, in mm;

h is the height of the test piece, in mm;

f is the deflection equal to the difference between the results obtained in measuring the deflection at the upper and lower limits of loading, in mm.

NOTE If the loading between the upper and lower limits is carried out repeatedly, the deflection is calculated using the arithmetic means of the results.

The results shall be expressed to a precision of 0,1 N/mm^2 (MPa).

8.2 When required, the modulus of elasticity E_W shall be adjusted to 12 % moisture content using nationally or internationally recognized method.

NOTE An approximate adjustment of the modulus of elasticity to 12 % moisture content can be done using Formula (2), which is valid for moisture contents of (12 ±5) %:

$$E_{12} = \frac{E_W}{1-\alpha(W-12)} \quad (2)$$

where

α is the correction factor for the moisture content, equal to 0,02;

W is the moisture content of the wood, determined according to ISO 13061-1.

8.3 The mean and the standard deviation of the results obtained for individual test pieces in a sample shall be calculated to a precision of 0,1 N/mm^2 (MPa).

9 Test report

The test report shall contain the following particulars:

a) a reference to this part of ISO 13061, i.e. ISO 13061-4;

b) details concerning sizes of the test pieces and test span;

c) sampling details in accordance with ISO 3129;

d) test results and their statistical values, calculated as specified in Clause 8;

e) moisture content and density of wood of each test piece measured in accordance with ISO 13061-1and 13061-2, respectively;

f) method and value of the coefficient used for the adjustment of the test results to a 12 % moisture content, if applicable.

g) speed of testing;

h) direction of application of the load to the test piece (radial or tangential);

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i) date when the test was carried out;

j) name of the organization which carried out the test.

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