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

Part 3: Determination of ultimate strength in static bending

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

Partie 3: Détermination de la contrainte de rupture en flexion statique

Reference number
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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 13061-3 cancels and replaces ISO 3133:1975, 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 parts 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*

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

— *Part 16: Determination of volumetric swelling*

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

Introduction

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

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

Part 3: Determination of ultimate strength in static bending

1 Scope

This part of ISO 13061 specifies a method for determining the ultimate strength of wood in static bending by measuring the breaking load applied 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 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 specimens — Part 2: Determination of density for physical and mechanical tests*

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

3 Terms and definitions

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

4 Principle

The ultimate strength in static bending (modulus of rupture) is determined by measuring the maximum load required to cause rupture of the test piece under static load applied in the mid-span of a simply supported beam.

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, 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, 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.

If the test is combined with the determination of the modulus of elasticity in static bending, an arrangement for measuring linear deflection to an accuracy of at least 0,02 mm should be made, in accordance with ISO 13061-1.

5.5 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 reaction supports) of 12 to 16 times the height of the test pieces and sufficient bearing length.

The 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 to 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.

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 between 12 and 16. 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.

If the test is combined with the determination of the modulus of elasticity bending, the span shall be 14 times the height of the test piece, in accordance with ISO 13061-4.

7.3 The load shall be applied continuously at a constant rate of loading or constant rate of movement of the loading head such that the test piece is broken in not less than 0,5 min and not more than 5 min from the beginning of loading. Read the maximum load to the accuracy specified in 5.1.

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 As soon as the test has been completed, take sample(s) from the undamaged portion(s) of the test piece near point of rupture 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 ultimate strength in static bending (modulus of rupture), $\sigma_{b,W}$, of each test piece at the moisture content, W, at the time of test shall be calculated, in N/mm^2 (MPa), using the following formula:

$$\sigma_{b,W} = \frac{3P_{\max} l}{2bh^2}$$

where

$P_{\max}$ is the maximum load, in N;

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

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

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

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

8.2 When required, the ultimate strength in static bending (modulus of rupture), $\sigma_{b,W}$, shall be adjusted to 12 % moisture content using a nationally or an internationally recognized method.

NOTE An approximate adjustment of the ultimate bending strength to 12 % moisture content can be done using the following formula, which is valid for moisture contents of (12 ±5) %:

$$\sigma_{b,12} = \sigma_{b,W}\left[1 + \alpha\left(W - 12\right)\right]$$

where