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

**Part 16:  
Determination of volumetric swelling**

*Propriétés physiques et mécaniques du bois — Méthodes d'essais sur  
petites éprouvettes de bois sans défauts —*

*Partie 16: Détermination du gonflement volumique*

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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](http://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](http://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 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 the following URL: [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 218, *Timber*.

This first edition of ISO 13061-16 cancels and replaces ISO 4860:1982, which has been technically revised. Changes have been made with regards to the sizes, moisture content of test pieces and adjustment for moisture content.

A list of all parts in the ISO 13061 series can be found on the ISO website.

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

## Part 16: Determination of volumetric swelling

### 1 Scope

This document specifies methods for the determination of volumetric swelling of wood.

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

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.

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

- ISO Online browsing platform: available at <http://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

### 4 Principle

Stereometric method and immersion method are specified for determining the volumetric swelling by measuring volume of a test piece after drying to a constant mass and after soaking in water to a constant volume. The volume of the test pieces is calculated as a product of the linear dimensions of the test piece in stereometric method and measured as the volume of water displaced or the mass of the water displaced in immersion method. The volumetric swelling is calculated as the change of the volume expressed as a percentage of the original volume. The initial measurements shall be taken on test pieces at absolutely dry (oven-dry) condition. The final measurements shall be taken on the fully saturated test pieces.

### 5 Stereometric method

#### 5.1 Apparatus

**5.1.1 Measuring instruments**, capable of determining dimensions to an accuracy of 0,02 mm, fitted with parallel flat ends each of diameter 5 mm to 8 mm and applying a clamping force which will not cause any deformation greater than the accuracy of the instrument.

**5.1.2 Oven**, a forced convection oven that can be maintained at a temperature of  $(103 \pm 2)$  °C throughout the drying chamber for the time required to dry the specimen to the end point shall be used. The oven shall be vented to allow the evaporated moisture to escape.

**5.1.3 Desiccator**, a vapour-tight container with absorbent material (e.g. silica gel, calcium chloride, etc.) to maintain the air dry.

**5.1.4 Vessel**, containing distilled water.

**5.1.5 Balance**, accurate to 0,001 g.

## 5.2 Preparation of test pieces for stereometric method

**5.2.1** The preparation and number of test pieces shall be in accordance with ISO 3129.

### 5.2.2 Test pieces for determining volumetric swelling

Test pieces shall be made in the form of rectangular prisms with the size of at least 20 mm in radial and tangential directions and at least 5 mm along the grain.

### 5.2.3 Inclination of annual rings of test pieces

The angle of inclination of growth rings to a pair of opposite radial faces of the test pieces shall not exceed 10°.

### 5.2.4 Marking of measurement points

Measurement points shall be marked at the middle of each surface of test piece. The centre points shall be marked on both faces of tangential and radial surfaces for determining the dimension in radial and tangential directions, respectively. Dimensions of the test pieces shall be measured between the marks at each stage of moisture conditions.

## 5.3 Procedure

### 5.3.1 Determination of the dimensions of test pieces at absolutely dry (oven-dry) condition

The test pieces shall be open-piled and dried to constant mass at a temperature of  $(103 \pm 2)$  °C in the oven ensuring no checks distorting their dimensions and shape occur. Check the changes in mass of two or three control test pieces after 8 h of drying and repeat the measurements every 8 h or longer until the difference between two successive weighing does not exceed 0,2 % of the test pieces or when the difference between two successive measurements does not exceed 0,02 mm. Test pieces in which checks occurred during the test period shall be disregarded. Cool the test pieces to room temperature in the desiccator. Measure the radial and tangential dimensions,  $l_{r1}$  and  $l_{t1}$ , of each test piece to an accuracy of 0,02 mm.

### 5.3.2 Determination of the dimensions of test pieces in fully saturated condition

The moisture content of test pieces shall be considerably higher than the fibre saturation point (FSP). Soak the test pieces in distilled water at temperature of  $(20 \pm 2)$  °C until no further change in dimensions occurs. Check the changes in dimensions every three days through repeated measurements at the same points until the difference between two successive measurements does not exceed 0,02 mm. Measure the radial and tangential dimensions,  $l_{r2}$  and  $l_{t2}$ , of each test piece to an accuracy of 0,02 mm.

## 5.4 Calculation and expression of results

Calculate the total volumetric swelling,  $\alpha_v$ , as a percentage by using [Formula \(1\)](#):

$$\alpha_v = \frac{(l_{r2} \times l_{t2}) - (l_{r1} \times l_{t1})}{l_{r1} \times l_{t1}} \times 100 \quad (1)$$

where

$l_{r2}$  and  $l_{t2}$  are the dimensions, in millimetres, of the fully saturated test piece, measured in the radial and tangential directions, respectively;

$l_{r1}$  and  $l_{t1}$  are the dimensions, in millimetres, of the test piece at absolutely dry (oven-dry) condition, measured in the radial and tangential directions, respectively.

Express the result to the nearest 0,1 %.

## 6 Immersion method

### 6.1 Apparatus

**6.1.1 Oven**, a forced convection oven that can be maintained at a temperature of  $(103 \pm 2)$  °C throughout the drying chamber for the time required to dry the specimen to the end point shall be used. The oven shall be vented to allow the evaporated moisture to escape.

**6.1.2 Desiccator**, a vapour-tight container with absorbent material (e.g. silica gel, calcium chloride, etc.) to maintain the air dry.

**6.1.3 Vessel**, containing distilled water.

**6.1.4 Balance**, accurate to 0,001 g.

### 6.2 Preparation of test pieces for immersion method

**6.2.1** The selection, preparation and the minimum number of test pieces shall be in accordance with ISO 3129.

**6.2.2** Test pieces for determining volumetric swelling by immersion method may be made in any shapes and shall be at least 4 cm<sup>3</sup> in volume.

### 6.3 Procedure

#### 6.3.1 Determination of the volume of test pieces at absolutely dry (oven-dry) condition

The test pieces shall be open-piled and dried to constant mass at a temperature of  $(103 \pm 2)$  °C in the oven ensuring no checks distorting their dimensions and shape occur. Check the changes in mass of two or three control test pieces after 8 h of drying and repeat the measurements every 8 h or longer until the difference between two successive weighing does not exceed 0,2 % of the test pieces. Test pieces in which checks occurred during the test period shall be disregarded. Cool the test pieces to room temperature in the desiccator. Measure the volume,  $V_1$ , of each test piece to an accuracy of 0,01 cm<sup>3</sup> by measuring the volume of water displaced or by measuring the mass of the water displaced. The mass in grams is numerically equal to the volume in cubic centimetres.

Care shall be taken to prevent the influence of water absorption on the volume measurement at absolutely dry (oven-dry) condition. For example, a removable surface treatment can be applied before

measuring the volume. The thickness of the surface treatment shall not compromise the accuracy of the volume measurement

### 6.3.2 Determination of the volume of test pieces in fully saturated condition

The moisture content of test pieces shall be considerably higher than the fibre saturation point (FSP). Soak the test pieces in distilled water at a temperature of  $(20 \pm 2)$  °C until no further change in volume occurs. Check the changes in volume every three days through repeated measurements until the difference between two successive measurements does not exceed 0,01 cm<sup>3</sup>. Measure the volume of each test pieces,  $V_2$ , to an accuracy of 0,01 cm<sup>3</sup>.

### 6.4 Calculation and expression of results

Calculate the total volumetric swelling,  $\alpha_v$ , as a percentage by using [Formula \(2\)](#):

$$\alpha_v = \frac{V_2 - V_1}{V_1} \times 100 \quad (2)$$

where

$V_2$  is the volume, in cubic centimetres, of the fully saturated test piece;

$V_1$  is the volume, in cubic centimetres, of the test piece at absolutely dry (oven-dry) condition.

Express the result to the nearest 0,1 %.

## 7 Test report

The test report shall include the following information:

- a) a reference to this document, i.e. ISO 13061-16;
- b) sampling details in accordance with ISO 3129;
- c) the method used for determination of the volume of the test pieces;
- d) details pertaining to measurements of test pieces;
- e) test results and their statistical values calculated as specified in [5.4](#) or [6.4](#);
- f) date when the test was carried out;
- g) name of the organization which carried out the test.