



DRAFT INTERNATIONAL STANDARD ISO/DIS 13061-2

ISO/TC 218

Secretariat: DSSU

Voting begins on
2013-02-18

Voting terminates on
2013-05-18

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

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

Part 2: Determination of density for physical and mechanical tests

Propriétés physiques et mécaniques du bois — Méthodes d'essai sur petits modules —

Partie 2: Détermination de la masse volumique en vue des essais physiques et mécaniques

(Revision of ISO 3130:1975)

ICS 79.040

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This International Standard ISO 13061-2 was prepared by Technical Committee ISO/TC 218: *Timber*. This ISO 13061-2 cancels and replaces the ISO 3131: 1975, which has been technically revised.

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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.

This International Standard is the first revision of the ISO 3131:1975 Wood - Determination of density for physical and mechanical tests which has been approved for revision by the technical committee ISO/TC 218 – Timber during the 6th plenary meeting in Lviv, Ukraine. Countries that have voted for this approval of this revision include Belarus, Canada, China, Japan, Malaysia, New Zealand, Nigeria, Russia, Ukraine, U.S.A.

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Physical and Mechanical Properties of Wood – Test Methods for Small Clear Specimens -- Part 2: Determination of density for physical and mechanical tests

1 Scope

This International Standard specifies a method for determining the density of wood for physical and mechanical tests on small clear specimens. It may also be used to determine density of test specimens for other physical or mechanical test and/or to determine the relationship between density and other properties of wood.

2 Normative references

The following referenced document is indispensable for the application 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 3131 : 1975 Wood – Determination of density for physical and mechanical tests

3 Terms and definitions

For the purpose of this International Standard, the definitions contained in ISO 24294: (under revision) Round and Sawn Timber – Vocabulary apply.

3.1 Wood density

The mass of a unit volume of wood.

3.2 Density in the absolutely dry condition (Oven-dry density)

Density based on oven-dry mass of a test piece and its oven-dry volume.

3.3 Density at specified moisture content

Density based on mass of a test piece including moisture content and its volume at specified moisture content.

3.4

Conventional (Basic) density

Density based on oven-dry mass of a test piece and its green volume

3.5

Green volume

Volume of a test piece at moisture content greater than or equal to the fibre saturation point.

4 Principle

The density of wood is a ratio of mass to its volume (the weight of a test piece divided by its volume) at a certain level of moisture content. Wood density may be determined at oven-dry, partially dry, or green condition. The term "Basic (Conventional) Density" is used when the mass of the test piece is determined at absolutely dry condition i.e., oven-dry condition, but its volume is at a moisture content greater than or equal to the fibre saturation point. The determination of the mass of the test piece is by weighing and its volume is by measurement of its dimensions, or by other method. The mass of a test piece is determined by weighing, its volume is determined by measurement of its dimensions or by another method. The density is calculated as a ratio of the mass and the volume vary with moisture content of wood, the conditions under which density is determined shall be specified. Wood density may be determined at oven-dry, partially dry, or green condition. For partially dry (or air-dry) wood, 12 % moisture content is frequently used as a reference.

NOTE The volume of irregularly-shaped specimens can be determined by immersion in water or other liquid where the mass of displaced volume equals the volume of the test piece

5 Apparatus

5.1 Measuring Instrument - capable of measuring the dimensions (thickness, length and width) of the test pieces to the nearest 0,1 mm

5.2 Balance – capable of weighing to the nearest 0,01 g (or 0,001 g for testing under 7.5)

5.3 Equipment for the determination of moisture content - shall be in accordance with ISO 3130.

6 Preparation of test pieces

6.1 Test pieces for determining the density shall be prepared from material selected and conditioned in accordance with ISO 3129 and made preferably in the form of right prisms having a square cross-section of side not less than 20 mm and minimum length along the grain of (25 ± 5) mm. If the growth rings are more than 4 mm wide, the dimensions of the cross-section of the test piece shall be increased to include not less than five growth rings. For the determination of Conventional Density, test piece of any geometrical shape is permitted as long as the volume can easily be measured. The minimum number of test pieces shall be in accordance with ISO 3129.

After preparation, the test pieces shall be conditioned in accordance with clause 6.1 of ISO 3129 and stored under conditions which ensure that their moisture content remains unchanged.

6.2 To determine density of test specimens for other physical or mechanical test and/or to determine the relationship between density and other properties of wood, the specimens made for other tests or samples cut from them shall be used. The form, dimensions and method of taking samples depend on the form and dimensions of test specimens. At least one test piece per test specimen shall be taken near the point of interest (e.g. in the vicinity of the failure zone in destructive tests).

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

7 Procedure

7.1 Weighing

Weigh each test piece to an accuracy of $\pm 0,01$ g.

7.2 Measurement of dimensions

Measure the sides of the cross-section and the length of the test pieces of the cross-section and the length of the test pieces along the axes of symmetry to the nearest 0,1 mm.

7.3 Determination of moisture content

The moisture content of the test pieces shall be determined according to ISO 3130.

7.4 Determination of dry density

7.4.1 Determination of volume

The test pieces shall be dried to either oven dried or specified moisture content. Measure the dimensions or volume of the dry test pieces according to 7.2, and determine the moisture content of the test pieces according to ISO 3130.

7.4.2 Determination of mass

Weigh the test pieces according to clause 7.1.

7.5 Determination of Conventional Density

7.5.1 Determination of volume

The test pieces shall be soaked in distilled water at room temperature until no changes in dimension occur. Measure the dimensions or volume of the wet test pieces according to 7.2, and determine the moisture content of the test pieces according to ISO 3130. The moisture content of test pieces shall be greater than or equal to the fibre saturation point.

7.5.2 Determination of mass

Dry the test pieces to a constant mass, gradually so as to minimize their deformation and splitting. Weigh the test pieces according to clause 7.1.

8 Calculation and expression of results

8.1 The density ρ_w of each test piece at the moisture content w at the time of the test is given, in kilograms per cubic meter (or grams per cubic centimeter), by the formula :

$$\rho_w = \frac{m_w}{a_w \times b_w \times l_w} = \frac{m_w}{v_w} \quad (1)$$

where;

m_w is the mass, in kg (or g), of the test piece at moisture content w ;

a_w, b_w and l_w are the dimensions, in m (or cm), of the test pieces at moisture content w ;

V_w is the volume, in m^3 (or cm^3), of the test piece at moisture content w

The result shall be expressed to the nearest 5 kg/m^3 (or $0,005 \text{ g/cm}^3$).

When required, the density ρ_w shall be adjusted to a 12 % moisture content by the formula valid for moisture content from 7 % to 17 % :

$$\rho_{12} = \rho_w \left(1 - \frac{(1 - K)(W - 12)}{100} \right) \quad (2)$$

where K is the coefficient of volumetric shrinkage for a change in moisture content of 1 %. The value of K shall be that specified in National standards or shall be determined according to ISO 4858. For approximate calculations, the value of K can be taken as equal to $0,85 \times 10^{-3} \rho_w$ when the density is expressed in kilograms per cubic meter (kg/m^3) and $0,85 \rho_w$ when the density is expressed in grams per cubic centimeter (g/cm^3).

8.2 The density ρ_o of each test piece in the absolutely dry condition is given in kg/m^3 or g/cm^3 meter by the formula :

$$\rho_o = \frac{m_o}{a_o \times b_o \times l_o} = \frac{m_o}{v_o} \quad (3)$$

where;

m_o is the mass, in kg (or g), of the test piece in the absolutely dry condition ;

a_o, b_o , and l_o are the dimensions, in m (or cm), of the test pieces in the absolutely dry condition;

V_o is the volume, in m^3 (or cm^3), of the test piece in the absolutely dry condition.

The result shall be expressed to the nearest 5 kg/m^3 (or $0,005 \text{ g/cm}^3$).

8.3 Conventional density, ρ_y , of each test piece is given in kg/m^3 or g/cm^3 by the formula :

metermeter

$$\rho_y = \frac{m_o}{a_{max} \times b_{max} \times l_{max}} = \frac{m_o}{v_{max}} \quad (4)$$