INTERNATIONAL STANDARD

ISO 16978

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Wood-based panels — Determination of modulus of elasticity in bending and of bending strength

Panneaux à base de bois — Détermination du module d'élasticité en flexion et de la résistance à la flexion

Reference number
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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 16978 was prepared by Technical Committee ISO/TC 89, *Wood-based panels*.

ISO 16978 is based on ISO 9429 and European Standard EN 310.

Wood-based panels — Determination of modulus of elasticity in bending and of bending strength

1 Scope

This International Standard specifies a method for determining the apparent modulus of elasticity and bending strength of wood-based panels in flatwise bending.

2 Normative references

The following referenced documents are 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 9424, *Wood-based panels — Determination of dimensions of test pieces*

ISO 16999, *Wood-based panels — Sampling and cutting of test pieces*

3 Principle

The modulus of elasticity in bending and bending strength are determined by applying a load to the centre of a test piece supported at two points. The modulus of elasticity is calculated by using the slope of the linear region of the load-deflection curve; the value calculated is the apparent modulus, not the true modulus, because the test method includes shear as well as bending. The bending strength of each test piece is calculated by determining the ratio of the bending moment M, at the maximum load F_{max}, to the moment of its full cross-section.

4 Apparatus

4.1 Measuring instruments, as specified in ISO 9424.

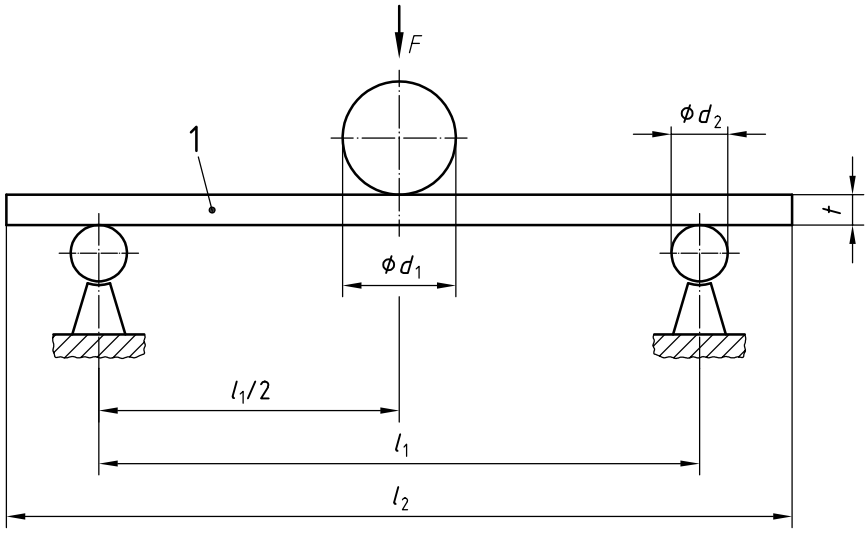
4.2 Testing apparatus, having the following essential components (see Figure 1).

4.2.1 Two parallel, cylindrical, roller-bearing supports, of length exceeding the width of the test piece and of $(10 \pm 0{,}5)$ mm diameter for panels of nominal thickness $\leqslant 6$ mm and of diameter $(15 \pm 0{,}5)$ mm for panels of nominal thickness > 6 mm.

The distance between the supports shall be adjustable.

4.2.2 Cylindrical loading head, of the same length and $(10 \pm 0{,}5)$ mm in diameter for panels of nominal thickness $\leqslant 6$ mm, and $(30 \pm 0{,}5)$ mm in diameter for panels of nominal thickness > 6 mm, placed parallel to the supports and equidistant from them.

Dimensions in millimetres



Key

1 test piece
F load
t thickness of the test piece

$l_1 \geqslant 20\ t$

$l_2 = l_1 + 50$

$\varnothing\ d_1 = \varnothing\ d_2 = 10 \pm 0{,}5$ for $t \leqslant 6$

$\varnothing\ d_1 = 30 \pm 0{,}5$; $\varnothing\ d_2 = 15 \pm 0{,}5$ for $t > 6$

NOTE Alternative arrangements may be used if a valid correlation to the specified arrangement can be proven.

Figure 1 — Arrangement of the bending apparatus

4.2.3 Suitable instrument, capable of measuring the deflection of the test piece in the middle of the span with an accuracy of 0,1 mm.

4.2.4 Measurement system, capable of measuring the load applied to the test piece with an accuracy of 1 % of the measured value.

5 Test pieces

5.1 Sampling and cutting

Sampling and cutting of the test pieces shall be carried out according to ISO 16999. Series of both transverse and longitudinal test pieces are required.

5.2 Dimensions of test pieces

The test pieces shall be rectangular, and of the following dimensions:

Unless otherwise specified the width b shall be (50 ± 1) mm.

In the case of extruded panels, cellular panels, or panels of similar structure with cavities parallel to the length of the test piece, the width of the test piece shall be at least twice the width of an individual core element

(e.g. two tube diameters plus two web thicknesses) and the test pieces shall have a symmetrical cross-sectional area as shown in Figure 2.

In test pieces with cavities perpendicular to the length, the loading head shall be located directly above a web.

Dimensions in millimetres

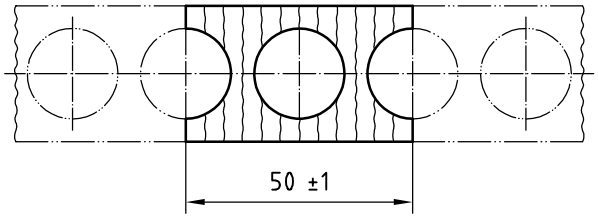


Figure 2 — Cross-section of tubular boards

The length l_2 shall be at least 20 times the nominal thickness plus 50 mm, with a maximum length of 1 050 mm and a minimum length of 150 mm.

If the deflection of the test piece is such that rupture (failure) does not occur, the distance between supports shall be reduced for testing the bending strength. The test report shall include the distance between supports at which failing tests were conducted. If this procedure needs to be adopted, a new set of test pieces shall be used.

Plywood test pieces shall be free of visible strength-reducing characteristics.

5.3 Conditioning

The test pieces shall be conditioned to constant mass in an atmosphere with a relative humidity of (65 ± 5) % and a temperature of (20 ± 2) °C. Constant mass is considered having been reached when the results of two successive weighing operations, carried out at an interval of 24 h, do not differ by more than 0,1 % of the mass of the test piece.

6 Procedure

6.1 Measure the width and thickness of each test piece according to ISO 9424 at the following points:

— the thickness at the intersection of the diagonals;

— the width at the mid-length.

6.2 Adjust the distance between the centres of the supports, to within 1 mm of at least 20 times the nominal thickness of the panel, but not less than 100 mm and not more than 1 000 mm. Measure the distance between the centres of the supports to the nearest 0,5 mm.

6.3 Place the test piece flat on the supports, with its longitudinal axis at right angles to those of the supports with the centre-point under the load (see Figure 1).

6.4 The load shall be applied at a constant rate of cross-head movement throughout the test. The rate of loading shall be adjusted so that the maximum load is reached within (60 ± 30) s.

Measure the deflection in the middle of the test piece (below the loading head), to an accuracy of 0,1 mm, and plot this value against the corresponding loads measured to an accuracy of 1 % of the measured value. If deflection is determined by incremental readings, at least 6 pairs of reading shall be used.

6.5 Record the maximum load to an accuracy of 1 % of the measured value.

6.6 Carry out tests on two groups of test pieces according to the two directions of the panel, i.e. in the longitudinal and transverse directions. Within each group, test half of the test pieces with the "top face" upwards, and half with the "bottom face" upwards.

7 Expression of results

7.1 Modulus of elasticity

7.1.1 The modulus of elasticity, E_b, in megapascals (MPa), of each test piece, is calculated from the equation:

$$E_b = \frac{l_1^3 (F_2 - F_1)}{4bt^3 (a_2 - a_1)} \quad (1)$$

where

l_1 is the distance between the centres of the supports, in millimetres (mm);

b is the width of the test piece, in millimetres (mm);

t is the thickness of the test piece, in millimetres (mm);

$F_2 - F_1$ is the increment of load, in newtons (N), on the straight-line portion of the load-deflection curve, (see Figure 3) (F_1 shall be approximately 10 % and F_2 shall be approximately 40 % of the maximum load);

$a_2 - a_1$ is the increment of deflection at the mid-length of the test piece (corresponding to $F_2 - F_1$).

The modulus of elasticity for each test piece shall be expressed to three significant figures.

7.1.2 The modulus of elasticity for each group of test pieces taken from the same panel (see 6.6) is the arithmetic mean of the moduli of elasticity of the appropriate test pieces, expressed to three significant figures.

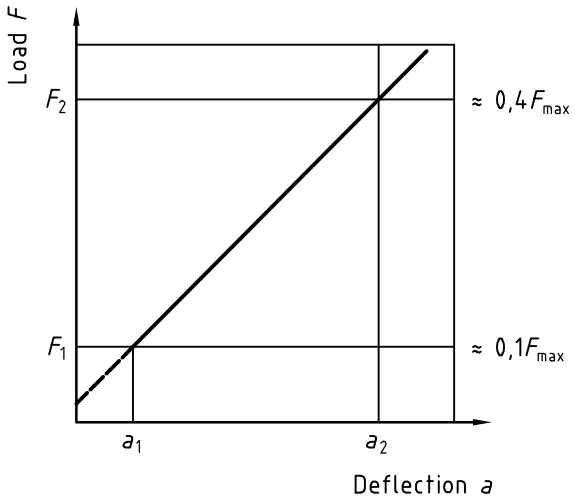


Figure 3 — Load-deflection curve within the range of elastic deformation

7.2 Bending strength

7.2.1 The bending strength R_b, in megapascals (MPa), of each test piece, is calculated from the equation:

$$R_b = \frac{3F_{max}l_1}{2bt^2} \quad (2)$$

where

F_{max} is the maximum load, in newtons (N);

l_1, b and t are defined in 7.1.1.

Express the bending strength of each test piece to three significant figures.

7.2.2 The bending strength for each group of test pieces taken from the same panel (see 6.6) is the arithmetic mean of the bending strengths of the appropriate test pieces, expressed to three significant figures.

8 Test report

The test report shall contain the following information:

a) name and address of the test laboratory;

b) sampling report according to ISO 16999;

c) date of the test report;

d) reference to this International Standard;

e) type and thickness of the panel;

f) relevant product specification;

g) surface treatment, if relevant;

h) length of the test pieces and distance between supports;

i) specific apparatus used, in case of different possibilities allowed in this International Standard;

j) test results expressed as stated in Clause 7;

k) all deviations from this International Standard.