INTERNATIONAL STANDARD 3129

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Wood — Sampling methods and general requirements for physical and mechanical tests

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up 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.

Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 3129 was drawn up by Technical Committee ISO/TC 55, *Sawn timber and sawlogs*, and circulated to the Member Bodies in June 1973.

It has been approved by the Member Bodies of the following countries :

Australia	India	Romania
Belgium	Ireland	South Africa, Rep. of
Bulgaria	Italy	Sweden
Canada	Japan	Thailand
Chile	Mexico	Turkey
Czechoslovakia	Netherlands	U.S.S.R.
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The Member Bodies of the following countries expressed disapproval of the document on technical grounds :

Austria
France
Germany
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Wood — Sampling methods and general requirements for physical and mechanical tests

1 SCOPE AND FIELD OF APPLICATION

1.1 This International Standard specifies methods for the selective and mechanical sampling of wood, for the conditioning of selected material and for the preparation of test pieces. In addition, it specifies the general requirements for physical and mechanical tests on small, clear test pieces free from visible defects.

1.2 The selective method of sampling should be used in cases where the coefficients of variation of the wood properties for one tree and between trees of one species are known and where it is possible to select material for samples from a large number of trees, logs and pieces of sawn timber.

1.3 The mechanical method of sampling should be used in cases where the mean values of the coefficients of variation of the wood properties are known and where it is possible to select material for samples only from a limited number of trees, logs and pieces of sawn timber.

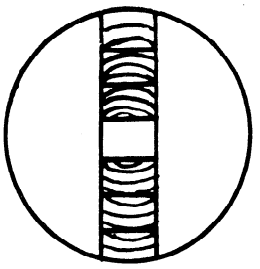

FIGURE 1 — **General scheme of cutting heart board from log**

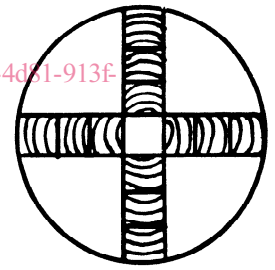

FIGURE 2 — **Scheme of cutting heart board from log of diameter 180 mm or less (permitted in mechanical sampling)**

2 SAMPLING

2.1 Selection of material

The material intended for physical and mechanical tests shall be selected taking due account of the purpose in mind (determination of the quality of stand wood, of a model tree, of a lot of sawn timber, of an individual board, etc.), as well as of the appropriate requirements for ensuring that the sample and its statistical properties are representative of the lot.

The material selected shall be in the form of logs, sawn timber and boards.

2.2 Conversion of material

2.2.1 *Logs*

A heart board shall be cut from a log (see figure 1). A heart board from a log of eccentric structure shall cover the geometrical centre. In mechanical sampling from a log 180 mm or less in diameter, heart boards may be cut in the direction of two mutually perpendicular diameters (see figure 2).

The thickness of the heart board shall be not less than 60 mm. Heart boards 40 mm thick may be cut from logs of diameter 180 mm or less. In this case, to obtain test pieces with cross-sectional dimensions greater than 30 mm, cross-sectional lengths not less than 100 mm long shall be cut from logs before sawing out heart boards.

2.2.2 *Sawn timber*

In selective sampling of sawn timber, a stick or sticks shall be cut out parallel to taper, the number of sticks being sufficient to ensure that the sample and its statistical properties are representative of the lot. The sticks shall be not less than 35 mm thick.

In mechanical sampling the heart boards cut in accordance with 2.2.1 and selected in accordance with 2.1 shall be converted parallel to taper into sticks 35 mm thick. The sticks containing pith shall be discarded.

The sawn timber without pith shall be converted into sticks in such a manner that at least one surface of the stick is radial or tangential.

If necessary, before sawn timber of thickness 60 mm or more is converted into sticks, a portion along the grain 100 mm long shall be cut to make test pieces with cross-sectional dimensions greater than 30 mm.

3 CONDITIONING OF MATERIAL

3.1 For test pieces with a standardized moisture content

Before conversion into test pieces, the wood shall be thoroughly dried (at a temperature lower than 60 °C) to a moisture content close to that of the equilibrium state whose temperature and humidity are specified in 4.6.1. It is desirable that the ends of the material be covered with a moisture-protective substance to prevent splitting.

3.2 For test pieces with a moisture content equal to and above the fibre saturation point

Before conversion into test pieces, the sticks shall be kept under conditions which prevent drying of the wood.

4 PREPARATION OF TEST PIECES

4.1 Form and dimensions

One test piece for each type of test shall be cut from each stick made as specified in 2.2.2. The form and dimensions of the test pieces shall be those specified in the relevant International Standards for methods of testing wood.

4.2 Direction of grain

The grain of the wood shall be parallel to the longitudinal axis of the test pieces. Growth rings on the end surfaces of test pieces shall be parallel to one pair of opposite faces and perpendicular to the other pair. Adjacent faces shall be at right angles.

NOTE — The grain of the wood shall be at right angles to the longitudinal axis of the test pieces for testing perpendicular to the grain.

4.3 Deviations from nominal dimensions

The permissible deviations of the gauge length of the test pieces from nominal dimensions shall not exceed ± 0,5 mm. Any value taken within the limits of permissible deviation shall be kept throughout the test piece to an accuracy of ± 0,1 mm. The dimensions of test pieces not used in calculations (for example, the length of the test piece for the static bending test) shall be kept to an accuracy of ± 1 mm. The working surfaces of the test pieces shall be clean finished.

4.4 Marking

Each test piece shall be marked to indicate the place where the test pieces were cut from the selected material. Other characteristics of the mark should be specified in national standards.

4.5 Number

4.5.1 The number of test pieces shall be specified taking due account of the purpose in mind (determination of the quality of stand wood, of a model tree, of a lot of timber, of an individual board, etc.), as well as of the method of sampling used and of the degree of test precision required. The values of the main physical and mechanical properties shall be determined with an index of test precision of 5 % at a confidence limit of 0,95.

4.5.2 In selective sampling, the minimum number of test pieces n_{min} is given by the following formula :

$$n_{min} = mn = \frac{V^2 t^2}{p^2} \left[\frac{(n\sigma_b^2/\sigma_i^2) + 1}{(\sigma_b^2/\sigma_i^2) + 1} \right]$$

where

m is the quantity of selected material (logs, sawn timber, boards, etc.);

n is the mean number of test pieces cut from each piece of the selected material;

V is the percentage coefficient of variation for the property to be determined;

t is the index of result authenticity (a half-length of the confidence interval in fractions of the standard deviation);

p is the percentage index of test precision (the relation between the standard deviation of the arithmetic mean and the arithmetic mean);

σ_b^2 is the expected variance of the property in the selected material;

σ_i^2 is the expected variance of the property within one piece of the material.

The results shall be rounded to the nearest whole number.

4.5.3 In mechanical sampling, the minimum number of test pieces n_{min} is given approximately by the formula :

$$n_{min} = \frac{V^2 t^2}{p^2}$$

where V, t and p are as defined in 4.5.2

The results shall be rounded to the nearest whole number.

4.5.4 For an approximate determination of the minimum number of test pieces, the mean values of the coefficients of variation for wood properties shown in the following table may be used.

Wood property	Coefficient of variation %
Number of growth rings in 1 cm	37
Percentage of late wood	28
Density	10
Equilibrium moisture content	5
Coefficient of shrinkage : linear	28
volumetric	16
Ultimate compressive strength parallel to grain	13
Ultimate strength in static bending	15
Ultimate shearing strength parallel to grain	20
Modulus of elasticity in static bending	20
Proportional limit (conventional ultimate strength) in compression perpendicular to grain	20
Ultimate tensile strength : parallel to grain	20
perpendicular to grain	20
Impact strength in bending	32
Hardness	17

4.6 Conditioning

4.6.1 Test pieces made of the material conditioned according to 3.1 shall be conditioned at a temperature of 20 ± 2 °C and a relative humidity of 65 ± 3 % to bring the moisture content of the wood to that of equilibrium.

In certain climatic conditions, test pieces may be conditioned at a temperature above 20 °C with the appropriate change in relative humidity to obtain the same equilibrium moisture content.

4.6.2 Test pieces made of the material as specified in 4.2 shall have a moisture content equal to or greater than the fibre saturation point. It is permissible to make test pieces for compression and shearing from material with a moisture content below the fibre saturation point. In this case, test pieces shall be soaked prior to testing until no further changes in dimensions are recorded.

4.6.3 After conditioning, test pieces shall be stored under conditions which ensure that their moisture content remains unchanged till testing.

5 GENERAL REQUIREMENTS FOR PHYSICAL AND MECHANICAL TESTS

5.1 Temperature and humidity conditions in the laboratory

The temperature in the laboratory where the tests are carried out shall be maintained at 20 ± 2 °C. The relative humidity should preferably be 65 ± 3 %.

If it is not possible to maintain this relative humidity in the laboratory, test pieces shall be tested immediately after conditioning or on their removal from the sealed vessels.

5.2 Procedure

5.2.1 Carry out the tests in accordance with the appropriate International Standards.

5.2.2 After the tests have been carried out, determine the moisture content and, when required, the density of the test pieces. It is recommended that the moisture content be determined on samples cut from the test pieces. The minimum number of test pieces n_W used for the determination of their mean moisture content shall be at least 3 and is given by the formula :

$$n_W = n_{\min} \frac{V_W^2}{V^2}$$

where

$n_{\min}$ is the number of test pieces used for the determination of an index of a wood property with coefficient of variation V;

V_W is the coefficient of variation for the moisture content of the test pieces.

The results shall be rounded to the nearest whole number.

6 CALCULATION AND EXPRESSION OF RESULTS

6.1 The values of the wood properties shall be calculated using the formulae given in the International Standards for the appropriate test methods.

6.2 In treating the test results, the following shall be estimated :

a) the arithmetic mean, $\bar{x}$, from the formula :

$$\bar{x} = \frac{\Sigma x_i}{n}$$

b) the standard deviation, s, from the formula :

$$s = \pm \sqrt{\frac{\Sigma (x_i - \bar{x})^2}{n-1}}$$

c) the mean error, s_r, of the arithmetic mean, from the formula :

$$s_r = \pm \frac{s}{\sqrt{n}}$$

d) the percentage coefficient of variation, V, from the formula :

$$V = \frac{s}{\bar{x}} \times 100$$

e) the percentage index of test precision, p, at a confidence limit of 0,95, from the formula :

$$p = \frac{2s_r}{\bar{x}} \times 100$$

where

x_i is the value of an individual observation;

n is the number of observations.

6.3 If necessary, the test results should be adjusted to a 12 % moisture content. If the mean moisture content is determined from the moisture content of several test pieces, it is permissible to correct the arithmetic mean of the test results for moisture content.

7 TEST REPORT

The results of measurements and calculations shall be stated in the test report. The following shall be also indicated in the test report : type of test, the direction of applied load, temperature and air humidity in the laboratory, species of wood, and details concerning sampling of the test pieces.

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