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**Structural timber — Machine strength  
grading — Basic principles**

*Bois de structure — Classification mécanique selon la résistance —  
Principes de base*

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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.

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.

ISO 13912 was prepared by Technical Committee ISO/TC 165, *Timber structures*.

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## Introduction

The general principle of this International Standard is that any type of machine strength-grading procedure is acceptable, provided it is defined, controlled, and documented to the extent required to reflect the degree of reliability intended for the structural application of the product.

The body of this International Standard specifies the essential features common to all machine strength-grading operations. The requirements are minimal so as to ensure maximum scope and flexibility in the application of this International Standard to the machine strength-grading process as applied to timber.

Annex A provides a conformance standard reflecting the requirements of this International Standard.

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# Structural timber — Machine strength grading — Basic principles

## 1 Scope

This International Standard establishes the basic principles for rules and procedures governing the machine sorting of timber for use in structural applications.

## 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 13910, *Structural timber — Characteristic values of strength-graded timber — Sampling, full-size testing and evaluation*

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## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13910 and in Annex A apply. The terms and definitions given in Annex A are representative of those in rules and procedures governing the machine sorting of timber for use in structural applications.

## 4 Symbols and abbreviated terms

For the purposes of this document, the symbols and abbreviated terms given in ISO 13910 and in Annex A apply. The symbols and abbreviated terms given in Annex A are representative of those in rules and procedures governing the machine sorting of timber for use in structural applications.

## 5 General

### 5.1 Machine strength-graded timber

Machine strength graded timber is sawn wood that has been machine sorted according to selected criteria allowing for classification into structural grades. The machine criteria identify mechanical and/or physical properties that reflect the timber strength and may affect the utility of the product.

### 5.2 Machine strength-grading operations

A typical machine strength-grading operation shall be comprised of a grading machine that sorts an input resource into one or more grades (see Figure 1). Some of the lumber may not meet the requirements of the minimum specified grade.

The grading machine comprises one or more devices that may measure properties along the length of a piece of timber as it passes through the machine. For some machines, properties along the length of a piece of timber are not measured, but rather properties are measured that relate to the piece of timber considered in total as a single unit. End portions of the timber may not be scanned [see Figure 2 a)].

The data recorded by the machine shall be processed so as to produce a sorting criterion, and this sorting criterion is used as a basis for assigning a grade of machine strength timber.

Visual requirements for the total piece of timber, the unscanned end portions, or both should be specified to supplement the information obtained by the machine.

NOTE 1 Within the context of this International Standard, the term “scanner” is used to denote the device used to measure a property of the timber, and the term “scanned length” is used to denote that portion of the timber for which measurements are made by the scanning device if it measures properties along the length of a piece of timber.

NOTE 2 In the use of the conventional bending type of strength-grading machine, the only parameter that is measured (mechanically) along the length of each piece of timber (except for the unscanned end lengths) is the local modulus of elasticity on flat.

NOTE 3 For a machine using single or multiple scanners, it may be common to use the data obtained to produce a prediction of strength along the length of a piece of timber [see Figure 2 b)]. For this case, the minimum predicted strength value within the piece is usually taken to be the grade control criterion.

### 5.3 Machine strength-grading principles of quality control

Machine grading is one element of quality control operations. This International Standard requires that the quality control related to the machine grading operation is undertaken by placing checks on the four components of the strength grading operation: 1) the resource and sawn timber inputs; 2) the machine operation; 3) the visual requirements (when specified); and 4) the graded timber output (see Figure 1).

In theory, it should be possible to control quality, either

- a) by control on the resource input and the machine operation, or
- b) by checks of the quality of the output grades.

However, in practice, additional monitoring is generally required.

For example,

- when using a), care must be taken to define and ensure that the resource is similar to that initially used to establish the machine settings;
- when using b), the initial evaluation (see 8.2) should involve sample sizes larger than those normally used for daily evaluation (see 8.3) to ensure that the 5-percentile strength requirements are met.

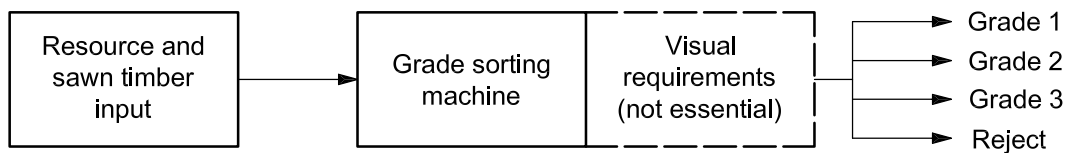
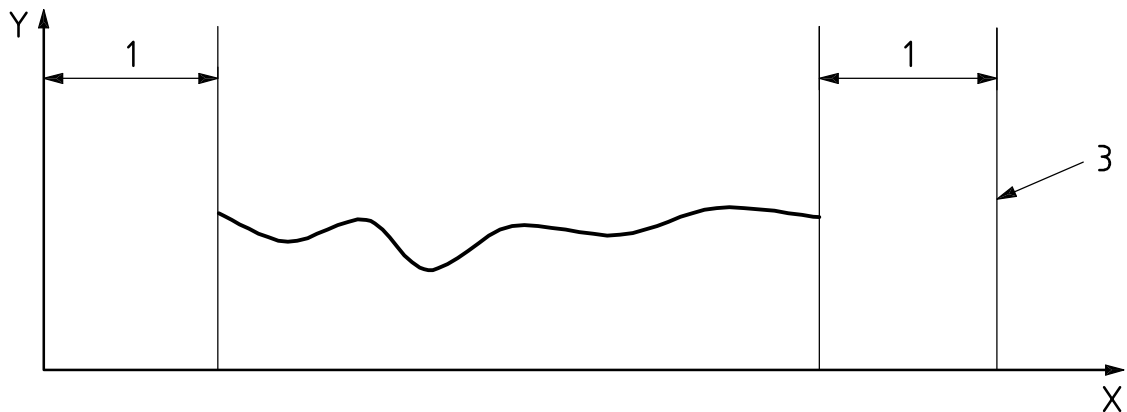
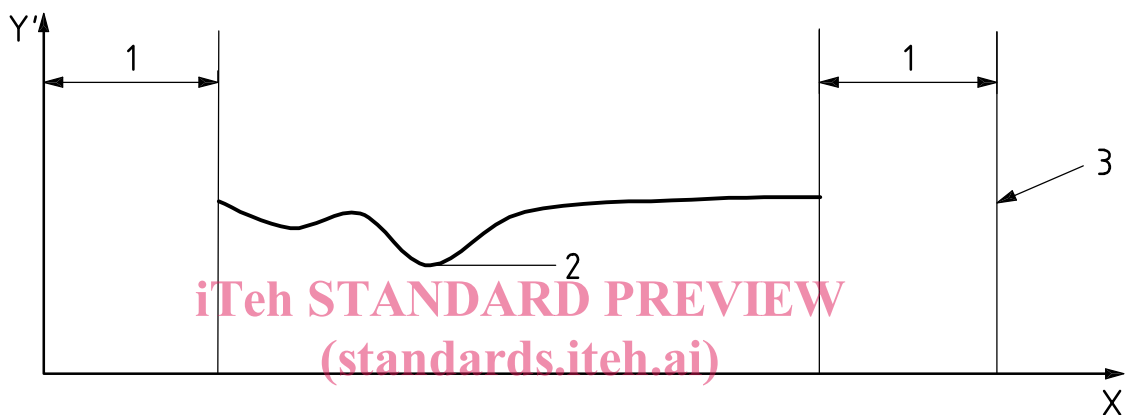


Figure 1 — Schematic of machine strength-grading operation





a) Typical output of a scanner



b) Typical form of processed output

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**Key**

- X distance from start of piece
- Y scanner output
- Y' predicted strength
- 1 unscanned length
- 2 minimum predicted strength
- 3 end of piece

Figure 2 — Measurements made by a typical strength-grading machine

**6 Resource and sawn timber input requirements****6.1 General**

The input resources shall be identified in terms of all parameters that may affect the output of the machine grade sorting operation.

**6.2 Input requirements****6.2.1 Resource**

The parameter that shall be identified is the timber species or mixture of species.

Other parameters that may be identified are

- a) silvicultural practices used,
- b) log source,
- c) log size,
- d) cutting pattern used to manufacture sawn timber from logs, and
- e) any other parameters deemed to be important.

### 6.2.2 Sawn timber

Parameters that shall be specified are

- a) condition (such as seasoned, unseasoned, etc.),
- b) moisture content, and
- c) any other parameters deemed to be important.

### 6.3 Control of inputs

A periodic check on the resource and sawn timber inputs should be defined and specified.

### 6.4 Reprocessing of previously graded material

If major reprocessing of previously graded material is permitted, then any requirements for re-grading of the material should be specified.

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## 7 Machine strength-grading requirements

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### 7.1 Machine requirements

In addition to verification of the calibration of the scanner, all machine checks specified by the machine manufacturer shall be undertaken.

### 7.2 Machine grading requirements

The machine grading process shall specify, at regular intervals, checks to ensure:

- a) **repeatability** – within prescribed limits, the scanners shall provide the same readings for repeated passes of the same piece of timber;
- b) **calibration** – within prescribed limits, scanners shall reproduce the original readings made on special pieces of timber set aside for calibration purposes or on non-timber calibration bars;
- c) **consistency** – within prescribed limits and where scanners provide readings along the length of timber, the data from scanners shall indicate a consistent calibration all along the length of a piece of timber.

Grading machines that use the same types of scanners should be calibrated against the same check procedure.

NOTE Grading machines that are not identical but use the same types of scanners include a number of conventional strength-grading machines. In such cases and for calibration purposes, all machines should be calibrated against a common standard test (e.g. ISO 13910) on timbers selected for calibration purposes.

### 7.3 Visual grading requirements

Where visual grading requirements are deemed to be important then rules to satisfy the strength requirements shall be specified and rules to satisfy the utility requirements may be specified.

For the visual grading requirements that are specified, then a periodic check shall be made to assess the accuracy of the grading process. If a check indicates that the process is inadequate, then appropriate measures may be specified to modify the process so that the process is adequate.

An example of visual strength-grading requirements, as applied to rectangular timber for structural applications, is given in Annex A.

## 8 Machine graded timber structural properties

### 8.1 General

The critical properties of strength-graded timber are structural properties. These properties shall be as defined and measured as specified in the test methods defined in ISO 13910.

The structural design properties shall be determined from tests on timber having a defined moisture content, if the tests are conducted on timber having a moisture content that differs from that specified by the procedure conforming to this International Standard, the properties resulting from the tests shall be adjusted (using sound engineering principles) so that the structural design properties reflect the intent of these basic requirements and/or the applicable associated design codes.

### 8.2 Initial evaluation

Once the grading operation has been selected, evidence shall be provided that the resultant output grades have the structural properties stated for the material. This evidence may be linked to other mills carrying out equivalent or similar sorting procedures.

For cases where such evidence is not available or it is not appropriate to link the evidence to other mills, an initial test program should be specified. The requirements for this test program should be based on sound sampling principles and the tests for the structural properties shall be based on the test procedures specified in 8.1.

### 8.3 Daily evaluation

When specified in the documentation one or more structural properties shall be measured for each production shift on a limited sample of timber. The data obtained shall be applied to a statistical process control procedure and the results used to monitor the control of the strength grading operation.

### 8.4 Periodic evaluation

Direct measurement of the structural properties of full-size timber shall be undertaken if there is a reason to expect that the structural properties of machine graded lumber have changed and may also be specified to be undertaken at periodic specified intervals.

**NOTE** The number and scope of periodic evaluations required depends, to some extent, on the system being used to undertake the evaluations. One type of statistical process control procedure and its use in quality control is included in the example standard of Annex A.

## 9 Product identification

A product identification mark on the timber shall be specified to indicate the standard on which the sorting is based, the grade and/or strength class, and the producer responsible. The product identification mark may also include other information deemed important.

Each piece of timber shall be marked except for high quality strength-graded timber intended for structural and appearance purposes. For this high quality appearance timber, each shipment shall be accompanied by documentation containing the product identification requirements specified in the standard.

## 10 Documentation

Documentation requirements shall include:

- a) standard on which the machine strength-grading process is based;
- b) specifications for the timber grade criteria;
- c) specifications and control checks of the resource input where applicable to machine control operations;
- d) specifications and control checks for the machine grade sorting process;
- e) where applicable, specifications and control checks for the visual requirements;
- f) specifications and control checks of the structural properties;
- g) specifications for the identification of the product;
- h) methods for assigning and confirming a grade; and
- i) any other specifications or materials deemed to be important.

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