DRAFT INTERNATIONAL STANDARD ISO/DIS 10983

ISO/TC **165** Secretariat: **SCC**

Voting begins on **2013-01-28** Voting terminates on **2013-04-28**

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

Timber — Finger joints — Minimum production requirements and testing methods

Bois — Aboutages — Exigences minimales de production et méthodes d'essais

[Revision of first edition (ISO 10983:1999)]

ICS 91.080.20

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Pour accélérer la distribution, le présent document est distribué tel qu'il est parvenu du secrétariat du comité. Le travail de rédaction et de composition de texte sera effectué au Secrétariat central de l'ISO au stade de publication.

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 10983 was prepared by Technical Committee ISO/TC 165, *Timber Structures*.

This second edition cancels and replaces the first edition (ISO 10983:1999), which has been technically revised.

Introduction

This International Standard sets out minimum production and testing requirements for structural finger joints. It includes requirements for documentation of manufacturing and test procedures in a quality manual to ensure ongoing consistent quality. TC 165 is not prepared to recommend the use of finger joints in structural timber components where the manufacturing process is not described by a production facility's quality manual for the following reasons:

a) Structural properties can only be assigned to a finger joint that is clearly defined. Such definition requires a clear description, within the production facility's quality manual, of the raw material inputs (wood and adhesive), the manufacturing process, and quality assurance procedures.

b) Processes which are not written in a production facility's quality manual and promulgated to the personnel responsible for manufacturing the finger joint are unlikely, over lengthy periods of time, to be manufactured consistently.

Other principles built into the development of this International Standard are as follows.

— This International Standard applies only to the finger-joint production and makes reference only to the maintenance of finger-joint strength. Finger joints are found in both glulam laminations and finger-jointed timber used directly for structural applications. No attempt is made in this International Standard to relate compliance testing to the properties of either glulam or finger-jointed timber.

— Qualification testing is undertaken to establish characteristic strengths and target strengths for compliance (daily quality control) testing. The precise test configurations are not specified in this International Standard, which permits the use of a wide variety of test equipment. However, it is a requirement that the same equipment and configuration used for qualification testing also be used for compliance testing. Both bending and tension tests are provided.

Timber Structures — Finger joints for structural timber — Production and testing requirements

1 Scope

This International Standard specifies minimum requirements for the manufacture and testing of bonded finger joints in structural wood products such as glued laminated timber, cross laminated timber, and finger jointed timber.

Although most finger joints are produced in coniferous species (softwoods), this International Standard also applies to broadleafed species (hardwoods) where information is available to enable them to be satisfactorily bonded.

It does not cover impressed (die-formed) joints. In the case of glued laminated timber, it applies only to individual laminations. Large finger joints in glued laminated timber are not covered by this International Standard.

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.

ISO20152-1, Timber structures – Bond performance of adhesives –Basic requirements

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

finger joint

end joint formed by machining a number of similar, tapered, symmetrical fingers in the ends of timber members which are then bonded together

3.2

production batch

a group of finger joints, all of which have the same profile, are manufactured from the same species of timber, have the same nominal cross-section, are bonded with the same adhesive, and are made during a continuous run on one production line

3.3

qualification testing

testing in bending or tension performed to establish the mean and lower 5% tolerance limit strength with 75% confidence when the finger joint process is first established.

4 Symbols (and abbreviated terms)

a distance between support and nearest applied load in bending test, in millimetres

b smaller dimension of cross-section

h larger dimension of cross-section

f_m bending strength of a single finger joint

f_t tension strength of a single finger joint

l distance between supports in bending test

P maximum force applied to finger jointed specimen during bending test

T maximum force applied to finger jointed specimen during tension test

5 Production Requirements

5.1 General

The cutting and the bonding operations of finger joints shall result in reliable and durable bonds of the required strength. The premises shall meet the requirements of cleanliness, air temperature, and relative humidity to ensure a satisfactory production environment. Procedures for the operation of the production facility and for the initial and ongoing quality evaluation shall be documented in a quality manual. All machinery and equipment necessary for the production process shall be available and in good working order. Timber shall be properly graded. Adhesives shall be compatible with the species and treatment in conformance with the adhesive manufacturer's recommendations. Cutting, bonding, and handling of finger jointed timber shall be in conformance with the production facility's quality manual.

5.2 Timber

5.2.1 Species

Any wood species shall be permitted provided that sufficient information on the species is available to enable the timber to be bonded satisfactorily. Different species with similar strength and bonding characteristics shall be permitted to be grouped together for qualification and compliance testing.

5.2.2 Timber Grading

Individual pieces of timber to be finger-jointed shall be graded according to the product requirements as described in the production facility's quality manual. Specific limits shall be defined for knots, grain deviations, wane, and other characteristics determined to be detrimental to the performance of the product. The maximum size and extent of knots and other strength reducing characteristics at the ends of the pieces to be finger-jointed shall be limited as defined in the quality manual to minimize their effect on the strength of the joint.

5.2.3 Moisture content and temperature

During assembly and curing, the moisture content and temperature of the wood at the joint shall be within the range specified by the adhesive manufacturer.

Moisture content shall be measured by the use of a regularly calibrated moisture meter.

5.2.4 Chemically treated timber

Wood treated with chemicals such as those used to improve durability or fire performance shall be considered as a separate species for the purposes of finger joint production and quality control.

5.3 Adhesive

5.3.1 General

The adhesive shall have sufficient strength and durability to ensure that that the integrity of the bond will be maintained throughout the intended lifetime of the structure. Compatibility of the adhesive, wood substrate, and plant procedures shall be demonstrated through qualification tests prior to production. The adhesive used shall meet the requirements of ISO20152-1.

5.3.2 Adhesive Manufacturer's Specifications

The specifications of the adhesive manufacturer shall be followed with respect to the following:

a) mixing of the adhesive;

b) use of fillers;

c) preheating of the timber (by high frequency, infrared or other methods);

d) adhesive application;

e) open and closed assembly times;

f) curing of the adhesive;

g) temperature of the air and the timber before and during curing.

h) moisture content of the timber at the joint

5.4 Processing

5.4.1 Application of Adhesive

The method used for adhesive application shall ensure that all finger surfaces in the assembled joint are covered with the adhesive.

5.4.2 Assembly

Joints shall be bonded as soon as possible, and not later than 24 h, after machining. Between machining and assembly, care shall be taken to keep the cut surfaces of the fingers clean. The members shall not be stored in conditions likely to lead to distortion.

5.4.3 End pressure

The application of end pressure shall be adequate to bring the mated joint surfaces into contact, while maintaining proper tip gaps and joint alignment. End pressure shall be maintained until the joint has cured adequately to enable the jointed timber to be moved without weakening the joint. Curing of the adhesive shall be completed before further processing, unless it has been demonstrated that the finger joints will have sufficient and reliable strength to allow immediate processing.

5.5 Quality Control

5.5.1 General

The manufacturer shall establish and document requirements for lumber, adhesive, and processing with corresponding quality control procedures.

Each step in the production process, including lumber grading, finger joint machining and fit, adhesive application, joint assembly and handling, adhesive curing, and final finishing shall be assessed for each production batch. Finger joint strength shall be established through initial qualification testing and verified for each production batch through ongoing compliance testing.

5.5.2 Facilities, equipment, and personnel

All necessary facilities, equipment, and personnel shall be available to carry out the necessary inspections and tests. The manufacturer shall control, calibrate and maintain inspection, measuring, and test equipment, to demonstrate the conformity of the finger joints to the requirements of this International Standard. Equipment shall be used in a manner which ensures that measurement tolerances are known and are consistent with the required measurement capability.

5.5.3 Responsibility and authority

The responsibility, authority, and interrelation of all personnel who manage, perform, and verify work affecting quality shall be defined. Persons responsible to initiate action to prevent the occurrence of non-conformity of finger joints and to identify and record any quality problems with finger joints shall be clearly identified.

5.5.4 Factory production control

At every production facility, the manufacturer shall appoint a person or persons who shall have appropriate authority, knowledge, and experience of the production of finger joints to be responsible for conducting and supervising factory production and quality control procedures and ensuring that the requirements given in this International Standard are implemented and maintained.

5.5.5 Review

The quality control system adopted to satisfy the requirements of this International Standard shall be reviewed at appropriate intervals by the manufacturer's management to ensure its continuing suitability and effectiveness.

Records of such reviews shall be maintained.

5.5.6 Quality Manual

The manufacturer shall document all procedures relevant to the production and quality control of finger joints in a quality manual. At a minimum, the quality manual shall describe:

a) the organizational structure, including responsibilities and powers of the management with regard to conformity of the finger joints;

b) all procedures for specifying and verifying the quality of the timber and the adhesive;

c) each step in the production process;

d) all inspections and tests that will be carried out before, during, and after manufacture, and the frequency with which they are to be carried out.

The quality manual shall be available to production and quality personnel as needed to ensure consistent application of production and quality control procedures.

6 Testing Requirements

6.1 General

Finger joint strength shall be established through initial qualification testing and verified for each production batch through ongoing compliance testing. Specimens are permitted to be tested in either bending or tension as chosen by the manufacturer or as required by an accreditation agency; however, the same configuration used for qualification testing shall also be used for compliance testing.

6.2 Materials

Finger joints with differences in processing, treatment, timber species (or species group), joint geometry, or adhesive shall be evaluated separately. Sample joints shall be selected from and represent normal production. The timber densities shall be representative of the species and grade concerned. At the time the sample joints are manufactured, the timber shall be at the moisture content at which production joints would normally be made. The surface finish of the specimens at the time of testing shall be typical of the jointed timber normally supplied by the manufacturer.

Specimens for qualification testing shall be tested in the fully-cured condition. Specimens for compliance testing are permitted to be tested in the fully-cured condition or in a partially-cured condition, provided that a consistent relationship has been established between fully-cured strength and partially-cured strength. Where partially-cured specimens are tested for compliance, the time between bonding of the joint and testing shall be consistent to ensure that a similar degree of cure is achieved for each specimen. The relationship between partially-cured end joint strengths and fully-cured end joint strengths shall be reevaluated periodically at intervals of one month or less.

6.3 Testing procedure

Testing shall be conducted in accordance with Annex A for bending tests or Annex B for tension tests. Each specimen shall contain a finger joint at mid-length. Where possible, the whole jointed cross-section shall be tested. However, test specimens not covering the full cross-section of the jointed timber may be used provided that two specimens, each making up at least one-third of the cross-section, are tested. In bending tests, these specimens shall include the edges of the original cross-section and these edges shall be on the tension side of the specimen in the bending test. Only the lower test result shall be considered.

6.4 Recording requirements

For the finger joints tested, the following information shall be recorded and signed by the person responsible for the testing:

a) date of production;

b) date of testing;

c) wood species;

d) timber grade;

e) chemical treatment;

f) type of resin and hardener;

g) width and thickness of the timber;

h) test load at failure;

i) bending or tension strength;

j) description of the failure mode (wood failure percentage).

All documentation shall be registered so that the raw materials and production conditions for the finger joints are traceable.

6.5 Qualification testing

6.5.1 General

During the running-in period of a new finger-jointing line, or in the case of significant changes in an existing line (including changes of profile), specimens shall be tested in either bending or tension. The cross-sections of the specimens shall be equal to the maximum which the manufacturer intends to finger-joint.

6.5.2 Sample size

A minimum of 30 jointed specimens shall be sampled and tested. Where failure of a specimen occurs away from the joint, with a strength below the target characteristic value for the test, the test results for that specimen may be excluded in the assessment. The test results for a maximum of two such specimens shall be permitted to be excluded. If such exclusions leave fewer than 30 valid results, then tests on further specimens shall be carried out to give at least 30 valid results.

6.5.3 Characteristic strength

The characteristic bending or tension strength, as appropriate, defined as the lower 5% tolerance limit strength with 75% confidence, shall be determined by an appropriate statistical method. The mean bending or tension strength, as appropriate shall also be determined.

6.6 Compliance Testing

6.6.1 General

Daily testing in either bending or tension is used to help assure that the required finger joint strength is maintained over time and to provide a level of confidence that a production batch is satisfactory. The approval of a production batch is contingent on a successful demonstration of compliance with the strength requirements.

NOTE: In addition to the basic requirements of this section, additional testing may be specified for some production to meet requirements of applicable product standards. For example, in-line or other frequent proof loading is frequently required for finger-jointed timber to be used as individual members in tension or bending. Recommended tests for proof loading in Bending or Tension are shown in Annex C and Annex D.

6.6.2 Sampling

A representative sample of finger joints shall be drawn at random from each work shift and each production line. Specimens shall be taken for testing from the production of each shift and each production line, as far as possible evenly distributed in time and timber sizes over the shift. Minimum requirements for sampling shall be established by the relevant product standard and included in the plant quality manual.

6.6.3 Compliance requirements

Minimum requirements for compliance shall be established by the relevant product standard and included in the plant quality manual. Statistical process control techniques shall be permitted to be used to determine compliance with the strength requirements.