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Adhesives — Wood-to-wood adhesive bonds — Determination of shear strength by compression loading

Adhésifs — Joints collés de bois à bois — Détermination de la résistance au cisaillement par effort de compression

Reference number
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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.

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. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 6238 was prepared by Technical Committee ISO/TC 61, *Plastics*.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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Adhesives — Wood-to-wood adhesive bonds — Determination of shear strength by compression loading

1 Scope and field of application

This International Standard specifies a method for determining the shear strength of wood-to-wood adhesive bonds, with a standard specimen loaded in compression and under specified conditions of preparation, conditioning and testing. This method is intended for testing only those adhesives used in bonding wood to wood.

NOTES

1 To carry out this test, basic information regarding certain variables is needed by the testing laboratory (see annex A).

2 This method is not intended for use in testing manufactured products.

2 Reference

ISO 291, *Plastics — Standard atmospheres for conditioning and testing.*

3 Apparatus

3.1 Apparatus for preparation of adhesive

3.1.1 Balance and **equipment** capable of measuring the proportions of the adhesive mix to within a tolerance of ±1%.

3.1.2 Mixing equipment to ensure homogeneous mixing of the constituents with minimum aeration of the adhesive (except foamed adhesive).

3.1.3 Spreading equipment such as a **wire-wound bar, roller spreader, curtain coater** or **suitable hand applicators,** capable of spreading the adhesive uniformly within ±5 % of the desired spread.

3.1.4 Equipment, designed to exert the required pressure evenly over the whole bonded area within ±5 % of the desired value, for example a **press** or **clamps**. If necessary, **heated platens** capable of maintaining the prescribed temperature within ±2 °C during pressing.

3.2 Testing apparatus

3.2.1 Analytical balance.

3.2.2 Linear measuring device, to read to 0,05 mm, e.g. vernier caliper or micrometer.

3.2.3 Testing machine, capable of exerting a compressing force of at least 70 kN with an accuracy of ±2 %. The force shall be applied at a uniformly increasing rate so that the specimen fails within 60 ± 20 s.

The testing machine shall be fitted with a shearing tool containing a self-aligning seat to ensure uniform lateral distribution of the force. A shearing tool as shown in figure 1 has been found satisfactory.

NOTE — It is necessary for all equipment, including gauges, thermometers, etc., to be calibrated regularly, as prescribed by the testing authority of each country.

4 Test specimens

4.1 The timber species, timber quality and timber moisture content for the specimens shall be as described in annex B.

4.2 Individual test joints shall conform to the form and dimensions shown in figure 2. The individual test joints shall be cut from bonded blocks prepared as described in clauses 5 and 6.

4.3 For adhesive quality control purposes, test a minimum of three test joints from each of three different bonded blocks, prepared as described in clauses 5 and 6.

4.4 Where greater precision is required, test a minimum of five test joints from each of four different bonded blocks.

5 Preparation of test blocks

5.1 Blocks shall be cut from the timber, preferably of a size such that five test joints may be cut from one bonded block as shown in figure 3. The grain direction shall be parallel to the longest dimension of the block. The blocks shall have surfaces substantially free from saw marks. The blocks shall be weighed and assembled in pairs so that blocks of approximately the same relative density are glued together. By agreement between the interested parties the surfaces may be lightly sanded; they shall be free from dirt, dust, or other contamination. Unless otherwise agreed between the interested parties, the thickness of each of the blocks shall not vary by more than 0,1 mm to ensure even pressure during cure.

NOTE — Test joints with a bond area of 50 mm × 40 mm are the most common type. However, by agreement between the interested parties test joints with other bond areas can be used. Test joints with 25 mm × 25 mm bond areas have been found to give no greater variability and are more economical with regard to the material required.

5.2 Prepare and apply the adhesive to the blocks in accordance with the procedure recommended by the manufacturer of the adhesive. Assemble and press the coated blocks, also in accordance with the recommendations of the manufacturer of the adhesive. Number each bonded block. The net mass of the adhesive applied may be verified by weighing the blocks before and after spreading the adhesive.

6 Conditioning of test blocks

Upon release of pressure, condition the bonded blocks at a relative humidity of (50 ± 5) % or (65 ± 5) % and a temperature of 23 ± 2 °C, either for a period of 7 days or until they attain a constant mass, whichever is the longer period. (Constant mass is considered to be reached when the results of two successive weighing operations, carried out at an interval of 6 h, do not differ by more than 0,1 % of the mass of the bonded block.)

Conditioning may be extended beyond this limit by agreement between the interested parties.

NOTE — Other conditions of humidity and temperature may be used by agreement between the interested parties.

7 Preparation of test joints

7.1 Reduce the width of the test blocks to 50 ± 0,5 mm by planing or sawing an approximately equal amount from each side. Then cut approximately 10 mm from each end before cutting the test joints. Cut the individual test joints as shown in figure 3. When preparing the test specimens, make sure that the loaded surfaces are smooth and parallel to each other and perpendicular to the height. While reducing the lengths of the overlap to 40 ± 0,5 mm, ensure that the saw cuts extend to, but not beyond, the glue line. Also ensure that the saw cuts are perpendicular to the major axis.

Number each test joint consecutively from one end of the bonded block to the other.

7.2 Store the test joints in the conditioning atmosphere described in clause 6, until tested. The bonded blocks may be briefly removed for the cutting operations.

8 Procedure

8.1 Place the test joint in the shearing tool so that the force may be applied as described in 3.2.3. The position of the test joint in one type of shearing tool is shown in figure 1. Apply a continuously increasing force or a continuous motion of the movable head so that the test joint fails within 60 ± 20 s.

8.2. Record the force at break and the percentage wood failure for each test joint, estimated as described in 8.3. Express all forces in kilonewtons to the nearest 100 N.

8.3 In order to determine the wood failure after testing, illuminate the specimen with oblique light, incident at an angle of 10° to 15°. The light source shall have a black, non-reflecting shade. A clear incandescent 150 W bulb or a 15 W fluorescent tube shall be used. The distance between the incandescent bulb and the specimen shall be between 150 and 250 mm and the distance between the fluorescent tube and the specimen shall be between 25 and 75 mm. Determine the proportion of area covered by wood, irrespective of depth of failure. If the shear fracture does not extend over the whole test area, then wood failure shall be calculated as a proportion of the fractured area.

In assessing wood failure, both sides of the fracture shall be evaluated in conjunction. The wood failure shall be evaluated to the nearest 10 %.

9 Expression of results

9.1 Calculate for each specimen the force in kilonewtons or the stress in kilopascals* at break.

9.2 Calculate the mean $\bar{x}$ and the standard deviation s of the force or stress at break and of the percentage wood failure for the test specimens from each bonded block and for all the specimens tested, by the following formulae:

$$\bar{x} = \frac{\Sigma x}{n} \quad \text{and} \quad s = \sqrt{\frac{n\Sigma x^2 - (\Sigma x)^2}{n(n-1)}}$$

where

x is each individual result;

n is the number of specimens tested.

10 Test report

The test report shall include the following particulars:

a) reference to this International Standard;

b) complete identification of the adhesive tested, including type, source, manufacturer's code number, physical form, etc;

c) timber species used, its moisture content at the time of spreading, and description of bonding surfaces, including, if known, the age of the surface;

* 1 kPa = 1 kN/m^2

d) application and bonding methods and conditions used in preparing the test joints;

e) conditioning atmosphere and temperature, and conditioning procedure used for the specimens before testing;

f) temperature and relative humidity of the test room;

g) rate of applying force or crosshead speed;

h) dimensions and number of bonded blocks represented;

i) number of test joints tested;

j) individual test results, identified with regard to bonded block of origin and the numbers of the test joints;

k) the mean breaking force or stress and the mean percentage of wood failure for each bonded block and for all specimens;

l) standard deviation of breaking force or stress for each bonded block and for all specimens;

m) all modifications of the test procedure that may have affected the results.

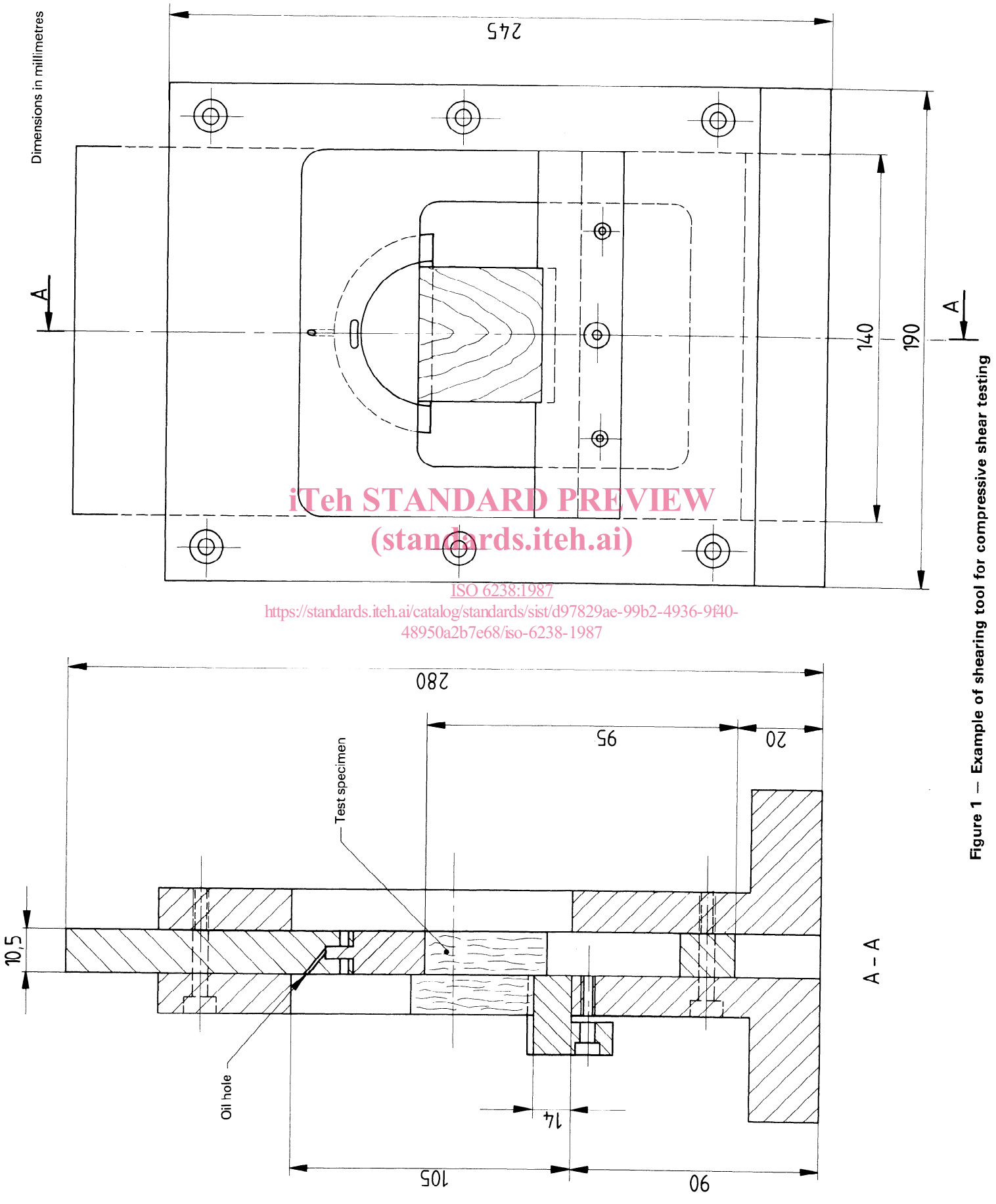

Figure 1 — Example of shearing tool for compressive shear testing

Dimensions in millimetres

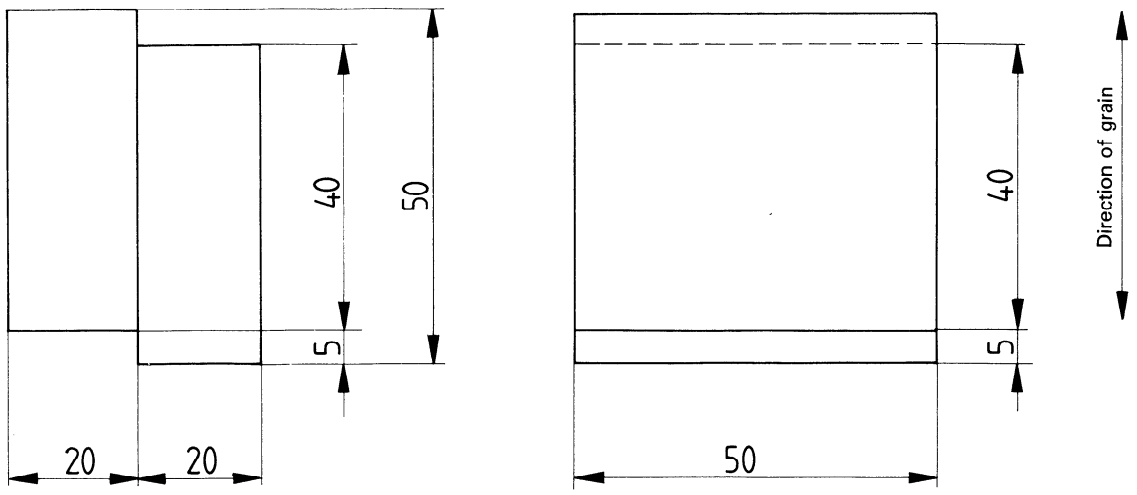

Figure 2 — Form and dimensions of test specimen

Dimensions in millimetres

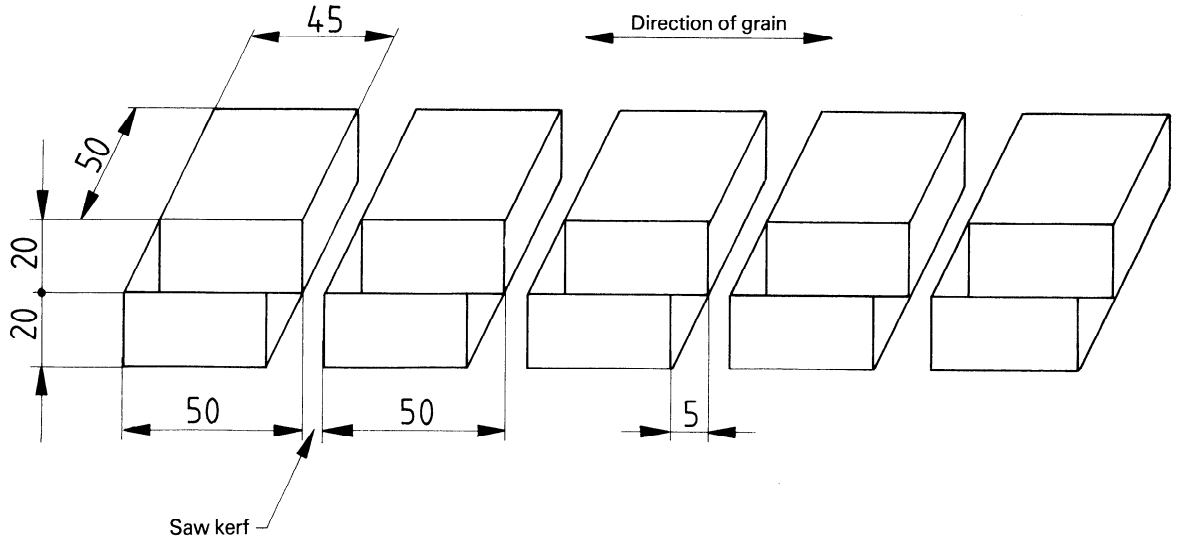

Figure 3 — Method of cutting test specimens from bonded blocks

Annex A

Information required prior to testing

(Forms part of the Standard.)

The results of strength tests of adhesive bonds are dependent on the conditions under which the bonding process is carried out. Unless otherwise agreed, the bonding conditions shall be specified by the manufacturer of the adhesive.

In order to ensure that complete information is available to the individual conducting the tests, the manufacturer of the adhesive should furnish numerical values and other specific information for each of the following variables:

a) the recommended moisture content of the wood at the time of gluing;

b) whether or not the surface of the wood to be bonded may be abraded prior to bonding;

c) complete mixing directions for the adhesive;

d) conditions for application of the adhesive, including the rate of spread, number of coats to be applied, whether to be applied to one or both surfaces, and the conditions of drying;

e) assembly conditions before application of pressure, including open and closed assembly time and temperature;

f) pressing conditions, including time, glue line temperature, and pressure;

g) conditioning procedure before testing, including time, temperature and relative humidity.

If a range is prescribed for any variable by the manufacturer of the adhesive, it shall be assured that any arbitrarily chosen value within such a range or any combination of such values for several variables will be acceptable.

Annex B

Timber species, surfaces, quality and moisture content

(Forms part of the Standard.)

B.1 Timber species

The standard timber species for testing the adhesive shall have a mean density between 670 and 770 kg/m^3 at 12 % moisture content and a mean shear strength parallel to the grain between 13,0 and 18,0 MPa at the same moisture content. Some suitable species are listed in the table. The timber shall not be treated or coated. Any other species of timber may be used by agreement between the interested parties.

NOTE — For a block of timber at a moisture content other than 12 %, the approximate value of the density ϱ_{12} at 12 % moisture content may be determined by the following formula:

$$\varrho_{12} \approx \frac{112\,m}{V(100 + H)}$$

where

m is the mass of the block, in kilograms;

V is the volume of the block, in cubic metres;

H is the moisture content of the block, expressed as a percentage by mass.

The above formula does not take into account the change in volume due to change in moisture content. For a more exact calculation, use the following formula:

$$\varrho_{12} = \varrho_H \left[1 - \frac{(1 - v)\,(H - 12)}{100}\right]$$

where

$$\varrho_H = \frac{m_H}{V_H} \quad \text{and} \quad v = \frac{V_0 - V_H}{V_H \times H} \times 100$$

in which

ϱ_H is the density at moisture content H;

m_H is the mass, in grams, of the specimen at moisture content H;

V_H is the volume, in cubic centimetres, of the specimen at moisture content H;

v is the coefficient of shrinkage;

H is the moisture content;

V_0 is the volume, in cubic centimetres, of the dry specimen.

B.2 Timber quality and surface

The blocks for the test specimens may be smoothly sawn or planed prior to abrading. They shall be of straight grain and free from all defects that may interfere with the bond strength, such as knots, holes, cracks, bark or gum pockets, short grain, distorted grain, or decay.

B.3 Timber moisture content

The moisture content of the wood immediately before adhesive application shall be within the range of the moisture content recommended by the adhesive supplier. In the absence of such recommendations the moisture content shall be (10 ± 2) % for room temperature setting adhesives and (7 ± 2) % for hot setting adhesives. Except where otherwise agreed upon between the interested parties, the moisture content shall be determined on at least two representative specimens by the oven-dry method (constant mass at 103 ± 2 °C).