



## Standard Test Method for Strength Properties of Adhesives in Two-Ply Wood Construction in Shear by Tension Loading<sup>1</sup>

This standard is issued under the fixed designation D 2339; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

### INTRODUCTION

The accuracy of the results of strength tests of adhesive bonds depends on the conditions under which the bonding process is carried out. Unless otherwise agreed upon between the manufacturer and the purchaser, the bonding conditions shall be prescribed 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 shall furnish numerical values and other specific information for each of the following variables:

- (1) The moisture content of the wood at the time of bonding.
- (2) Complete mixing directions for the adhesive.
- (3) Conditions for application of the adhesive including the rate of spread or thickness of film, number of coats to be applied, whether to be applied to one or both surfaces and the conditions of drying where more than one coat is required.
- (4) Assembly conditions before application of pressure, including the room temperature, length of time, and whether open or closed assembly is to be used.
- (5) Curing conditions, including the amount of pressure to be applied, the length of time under pressure, and the temperature of the assembly when under pressure. It should be stated whether this temperature is that of the bondline, or of the atmosphere at which the assembly is to be maintained.
- (6) Conditioning procedure before testing, unless a standard procedure is specified, including the length of time, temperature, and relative humidity.

A range may be prescribed for any variable by the manufacturer of the adhesive if it can be assumed by the test operator that any arbitrarily chosen value within such a range or any combination of such values for several variables will be acceptable to both the manufacturer and the purchaser of the adhesive.

### 1. Scope

1.1 This test method covers the determination of the comparative shear strengths of adhesives when tested on a standard specimen and under specified conditions of preparation, conditioning, and testing. This test method is intended to be applied only to adhesives used in bonding wood to wood.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appro-*

*priate safety and health practices and determine the applicability of regulatory limitations prior to use.*

### 2. Referenced Documents

#### 2.1 ASTM Standards:<sup>2</sup>

- D 143 Test Methods for Small Clear Specimens of Timber
- D 907 Terminology of Adhesives

### 3. Terminology

#### 3.1 Definitions:

3.1.1 *shear, n*—in an adhesively bonded joint, stress, strain, or failure resulting from applied forces that tends to cause adjacent planes of a body to slide parallel in opposite directions.

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee D14 on Adhesives and is the direct responsibility of Subcommittee D14.30 on Wood Adhesives.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

#### 4. Significance and Use

4.1 By the nature of the way adhesives are used in two-ply wood construction, shear strength is an important performance criteria.

4.2 Shear strength measured by this test method is suitable for use in adhesive development, manufacturing quality control, and in materials-performance specifications.

#### 5. Apparatus

5.1 Adjust the loading rate of the testing machine between 4535 and 7560 g/s (600 and 1000 lb/min). Where the testing machine is adjusted by rate of crosshead movement rather than load application rate, select an appropriate head movement rate so as to yield an average load application rate in the 4535 and 7560 g/s (600 and 1000 lb/min) range. Provide suitable grips and jaws so that the specimen can be gripped tightly and held in alignment as the load is applied. The grips and jaws shown in Fig. 1 have been found satisfactory. Locate the testing machine in an atmosphere such that the moisture content of the specimens developed under the conditions prescribed in Section 7 is not noticeably altered during testing.

#### 6. Preparation of Test Panels

6.1 The standard substrate for this test is 1.6 mm ( $1/16$  in.) thick rotary-cut or sliced veneer of sweet birch (*Betula lenta*) or yellow birch (*Betula alleghaniensis*). Any other thickness or species of veneer may be substituted upon written agreement between the party requesting this test and the manufacturer of the adhesive. Select veneer that is free of defects such as knots or distorted grain around knots, cracks, short grain (fibers out of plane), rough surfaces, or unusual discoloration which would indicate decay. Do not sand the veneer.

6.2 Cut the selected veneer into a size suitable for pressing and for cutting specimens with minimal waste. Allow at least 13 mm ( $1/2$  in.) for trim around the edges.

NOTE 1—When cutting the veneer to size, ensure that the fiber direction is parallel and perpendicular to the edges. Appearance may be deceptive. If there is any question, check the fiber direction with a scratch awl.

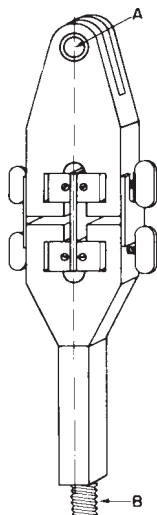


FIG. 1 Grips and Jaws

6.3 Condition the veneer to within  $\pm 1\%$  of the moisture content recommended by the adhesive manufacturer or the party requesting this test. In the absence of any guideline, condition the veneer to 10 to 12 % moisture content based on the oven dry weight. Check moisture content of recommended samples in accordance with Sections 124 to 127 of Test Methods D 143.

6.4 Prepare the adhesive in accordance with the adhesive manufacturer's instructions.

NOTE 2—If a species of lower strength is used and the specimens fail predominantly in tension at the saw kerfs, prepare and test a new set of specimens, either by using thicker veneers or by reducing the distance between the saw kerfs to 12.7 mm (0.5 in.) (see Fig. 2).

6.5 Apply the adhesive to each veneer in accordance with the adhesive manufacturer's instructions. Allow the prescribed open assembly time, if any, before reassembling the pieces.

6.6 Assemble the veneer into two-ply panels so that the grain in the two plies is parallel. Allow the prescribed closed assembly time, if any, before pressing. Press the assembly under the conditions prescribed by the adhesive manufacturer.

#### 7. Conditioning of Test Panels

7.1 Upon removal from pressure, condition the panels at a relative humidity of  $50 \pm 2\%$  and at a temperature of  $23 \pm 1^\circ\text{C}$  ( $73.4 \pm 2^\circ\text{F}$ ) either for a period of 7 days or until specimens reach equilibrium as indicated by no progressive change in weight, whichever is the longer period. The length of this period of conditioning may be extended beyond this limit by written agreement between the purchaser and the manufacturer of the adhesive.

#### 8. Test Specimens

8.1 Cut test specimens from the test panel as shown in Fig. 3. Exercise care in grooving the specimens to ensure that the saw cut extends to, but not beyond, the bondline. This can be accomplished by first cutting the individual test slips from the panels as shown in Fig. 2 and then grooving them individually to the proper width, depth, and location with a hollow-ground grooving saw or any other tool that will give equally satisfactory results. Alternatively, the panels can first be grooved to the proper width, depth, and location after which the individual test specimens can be cut from them. Measure the width of each specimen and the distance between grooves to the nearest 0.25 mm (0.010 in.) to determine the shear area.

8.2 Retain the specimens in the conditioning atmosphere described in Section 7 until tested, except during the cutting operations.

8.3 Select and test at least 30 specimens, representing at least three different panels.

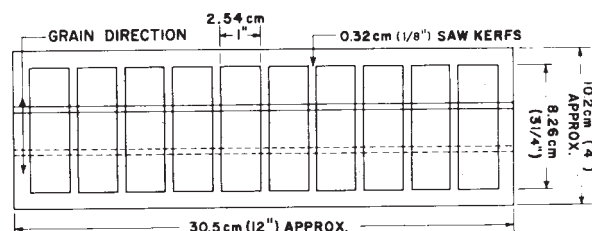


FIG. 2 Size of Test Panel and Method of Cutting Test Specimens

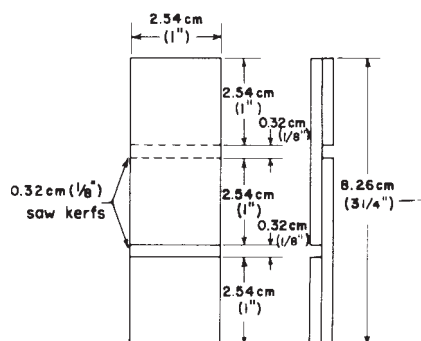


FIG. 3 Form and Dimensions of Test Specimen

## 9. Procedure

9.1 Place the test specimen in the jaws of the grips in the testing machine and grip tightly so that the specimen is perfectly aligned and parallel to the centerline of the jaws. If jaws such as those in Fig. 1 are used, then the specimen should be perfectly aligned with the pairs of jaws directly above each other and in such a position that an imaginary straight vertical line would pass through the glue line and through the points of suspension *A* and *B* as shown in Fig. 1. Place specimens in the jaws alternately so that in one case the upper notch is to the left and in the next case toward the right. Apply the load at a rate of 4535 to 7560 g/s (600 to 1000 lb/min), or select a crosshead speed that will yield this.

## 10. Calculation

10.1 Record the load at failure in kilograms (pounds), and calculate the shear stress at failure as Newtons per square meter (pounds per square inch), based on shear area calculated to the

nearest 0.06 mm<sup>2</sup> (0.01 in<sup>2</sup>). Estimate the percentage of wood failure to the nearest 5 % for each test specimen.

## 11. Report

11.1 Report the following information:

11.1.1 Complete identification of the adhesive tested, including type, source, manufacturer, code numbers, form, etc., and reporting of the wood species used as well as its moisture content when used.

11.1.2 Application and bonding conditions used in preparing the specimens,

11.1.3 Species and dimensions of specimens if other than prescribed in 6.1,

11.1.4 Conditioning procedure used for the specimens,

11.1.5 Temperature and relative humidity in the test room,

11.1.6 Number of specimens tested,

11.1.7 Number of panels represented,

11.1.8 Maximum and minimum loads at failure and percentages of wood failure. The standard deviation or all individual test values, or both, for the failing load values and wood failure values may be included in the report at the option of either the purchaser or the manufacturer of the adhesive, and

11.1.9 Average load at failure and the average percentage of wood failure.

## 12. Precision and Bias

12.1 A precision and bias statement does not exist for this test method because resources necessary for round-robin testing have not been forthcoming.

## 13. Keywords

13.1 adhesive; shear strength; tension loading; test method; wood; wood failure

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