Designation: D 5266 – 99

Standard Practice for Estimating the Percentage of Wood Failure in Adhesive Bonded Joints[1]

This standard is issued under the fixed designation D 5266; 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.

1. Scope

1.1 This practice provides procedures for estimating the percentage of wood failure that occurs in plywood-shear, block-shear, finger joint test specimens, or any other bondline involving wood.

1.2 The values stated in SI units are to be regarded as the standard. The values in parentheses are provided for information purposes 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 appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 905 Test Method for Strength Properties of Adhesive Bonds in Shear by Compression Loading[2]

D 906 Test Method for Strength Properties of Adhesives in Plywood Type Construction in Shear by Tension Loading[2]

D 2559 Specification for Adhesives for Structural Laminated Wood Products for Use Under Exterior (Wet Use) Exposure Conditions[2]

D 4688 Test Methods for Evaluating Structural Adhesives for Finger Jointing Lumber[2]

D 5572 Specification for Adhesives Used for Finger Joints in Nonstructural Lumber Products[2]

D 5751 Specification for Adhesives Used for Laminate Joints in Nonstructural Lumber Products[2]

2.2 *American National Standards:*

ANSI/HPMA HP American National Standard for Hardwood and Decorative Plywood[3]

ANSI/AITC A190.1 American National Standard for Wood Products—Structural Glued, Laminated Timber[4]

2.3 *Other Standards:*

American Plywood Association Proposed Standard Method for Estimating Percentage Wood Failure on Plywood Shear Specimens[5]

PS 1 U.S. Product Standard for Construction and Industrial Plywood[5]

Wood Handbook: Wood as an Engineering Material, Agricultural Handbook No. 72, Forest Service, Forest Products Laboratory (1987)[6]

Inspection Bureau Memorandum No. 1 Interpretation of Wood Failure[4]

2.4 *ASTM Adjunct:*

Photographs for Visually Estimating the Percentage of Wood Failure in Standard Adhesively Bonded Specimens[7]

3. Terminology

3.1 *Definitions:*

3.1.1 *deep wood failure*, *n*—failure that is invariably several to many cells away from the adhesive layer, in which the fracture path is strongly influenced by the grain angle and growth–ring structure.

3.1.2 *shallow wood failure*, *n*—failure that is invariably within the first one or two layers of cells beyond the adhesive layer in which the fracture path is not influenced by the wood–grain angle or growth-ring structure (see 7.7 and 8.1).

3.1.3 *wood failure*, *n*—the rupturing of wood fibers in strength tests on bonded specimens, usually expressed as the percentage of the total area involved which shows such failure.

4. Significance and Use

4.1 Wood failure is one of the principal means for determining the quality of an adhesively bonded wood joint.

[1] This practice is under the jurisdiction of ASTM Committee D-14 on Adhesives, and is the direct responsibility of Subcommittee D14.30 on Wood Adhesives.

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[2] *Annual Book of ASTM Standards*, Vol 15.06.

[3] Available from Hardwood Plywood Manufacturers' Association, 1825 Michael Faraday Drive, P.O. Box 2789, Reston, VA 22090-2789.

[4] Available from American Institute for Timber Construction, 11818 S. E. Mill Plain Blvd., Suite 415, Vancouver, WA 98684-5092.

[5] Available from American Plywood Association, P.O. Box 11700, Tacoma, WA 98411-0700.

[6] Available from Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402.

[7] Available from ASTM Headquarters. Order ADJD5266.

4.2 When evaluated after a water soaking, water soaking and drying, or boiling and drying, the percentage of wood failure is an important criterion for qualifying adhesives for use in plywood and glued laminated structural timber for exterior use, and for daily quality control of the processes for manufacturing plywood and glued, laminated timbers. Standards that use the percentage of wood failure are included in Section 2.

4.3 In plywood manufactured from North American softwood species, the percentage of wood failure of Test Method D 906 specimens, tested wet after either a vacuum-pressure soak-dry or boil-dry treatment, correlates with the percentage of panels that delaminate in outdoor exposure without protection.[8]

4.4 Similar correlations for other products have not been published.

5. Apparatus

5.1 Various light sources have been found useful in estimating wood failure. In determining compliance to standard specifications, the source must be agreed upon by the user of this practice and the individual or agency requiring these tests.

5.1.1 *Dual-Element Fluorescent Desk Lamp* equipped with one 15 W daylight and one 15 W cool white tube.

NOTE 1—This source is used by the American Plywood Association for compliance to the commercial standard PS 1.

5.1.2 *Circular Fluorescent Desk Lamp* with 5× viewing magnifier in the center of the lamp.

5.1.3 *Diffuse Natural Light* from a window facing away from the sun.

5.2 *Ruler*, with 2.54 mm (0.1-in.) divisions is recommended as an aid to estimating the area of torn wood fibers. A transparent template, the size of the specimen bond area and scribed with various shapes and areas with known percentages of the total area, is also useful for subdividing the area. An example of such a template is shown in Fig. 1.

5.3 *Low-Power Magnifying Glass*, of 3 to 5×, with a field of view able to encompass most of the failed surface, may be useful for inspecting areas where shallow wood failure is suspected.

6. Preparation of Test Specimens

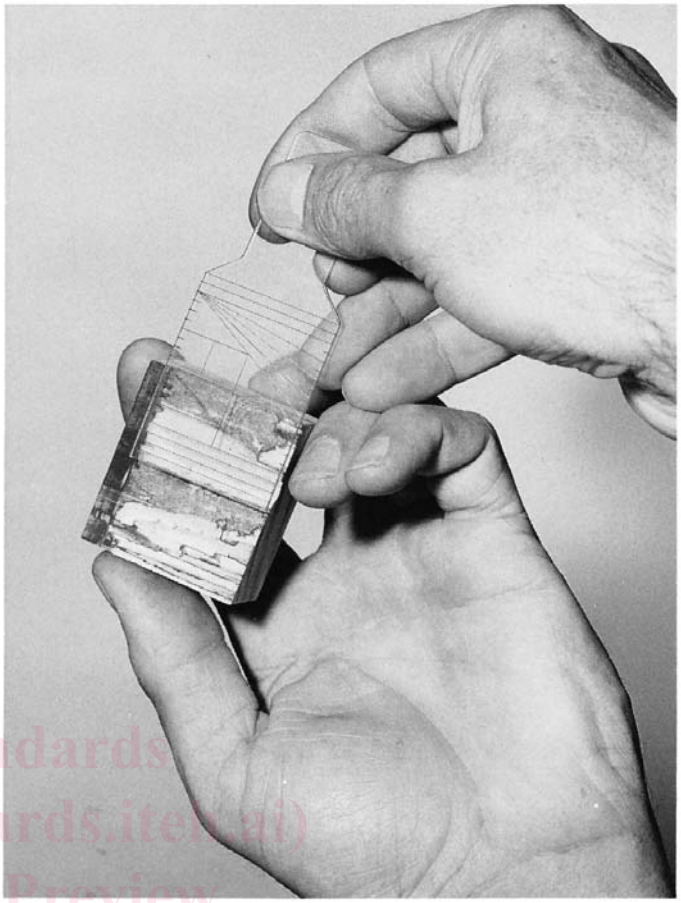
6.1 Prepare and test the specimens as outlined in the appropriate test method.

6.2 Do not estimate wood failure percentage of specimens with localized defects such as knots, knotholes, burl, and voids in the bond area, even if they are permitted within the grade of lumber or veneer being tested. Specimens with defects in the grip area may or may not be tested at the discretion of the user or in accordance with the policy of the testing organization.

6.3 Specimens with manufacturing defects, such as wiped bondline, chips, core gaps, and laps, may also be discarded by agreement between the interested parties.

6.4 If the specimens were tested wet, dry the failed surfaces in an air-circulating oven at 71°C (160°F), or under equivalent conditions, before estimating the percentage of wood failure.

[8] Perkins, N. S., *Predicting Exterior Plywood Performance, Proceedings Forest Products Research Society*, 1950, pp. 1–12.



NOTE 1—In this case, a standard D 905 shear block is shown.

FIG. 1 Example of Plastic Template Scribed with Lines and Shapes Representing Known Percentages of Given Area

7. Procedure

7.1 Work in a location where direct outside light does not fall on the specimen.

7.2 Select a light source described in 5.1, and use it consistently.

7.3 Open specimen halves as you would open a book.

7.4 Position the specimen below the light source as follows:

7.4.1 *Plywood*—Hold plywood specimens with the long dimension perpendicular to the line between the light source and the eye.

7.4.2 *Parallel Laminates*—Hold specimens with the grain direction perpendicular to the line between the light source and the eye. Tilt the specimen to reflect light from the light source to the eye.

7.4.3 *Finger joints*—Hold the specimen with the length of the fingers perpendicular to the line between the light source and the eye.

7.4.4 Refer to Fig. 2 for general positioning of the light source and the specimen grain direction in relation to the eye. In general, with the exception of plywood specimens, the grain direction is perpendicular to the line of sight between the light source and the eye.

7.5 Vary the tilt of the specimen, as shown in the side view in Fig. 2, so that areas of wood and adhesive failure can be