



Designation: D1101 – 97a (Reapproved 2013)

Standard Test Methods for Integrity of Adhesive Joints in Structural Laminated Wood Products for Exterior Use¹

This standard is issued under the fixed designation D1101; 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 integrity of adhesive joints for structural laminated wood members, such as laminated arches and beams, should be at least equal to that of the wood. Because initial strength tests generally are not an adequate measure of integrity of adhesive joints under severe service conditions, a test that simulates the effects of exterior exposure has been devised to evaluate adhesive joints in structural laminated wood members intended for this type of service.

1. Scope

1.1 These test methods cover an accelerated means of measuring the resistance to delamination of structural laminated wood members intended for exterior service.

1.2 These test methods are not intended as substitutes or replacements for the more severe test of resistance to delamination in Specification [D2559](#).

1.3 Two test methods are included. Choice of test method depends on purpose of the test and available time to complete.

1.3.1 *Test Method A*—This test requires 3 days to complete and is a method for determining the suitability of adhesives and manufacturing techniques and equipment for production of joints adequate for exterior service.

1.3.2 *Test Method B*—This test requires approximately 12½ h. (If excessive delamination occurs, the cycle is repeated). It is a quality-control type test for examining adhesive joint quality.

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

1.5 *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*:²

[D907 Terminology of Adhesives](#)

[D2559 Specification for Adhesives for Bonded Structural Wood Products for Use Under Exterior Exposure Conditions](#)

2.2 *Other Standards*:³

[ANSI A190.1–2012 American National Standard for Wood Products—Structural Glued Laminated Timber](#)

3. Terminology

3.1 *Definitions*—Many terms in these test methods are defined in Terminology [D907](#).

3.1.1 *glulam, n*—synonym for *structural-glued-laminated timber*.

3.1.2 *structural-glued-laminated timber, n*—an engineered stress-rated product of a timber laminating plant comprising assemblies of specially selected and prepared wood laminations securely bonded together with adhesives, with the following characteristics: (1) the grain of all laminations is approximately parallel longitudinally; and (2) the laminations may be comprised of pieces end-joined to form any length, of pieces placed or glued edge-to-edge to make wider ones or of pieces bent to curved form during gluing. (Synonym *glulam*) [ANSI A190.1-2012](#). American National Standard for Wood Products—Structural Laminated.

3.2 *Definitions of Terms Specific to This Standard*:

¹ These test methods are under the jurisdiction of ASTM Committee [D14](#) on Adhesives and are the direct responsibility of Subcommittee [D14.30](#) on Wood Adhesives.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.



3.2.1 *laminated wood, n*—the fabricated product resulting from the bonding of two or more laminations, with each lamination made from one or more pieces bonded either lengthwise, edgewise, or both, and all with the direction of the grain essentially parallel, to form a larger piece such as a structural member.

4. Significance and Use

4.1 The test is suitable for check testing properly selected samples from regular production or for determining the suitability of adhesives and bonding techniques for the production of joints for exterior service.

4.2 Vary the number of specimens taken from each member and the number of members selected for test depending on the total number of members involved and the purpose of the tests. It is advisable, however, to include at least three specimens in the test, with the specimens selected to represent the probable range of quality of the adhesive joints.

4.3 Adhesive joints at knots and knotty areas in general are not dependable under severe exposures. Disregard development of delamination at knots and do not include in the measurements or calculations.

5. Apparatus

5.1 *Autoclave*—An autoclave or similar pressure vessel designed to safely withstand pressures of at least 517 kPa (75 psi) is required for impregnating the specimens with water. Equip the pressure vessel with a vacuum pump or similar device capable of drawing a vacuum of at least 635 mm (25 in.) Hg (at sea level) in the vessel, and a pump or similar device for obtaining pressure of at least 517 kPa (75 psi) (gage pressure).

6. Test Specimens

6.1 Prepare or select the test specimens in such a manner that they are representative of the production run. When the test is employed to investigate new adhesives and procedures, ensure that enough specimens are available to cover fully the variables under study.

6.2 Take each test specimen from a full cross-section of the laminated member to be tested. Prepare by cutting perpendicular to the grain of the wood, 76 mm (3 in.) in length (along the grain). Cut the end-grain surfaces of the specimen with a sharp saw or other tool that produces a smooth surface.

6.3 Ensure that each test specimen is representative of all the bond lines but need not necessarily include all, and that each test specimen is at least 152 mm (6 in.) in depth, or the full depth of section if less than 152 mm (6 in.) deep.

6.4 Vary the number of specimens taken from each member and the number of members selected for test, depending on the total number of members involved and the purpose of the tests. It is advisable, however, to include at least three specimens in the test, with the specimens selected to represent the probable range of quality of the adhesive joints.

TEST METHOD A

7. Procedure

7.1 Place the test specimens in the autoclave or pressure vessel and weight them down. Admit water at a temperature of 18 to 27°C (65 to 80°F) in sufficient quantity so that the specimens are completely submerged. Separate the specimens by stickers, wire screens, or other means in such a manner that all end grain surfaces are freely exposed to the water. Draw a vacuum of 508 to 635 mm (20 to 25 in.) Hg (at sea level) and hold it for 5 min. Then release the vacuum and apply a pressure of 517 ± 34 kPa (75 ± 5 psi) for 1 h. With the specimens still completely immersed, repeat this vacuum pressure cycle making a two-cycle impregnating period requiring a total of 2½ h. Dry the specimens for a period of between 21 and 22 h at 64 to 67°C (147 to 153°F) and a relative humidity not greater than 15 %, in an oven capable of maintaining 45 to 50 air changes per minute when the oven is empty. During drying, place the specimens at least 50 mm (2 in.) apart with the end-grain surfaces parallel to the stream of air. Repeat the entire soaking-drying cycle twice to comprise a total test period of 3 days.

7.2 At the end of the final drying period, measure to the nearest 0.05 in. (1.3 mm) the total length of open adhesive joints (delamination on the end grain surface of the specimens). Do not regard failure in the wood due to checking or other causes as delamination (see [Note 1](#)). Ignore isolated delamination less than 2.5 mm (0.10 in.) long and more than 5.1 mm (0.20 in.) away from the nearest delamination.

NOTE 1—Delamination is a term used to express separation of the wood surfaces at the adhesive joints. When the separation is in the wood, even though very close to the adhesive joint, it is termed wood failure or checking. Magnification is often necessary to determine whether the failure is in the adhesive or in the wood. A feeler gage 0.08 to 0.10 mm (0.003 or 0.004 in.) in thickness is convenient for probing into the joint to determine if separation actually exists. A circular fluorescent desk lamp with 5× viewing magnifier in the center of the lamp has been found to work well and aid in these determinations.

TEST METHOD B

8. Procedure

8.1 Weigh and record to the nearest 1 g (0.002 lb) the weight of each test specimen. Place the test specimens in the autoclave or pressure vessel and weight them down. Admit water, at a temperature of 18 to 29°C (65 to 85°F) in sufficient quantity so that the specimens are completely submerged. Separate the test specimens by stickers, wire screens, or other means in such a manner that all end-grain surfaces are freely exposed to the water. Draw a vacuum of 508 to 635 mm (20 to 25 in.) Hg (at sea level) and hold it for 30 min. Then release the vacuum and apply a pressure of 517 ± 34 kPa (75 ± 5 psi) for 2 h. Dry the specimens for a period of approximately 10 h at 71°C (160°F) in an oven capable of maintaining 45 to 50 air changes per minute when the oven is empty (see [Note 2](#)). During drying, place the test specimens at least 50 mm (2 in.) apart with the end grain surfaces parallel to the stream of air.



NOTE 2—The relationship between the air temperature and the wet bulb reading yields an approximate relative humidity of 8 to 10 % and corresponds to a wet bulb depression of 70°F or 39°C.

8.2 The actual time in the drying oven is controlled by the weight of the test specimens. When their weight has returned to within 15 % of the original test specimen weight prior to the beginning of the test, delamination is then observed and recorded.

8.3 Measure to the nearest 1.3 mm (0.05 in.) the total length of open adhesive joints (delamination) on the end-grain surfaces of the specimens. Do not regard failure in the wood due to checking or other causes as delamination (see **Note 1**). Ignore isolated delamination less than 2.5 mm (0.10 in.) long and more than 5.1 mm (0.20 in.) away from the nearest delamination.

8.4 If the delamination observed at this point exceeds 5 %, the entire cycle is repeated once and the delamination observed and recorded at the end of the second cycle.

9. Calculation and Report

9.1 Express the total length of open adhesive joints on the two end-grain surfaces of each specimen as a percentage of the entire length of the adhesive joints exposed on these surfaces (except omit bond lines at knots and knotty areas). Report this value as the percentage delamination of the specimen.

10. Precision and Bias

10.1 No precision and bias exist for these test methods, as the necessary resources have not been forthcoming.

11. Keywords

11.1 exterior use; glulam; laminated wood; structural-glued-laminated timber; structural laminated wood

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