



Designation: D3498 – 03 (Reapproved 2011)

# Standard Specification for Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems<sup>1</sup>

This standard is issued under the fixed designation D3498; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This specification covers minimum performance standards and test requirements for gap-filling construction adhesives for bonding plywood to lumber framing, particularly floor joists, at the construction site.

1.2 This specification provides a basis for ensuring the quality of the adhesives and is not intended as an application specification.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 The following precautionary caveat pertains only to the test method portion, Section 11, of this specification: *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*:<sup>2</sup>

D572 Test Method for Rubber—Deterioration by Heat and Oxygen

D905 Test Method for Strength Properties of Adhesive Bonds in Shear by Compression Loading

D907 Terminology of Adhesives

D2016 Methods of Test for Moisture Content of Wood (Withdrawn 1987)<sup>3</sup>

D4300 Test Methods for Ability of Adhesive Films to

Support or Resist the Growth of Fungi

D4783 Test Methods for Resistance of Adhesive Preparations in Container to Attack by Bacteria, Yeast, and Fungi

E4 Practices for Force Verification of Testing Machines

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

## 3. Terminology

3.1 *Definitions*:

3.1.1 Many terms in this specification are defined in Terminology D907.

3.1.2 *gap-filling adhesive, n*—an adhesive capable of forming and maintaining a bond between surfaces that are not close-fitting.

3.1.2.1 *Discussion*—Close-fitting is relative to a given material and industry; for example, standards in construction differ from standards in electronics. Some adhesives will bond by bridging without completely filling the gap; others by filling the gap completely.

3.1.3 *open assembly time, n*—the time interval between applying adhesive on the substrates and closing them together before bonding.

## 4. Significance and Use

4.1 This specification establishes test methods and performance requirements for adhesives bonding plywood to wood framing members.

4.2 This specification provides a basis for ensuring the quality of the adhesives.

4.3 The tests provide shear strength performance data when the substrates are conditioned to simulate various conditions that may occur during sub-floor adhesive application and curing.

4.4 The tests are suitable for product performance certification and quality control programs, and can be useful to the general public, adhesive manufacturers, distributors, specifiers, architects, contractors, testing laboratories and other businesses and professionals.

4.5 The results do not include all possible conditions, which may occur during final assembly, but indicate a set of performance characteristics for laboratory controlled bonding variables.

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee D14 on Adhesives and is the direct responsibility of Subcommittee D14.70 on Construction 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.

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

## 5. Ordering Information

5.1 The adhesive may be furnished by the manufacturer in any suitable form agreeable to the purchaser.

## 6. Materials

6.1 The adhesive shall be a gap-filling construction adhesive that sets at temperatures as low as 40°F (4.4°C).

6.2 The adhesive shall not support mold or bacterial growth. If amylaceous or protein fillers and extenders are used in the adhesive formulation, the adhesive must not only pass the performance requirements of this specification, but in addition, possess sufficient anti-fungal properties to inhibit the growth of selected fungal species when tested in accordance with Test Methods **D4300** and selected bacterial species in accordance with Test Methods **D4783**. The adhesive manufacturer shall notify in writing the agency responsible for testing, certifying, and compliance labeling of the adhesive whether any such materials are present in the adhesive.

6.3 The adhesive, when completely set, shall form a resilient bond that shall be durable when protected from direct exposure to the weather, as defined by the requirements of this specification.

6.4 The adhesive shall be a uniform mixture suitable for extrusion by a caulking gun or other pressurized application equipment.

6.5 The adhesive shall permit an open assembly time of not less than 10 min when applied to the lumber framing in accordance with the manufacturer's instructions. It shall be functional, as defined in this specification, when applied to surfaces having a temperature range from 0 to 100°F (–17.8 to 37.8°C).

NOTE 1—Open assembly times that are less than 10 min as agreed upon between the manufacturer and user, are acceptable provided the adhesive meets the requirements of **Table 1**.

6.6 The adhesive shall be functional when applied to lumber framing free of standing water, ice, or snow.

## 7. Requirements

7.1 The adhesive shall conform to the strength and durability properties shown in **Table 1**.

## 8. Sampling

8.1 A representative sample totaling not less than 1 qt (946 cm<sup>3</sup>) of the adhesive shall be taken from each lot to be tested.

8.2 For the purpose of sampling, a lot shall consist of material from the same batch or blending operation subject to the same processing operations and conditions.

## 9. Number of Tests

9.1 The number of test specimens shall be as specified in each test method designated in Section **11** and **Table 1**. The average result for the specimens tested shall conform to the requirements prescribed in this specification.

## 10. Specimen Preparation

10.1 *Materials*—Use the following materials for the tests outlined:

10.1.1 *Plywood*— $\frac{5}{8}$ -in. or ( $\frac{19}{32}$ -in. (15.1-mm) thick, U.S. Product Standard PS-1–95 grade marked stamped, commercial plywood, Group 1 Species, exterior glue, or sanded exterior-grade plywood, underlayment type with A grade face ply for the adhesion surface. The plywood must be flat within  $\frac{1}{16}$  in. (2 mm); that is, the maximum permissible bow for a 16-in. (406-mm) length of plywood shall be  $\frac{1}{16}$  in. (2 mm). Make the measurement across the top surface of the plywood. Use bowed plywood only if it meets the limitation above and if the convexity occurs on the bottom surface that will contact the lumber. The plywood must be free of patches, core voids, and knot holes in the glue line area.

10.1.2 *Lumber*—2-in. (51-mm) (nominal) Douglas-fir and southern pine; (**Note 2**) clear dry lumber (moisture content of 8 to 15 %) (**Note 3**). The surface shall be free of bark, knots, splits, and pitch.

NOTE 2—Only the sapwood of loblolly, slash, longleaf, and shortleaf pine may be used.

NOTE 3—Test Methods **D2016** can be used to determine moisture content.

10.1.3 *Adhesive*—applied with a caulking gun.

10.2 *Number of Test Assemblies*—Prepare three wood-adhesive composite test assemblies as shown in **Fig. 1** for each condition specified.

**TABLE 1 Adhesive Strength and Durability Requirements**

Test	Property	Number of Specimens	Requirement	Section Reference
Test A (wet lumber)				
Douglas-fir	shear strength	24	150 psi (1.035 MPa), min avg	<b>11.2</b>
Southern pine	shear strength	24	150 psi (1.035 MPa), min avg	<b>11.2</b>
Test B (frozen lumber)				
Douglas-fir	shear strength	24	100 psi (0.689 MPa), min avg	<b>11.2</b>
Southern pine	shear strength	24	100 psi (0.689 MPa), min avg	<b>11.2</b>
Test C (dry lumber)				
Douglas-fir	shear strength	24	150 psi (1.035 MPa), min avg	<b>11.2</b>
GAP-filling				
Douglas-fir	shear strength	24	100 psi (0.689 MPa), min avg	<b>11.3</b>
Durability (moisture resistance)				
Douglas-fir	delamination	24	a minimum of 22 of 24 specimens shall show no delamination.	<b>11.4</b>
	shear strength	24	150 psi (1.035 MPa), min avg	<b>11.4</b>
Durability (oxidation resistance)	flexibility	3	no fracture of free film on mandrel bend or visible signs of melting after exposure	<b>11.5</b>

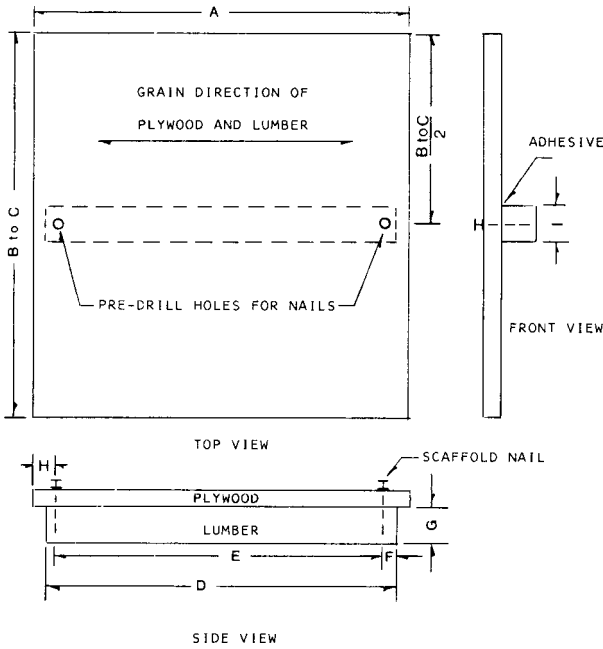


Table of Dimensions

	in.		mm	
	Dimension	Tolerance	Dimension	Tolerance
A	15¾	⅛	400	3
B	5½	...	140	...
C	16	...	406	...
D	15	⅛	381	3
E	13	⅛	330	3
F	1	⅛	25	3
G	1½ min	⅛	38 min	2
H	1¾	⅛	33	2
I	1½ max	⅛	38 max	2

FIG. 1 Test Assembly

10.3 Conditioning of Materials:

10.3.1 Cut lumber and plywood to the required size as shown in Fig. 1. If the lumber must be reduced in height, retain at least one mill-finished surface as the surface to be bonded. If

the lumber must be reduced in width to achieve a maximum 1½-in. (38-mm) dimension, plane both sides in equal amounts.

10.3.2 Pre-drill the plywood and lumber with a No. 37 (diameter 0.104 in. (2.64 mm)) to receive nails as shown in Fig. 1. Pre-drill the lumber to a depth of 1 in. (25 mm).

10.3.3 Condition the adhesive at 70 ± 5°F (21.1 ± 2.8°C) for a period of 48 h prior to use.

10.3.4 Condition the lumber and plywood in accordance with the schedules shown in Table 2, and the following procedures:

10.3.4.1 Run Test A (wet lumber) and Test B (frozen lumber) with both Douglas-fir and southern pine lumber.

10.3.4.2 Before fabricating samples with wet lumber surfaces (Test A), seal both ends of the lumber sections with paraffin. Completely submerge the lumber in water at 70 ± 5°F (21.1 ± 2.8°C) for 48 h for Douglas-fir, and for 2 h for southern pine. After submersion, wipe off visible surface water and expose the lumber for 48 h at 100 ± 5°F (37.8 ± 2.8°C), and 90 ± 5 % relative humidity. At the completion of the humidity cycle, submerge the lumber in water at 70 ± 5°F (21.1 ± 2.8°C) for 15 min. Wipe off visible surface water with a clean, dry cloth and immediately begin the fabrication procedure as outlined in 10.4.1.

10.3.4.3 Seal lumber for test assemblies with frozen lumber surfaces (Test B) at both ends with paraffin and submerge in water as described in Table 2. After submersion, wipe off visible surface water with a clean, dry cloth and store immediately at 0 ± 5°F (-17.8 ± 2.8°C) for 48 h.

NOTE 4—For safety, conditioning chambers should have no ignition sources within the vapor space.

10.4 Preparation of Shear Strength Specimens:

10.4.1 Apply an adhesive bead along the center line of a mill-finished surface of the lumber, such that the bead extends from one predrilled hole to the other, but not beyond. Apply sufficient adhesive to give 100 % coverage of the lumber surface, as evidenced by a “squeeze-out.” If it is necessary to apply the adhesive outside of the lumber conditioning chamber, remove only one piece of lumber at a time, apply the adhesive

TABLE 2 Conditioning of Materials before Fabrication of Test Assemblies

Test	Lumber		Plywood
	Douglas-fir	Southern Pine	
Test A (wet lumber)	48 h soak in water at 70 ± 5°F (21.1 ± 2.8°C), then	2 h soak in water at 70 ± 5°F (21.1 ± 2.8°C), then	48 h at 100 ± 5°F (37.8 ± 2.8°C) and 90 ± 5 % RH
	48 h at 100 ± 5°F (37.8 ± 2.8°C) and 90 ± 5 % RH, then	48 h at 100 ± 5°F (37.8 ± 2.8°C) and 90 ± 5 % RH, then	
	15-min soak in water at 70 ± 5°F (21.1 ± 2.8°C)	15 min soak in water at 70 ± 5°F (21.1 ± 2.8°C)	
Test B (frozen lumber)	48 h soak in water at 70 ± 5°F (21.1 ± 2.8°C), then	2 h soak in water at 70 ± 5°F (21.1 ± 2.8°C), then	48 h at 0 ± 5°F (-17.8 ± 2.8°C), with RH uncontrolled
	48 h at 0 ± 5°F (-17.8 ± 2.8°C), with RH uncontrolled	48 h at 0 ± 5°F (-17.8 ± 2.8°C), with RH uncontrolled	
Test C (dry lumber)	48 h at 100 ± 5°F (37.8 ± 2.8°C) and RH max of 40 %	...	same as lumber
Gap-filling	48 h at 70 ± 5°F (21.1 ± 2.8°C) and 50 ± 10 % RH	...	same as lumber
Durability (moisture resistance)	48 h at 70 ± 5°F (21.1 ± 2.8°C) and 50 ± 10 % RH	...	same as lumber