



Designation: D3498 – 19

# Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing<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 wood structural panels consisting of plywood or oriented strand board (OSB) to wood based floor system framing, particularly dimension lumber or wood I-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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

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

<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, 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.

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

D4300 Test Methods for Ability of Adhesive Films to Support or Resist the Growth of Fungi

D4442 Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials

D4444 Test Method for Laboratory Standardization and Calibration of Hand-Held Moisture Meters

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

### 2.2 Voluntary Product Standards:<sup>3</sup>

PS1 Structural Plywood

PS2 Performance Standard for Wood-Based Structural-Use Panels

## 3. Terminology

### 3.1 Definitions:

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

3.1.2 *gap class, n*—a classification used to indicate whether a product has been qualified using a 1/8 in. (1.59 mm) gap condition.

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

3.1.3.1 *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.

<sup>3</sup> Available from National Institute of Standards and Technology (NIST), 100 Bureau Dr., Stop 1070, Gaithersburg, MD 20899-1070, http://www.nist.gov.

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

3.1.5 *oriented strand board (OSB), n*—a mat formed panel product with oriented layers resulting in directional properties.

3.1.6 *panel type, n*—a classification used to indicate whether a product has been qualified using OSB and/or plywood panels.

3.1.7 *plywood, n*—a conventional all-veneer panel with alternate layers of veneer which are orientated perpendicular to each other.

3.1.8 *wood-I joist, n*—a structural member manufactured using sawn or structural composite lumber flanges and structural panel webs, bonded together with exterior exposure adhesives, forming an “I” cross-sectional shape.

**4. Significance and Use**

4.1 This specification establishes test methods and performance requirements for adhesives bonding plywood or OSB 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.

4.6 Successful testing compliance with plywood or OSB does not qualify the same adhesive formulation with the other.

**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.

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). Open assembly times less than 10 min, may be used if agreed upon between the manufacturer and user, 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.

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

## 7. Requirements

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

7.2 Performance of the adhesive for bonding plywood and OSB shall be evaluated separately.

7.3 Adhesive bonding performance with both plywood and OSB shall meet the requirements specified in this standard prior to certification in accordance with **Section 14**.

## 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 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 area.

10.1.2 *Oriented Strand Board (OSB)*— $\frac{5}{8}$  in. or  $\frac{19}{32}$  in. (15.1 mm) thick, U.S. Product Standard PS-2-grade marked stamped. The OSB must be flat within  $\frac{1}{16}$  in. (2 mm); that is, the maximum permissible bow for a 16 in. (406 mm) length of OSB shall be  $\frac{1}{16}$  in. (2 mm). Make the measurement across the top surface of the OSB. Use bowed OSB only if it meets the limitation above and if the convexity occurs on the bottom surface that will contact the lumber. The OSB must be free of any defect that could interfere with bonding to lumber substrate. Unless the OSB's grade stamp requires otherwise, the panel surface with the grade stamp shall be used for adhesion. No further surface modification or preparation is permitted.

10.1.3 *Lumber*—2 in. (51 mm) (nominal) Douglas-fir and southern pine; (**Note 1**) clear dry lumber (moisture content of 8 to 15 %) (**Note 2**). The surface shall be free of bark, knots, splits, and pitch.

**NOTE 1**—Only the sapwood of loblolly, slash, longleaf, and shortleaf pine may be used.

**NOTE 2**—Test Method **D4442** shall be used to determine moisture content.

10.1.4 *Adhesive*—applied as per the quantity and method recommended by the adhesive manufacturer to ensure full coverage of a  $\frac{1}{2}$  in. wide lumber surface. The dispensed bead diameter used for test specimen preparation shall be stated in the manufacturer's application instructions as the minimum application for  $\frac{1}{2}$  in. wide floor system framing. See the product marking requirement in **15.2.5**.

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

### 10.3 Conditioning of Materials:

10.3.1 Cut lumber and plywood or OSB 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  $\frac{1}{2}$  in. (38 mm) dimension, plane both sides in equal amounts.

10.3.2 Predrill the plywood or OSB and lumber with a No. 37 (diameter 0.104 in. (2.64 mm)) to receive nails as shown in **Fig. 1**. Predrill the lumber to a depth of 1 in. (25 mm).

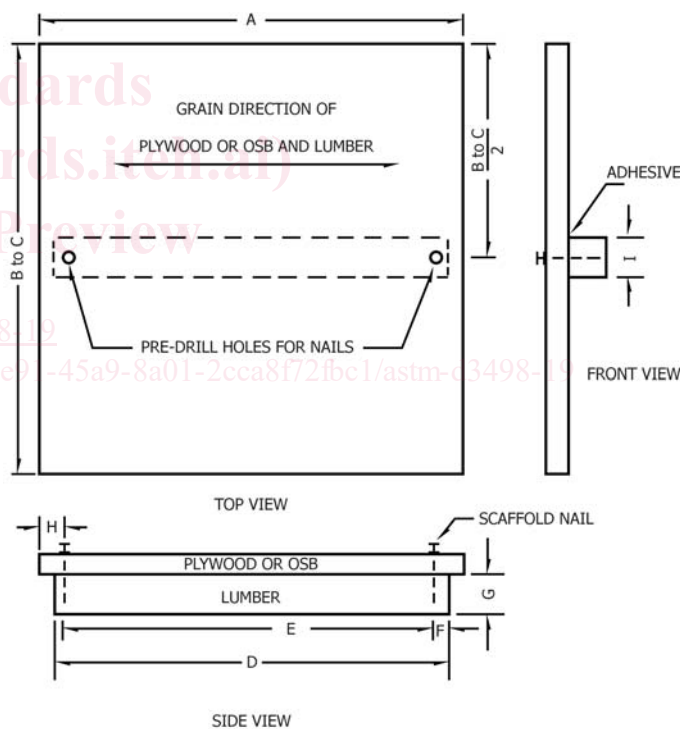


Table of Dimensions

Dimension	in.		mm	
	Dimension	Tolerance	Dimension	Tolerance
A	15 $\frac{3}{4}$	$\frac{1}{8}$	400	3
B	5 $\frac{1}{2}$	...	140	...
C	16	...	406	...
D	15	$\frac{1}{8}$	381	3
E	13	$\frac{1}{8}$	330	3
F	1	$\frac{1}{8}$	25	3
G	1 $\frac{1}{2}$ min	$\frac{1}{16}$	38 min	2
H	1 $\frac{3}{8}$	$\frac{1}{16}$	33	2
I	1 $\frac{1}{2}$ max	$\frac{1}{16}$	38 max	2

**FIG. 1** Test Assembly

TABLE 2 Conditioning of Materials before Fabrication of Test Assemblies

Test	Lumber		Plywood or OSB
	Douglas-fir	Southern Pine	
Test A (wet lumber)	48 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, then 15 min soak in water at 70 ± 5°F (21.1 ± 2.8°C)	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, then 15 min soak in water at 70 ± 5°F (21.1 ± 2.8°C)	48 h at 100 ± 5°F (37.8 ± 2.8°C) and 90 ± 5 % RH
Test B (frozen lumber)	48 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	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
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

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 or OSB 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 3—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 bead as quickly as possible and return the lumber to the conditioning chamber within a 2 min time period, then condition the lumber with adhesive applied for a minimum of 10 min and a maximum of 12 min in accordance with Table 3.

TABLE 3 Open Assembly Time Conditions

Test	Temperature	Humidity
Test A (wet lumber)	70 ± 5°F (21.1 ± 2.8°C)	50 ± 10 % RH
Test B (frozen lumber)	0 ± 5°F (–17.8 ± 2.8°C)	RH uncontrolled
Test C (dry lumber)	100 ± 5°F (37.8 ± 2.8°C)	40 % RH max
Gap-filling	70 ± 5°F (21.1 ± 2.8°C)	50 ± 10 % RH
Durability (moisture resistance)	70 ± 5°F (21.1 ± 2.8°C)	50 ± 10 % RH

10.4.2 Remove lumber and panels from the conditioning chamber one piece at a time to complete the assembly, complete the pressure application and then place the finished assemblies in the setting chamber in less than 3 min. Before placing the plywood or OSB on the adhesive-covered surface, insert spacers, ¼ in. wide by 0.006 in. thick by 4 in. long (6 by 0.15 by 102 mm), at the midpoint of the lumber and at the outboard side of each nail, as shown in Fig. 2. Before the spacer is inserted at the midpoint, scrape away a 1 in. (25 mm) segment of the adhesive bead at the midpoint. Do not permit adhesive between the spacer and substrate.

NOTE 4—Aluminum embossing tape is suggested for use as spacers.

10.4.3 Position the plywood or OSB on the adhesive-covered surface with the aid of a positioning jig as shown in Fig. 3. Nail in place with 6-penny (2 in. (51 mm) in length) scaffold nails. Make the top of the lower head of a scaffold nail flush with the surface of the plywood or OSB.

10.4.4 Apply a uniform pressure of 4 ± 0.25 psi (28 ± 2 kPa) across the entire bonded area of the assembly for a period of 1 min at 70 ± 5°F (21.1 ± 2.8°C). Apply this pressure by any appropriate means, including a press with a suitable insert between the nails or a combination of uniformly distributed weights between the nails.

10.4.5 Set the adhesive in the assemblies in accordance with the schedules shown in Table 4.

10.4.6 After the specified setting time, remove the nails, but leave the spacers in place. Using a sharp saw, cut off the plywood or OSB flush with the side surfaces of the lumber, at