Designation: D5868 – 01 (Reapproved 2023)

Standard Test Method for Lap Shear Adhesion for Fiber Reinforced Plastic (FRP) Bonding[1]

This standard is issued under the fixed designation D5868; 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 test method describes a lap shear test for use in measuring the bonding characteristics of adhesives for joining fiber reinforced plastics to themselves and to metals. The method is applicable to random and fiber oriented FRP.

1.2 This test method is intended to complement Test Method D1002 and extend the application to single-lap shear adhesive joints of fiber-reinforced plastic (FRP) adherends. This test method is useful for generating comparative apparent shear strength data for joints made from a number of FRP materials, providing a means by which FRP surface treatments may be compared.

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 *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:*[2]

D907 Terminology of Adhesives

D1002 Test Method for Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading (Metal-to-Metal)

D2093 Practice for Preparation of Surfaces of Plastics Prior to Adhesive Bonding

D3163 Test Method for Determining Strength of Adhesively Bonded Rigid Plastic Lap-Shear Joints in Shear by Tension Loading

D4896 Guide for Use of Adhesive-Bonded Single Lap-Joint Specimen Test Results

D5573 Practice for Classifying Failure Modes in Fiber-Reinforced-Plastic (FRP) Joints

E4 Practices for Force Calibration and Verification of Testing Machines

2.2 *SAE Standard:*

SAE J1525 Lap Shear Test for Automotive-Type Adhesives for Fiber Reinforced Plastic (FRP) Bonding[3]

3. Terminology

3.1 Adhesive terminology for this test method is covered in Terminology D907.

4. Summary of Test Method

4.1 This test method describes a procedure for the testing of lap shear bond strengths, using composite materials not recommended in Test Method D3163 such as FRP.

5. Significance and Use

5.1 Due to the increased use of adhesively-bonded FRP as a result of the inherent advantages afforded by bonded rather than mechanically-fastened joints (particularly the alleviation of stress risers and stress cracking), there is a need for tests by which joints of various FRP substrates and adhesives may be compared. This test method is intended to meet such a need.

5.2 Additional information on significance and use may be found in Guide D4896.

6. Interference

6.1 Apparent shear strength may be affected by substrate properties, such as moisture absorption and strength.

[1] This test method is under the jurisdiction of ASTM Committee D14 on Adhesives and is the direct responsibility of Subcommittee D14.40 on Adhesives for Plastics.

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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 Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, http://www.sae.org.

7. Apparatus

7.1 *Testing Machine,* conforming to the requirements and having the capabilities of the machine in Practices E4 with self-aligning grips capable of securely grasping the specimen throughout the test without allowing the specimen to slip.

8. Procedure

8.1 *Test Substrate:*

8.1.1 *Substrates*—Fiber reinforced plastic (FRP) as specified, with metal composition (heat treat, temper, and condition) and roughness as specified when bonding FRP to metal.

8.1.2 *Dimensions*—Cut fiber-reinforced plastic parts into flat coupons 1 in. by 4 in. (25.4 mm by 100 mm) at a nominal thickness of 0.1 in. (2.5 mm). In the case of FRP-to-metal bonding, use metal with a nominal thickness of 0.06 in. (1.5 mm). It is recommended that a diamond tip water-cooled saw blade be used, or a cutting method capable of producing sharp cut edges.

8.2 *Surface Preparations:*

8.2.1 Prepare the surface of the FRP in accordance with Practice D2093, or as recommended by the adhesive manufacturer. Surface roughening, solvent cleaning, and surface primers are acceptable, provided they do not reduce the FRP bulk properties. Use surface preparation adaptable to actual production conditions.

8.2.2 Prepare the surfaces of metals to eliminate burrs or bevels. Clean and dry them or surface treat them prior to bonding by using procedures prescribed by the adhesive manufacturer.

8.3 *Preparation of Test Joints:*

8.3.1 *Applications of Adhesive*—Apply the adhesive in accordance with the adhesive supplier's recommendations or as documented in the test report. In the case of two-part adhesives, mix in accordance with the supplier's suggested procedures.

8.3.2 *Adhesive Cure*—Cure the adhesive at room temperature or elevated temperature using prescribed conditions determined by the adhesive supplier.

8.3.3 *Joint Geometry*—Control joint geometry by appropriate fixturing, using glass beads or other suitable means to control a 0.03-in. (0.76-mm) adhesive bondline thickness. Use the minimum number of glass beads in the glueline needed to hold bondline thickness. Fixturing pressure is allowed. Lap shear overlap will be 1 in. by 1 in. (25.4 mm by 25.4 mm). (See Fig. 1.)

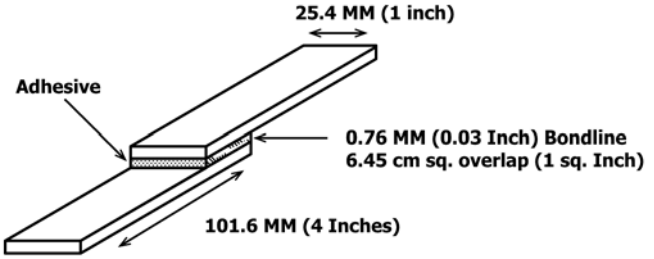

FIG. 1 Lap Shear Overlay

8.3.4 *Conditioning*—Allow bonded parts to cool to room temperature for at least 1 h if elevated temperature cures are employed. If the adhesive is room-temperature cured, allow full-cure time plus 10 % prior to testing.

8.4 *Testing:*

8.4.1 Initial grip separation is 3 in. (75 mm) with 1 in. (25.4 mm) minimum of each sample end held in the test grips.

8.4.2 The specimen loading rate is 0.5 in. (13 mm)/min. Note that a loading rate of 0.5 is an important difference compared to other ASTM standards.

8.4.3 Prepare a minimum of five lap shear samples in each case and test.

9. Report

9.1 Report the following information:

9.1.1 Complete identification of the adhesive tested, including type and manufacturer's code number.

9.1.2 Complete identification of the substrates used (including type of resin and fiber orientation) and method of surface preparation prior to bonding.

9.1.3 Cure schedule time and temperature for bonding sample, as well as any other conditions, such as sample conditioning, environmental exposures, etc.

9.1.4 Individual peak load values, psi (kPa) and averages by maximum and minimum values.

9.1.5 Test temperature and conditions.

9.1.6 Type of failure (such as fiber tear, cohesive, adhesive) should be reported, in accordance with Practice D5573.

10. Precision and Bias

10.1 No information is presented about either the precision or bias of this test method because resources necessary for testing have not been forthcoming. It is intended that data will be produced by October 2002.

11. Keywords

11.1 composite; FRP; lap shear