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Designation: D 4501 – 01$^{\epsilon 1}$

Standard Test Method for Shear Strength of Adhesive Bonds Between Rigid Substrates by the Block-Shear Method[1]

This standard is issued under the fixed designation D 4501; 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.

ϵ^1 NOTE—Adjunct references were corrected editorially in April 2006.

1. Scope

1.1 This test method describes a procedure and fixture used to determine shear strengths of adhesives used to bond materials with moduli higher than the modulus of the adhesive. The size and shape of the specimens are variable within the physical restraints of the fixture.

1.2 The values stated in SI units are to be regarded as the standard.

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:* [2]

D 907 Terminology of Adhesives

E 4 Practices for Force Verification of Testing Machines

2.2 *ASTM Adjuncts:*

Shearing Fixture Drawings[3]

3. Terminology

3.1 Many terms used in this test method are defined in Terminology D 907.

4. Summary of Test Method

4.1 In this test method, blocks, plates, or disks are bonded together, and the maximum force to shear them apart is determined.

5. Significance and Use

5.1 This test method provides an estimate of the shear strength of an adhesive on various machinable and nonmachinable substrate materials. It is particularly applicable for testing bonds between ceramic, glass, magnet moldings, and plastic parts with one flat face where machining would be difficult or impractical.

6. Apparatus

6.1 *Testing Machine*, conforming to the requirements of Practices E 4, with a capacity of not less than 44 kN (10 000 lbf) in tension.

6.2 *Shearing Fixture*— Perform the tests by using a shearing fixture consisting of a holding block and a shearing tool (Figs. 1 and 2). The holding block can accommodate specimens up to 80 by 80 by 13 mm (3 by 3 by ½ in.). For small specimens as shown in Fig. 3B, an adapter plate (Fig. 4) can be inserted into the holding block to keep the shearing blade within its guides and to locate the specimen under the clamp. The shearing blade can accommodate specimens up to 30 by 30 by 13 mm (1⅛ by 1⅛ by ½ in.).[3]

7. Test Specimens

7.1 Test specimens can be any size within the limits of the shearing fixture capacity, as given in 6.2. Suggested sizes are as follows:

7.1.1 *Metal Blocks*—25 by 25 by 6 mm (1 by 1 by ¼ in.).

7.1.2 *Ferrite or Ceramic Blocks*—25 by 18 by 13 mm (1 by ¾ by ½ in.).

7.1.3 *Wood or Plastic Blocks*—25 by 25 by 13 mm (1 by 1 by ½ in.).

7.1.4 *Glass Plates*—75 by 75 by 13 mm (3 by 3 by ½ in.).

7.2 Prepare the adhesive and apply in accordance with the recommendations of the adhesive manufacturer. Assemble the adhesive-coated specimens, and bond them in accordance with the procedure under investigation.

NOTE 1—Assemble the thrust surfaces, where the straight-sided specimen contacts the fixture, so that they are parallel to the fixture within

[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] Detailed drawings of the fixture are available from ASTM International Headquarters. Order Adjunct No. ADJD4501. Original adjunct produced in 1985.

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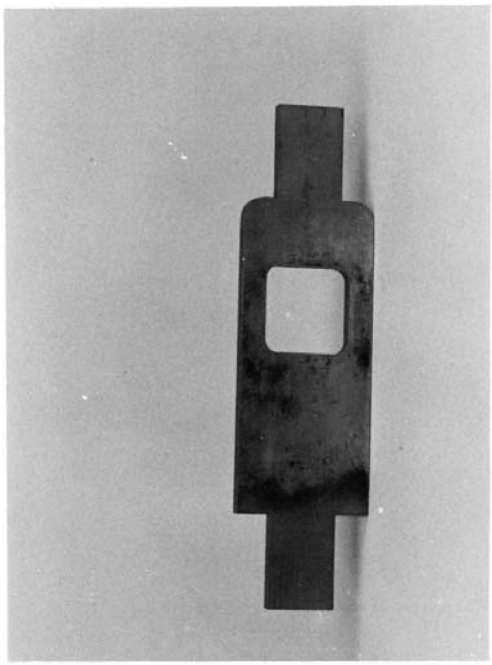

FIG. 1 Shearing Tool

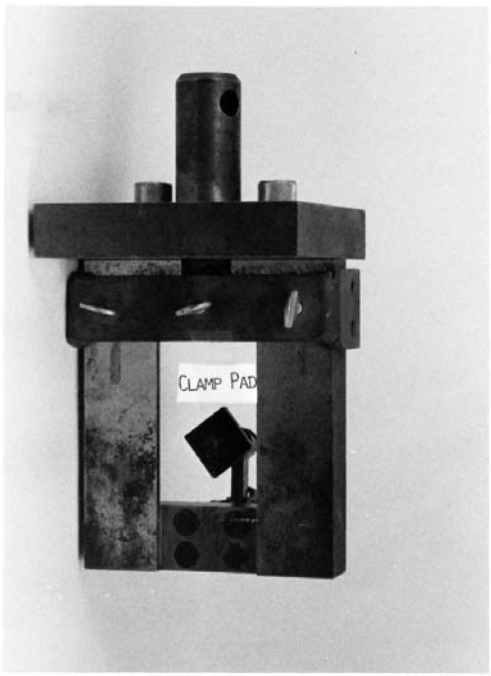

FIG. 2 Holding Block

0.005 in./in. (0.005 mm/mm). Center round or shaped specimens within the shear blade in such a way that a moment is not applied to the specimen during shearing.

7.3 Remove any flash or fillets on the loaded side prior to testing. Fig. 3 shows typical specimens after bonding.

7.4 Test at least five specimens for each test condition.

8. Procedure

8.1 Mount the shear fixture in the testing machine with the holding block on top.

8.2 Place the specimen in the shearing fixture in such a way that one of the adherends is engaged by the holding block and the other by the shearing tool (Fig. 5). Close the toggle clamp on the rear of the holding block to keep the specimen located against the back face (Fig. 6). (Some adjustment of the pad may be necessary to accommodate varying specimen thickness.)

8.3 Test the specimen using a crosshead speed of 1.26 mm/min (0.05 in./min). Record the maximum force sustained by the specimen.

9. Calculation

9.1 Express all bond strengths in megapascal (MPa) or pound-force per square inch (psi).

10. Report

10.1 Report the following information:

10.1.1 Complete identification of the adhesive tested, including type, source, and manufacturer's code numbers.

10.1.2 Complete identification of the adherends used, including dimensions and orientation in the test fixture, and the method of cleaning and preparing the surfaces prior to bonding.

10.1.3 Quantitative application and bonding conditions used.

10.1.4 Average thickness of adhesive layer after formation of bond, within 0.2 mm, and the means of measurement.

10.1.5 Sample conditioning and environmental exposure.

10.1.6 The temperature at which the test was performed.

10.1.7 Number of specimens tested.

10.1.8 The maximum shear stress reached for each specimen.

10.1.9 Average shear strength.

10.1.10 The nature of the failure: cohesion, adhesion, or voids in the bondline. Report the average percent of each.

11. Precision and Bias

11.1 Precision and bias for this test method are being determined and will be available by April 2005.

12. Keywords

12.1 block-shear; rigid substrates; shear strength

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