Designation: D 952 – 95

Standard Test Method for Bond or Cohesive Strength of Sheet Plastics and Electrical Insulating Materials[1]

This standard is issued under the fixed designation D 952; 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 covers the determination of the bond strength or ply adhesion strength of sheet plastic and electrical insulating materials. It is applicable to both laminated and nonlaminated thermoplastic and thermosetting materials and vulcanized rubber.

1.2 Test data obtained by this test method is relevant and appropriate for use in engineering design.

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

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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing[2]

D 4000 Classification System for Specifying Plastic Materials[3]

D 4066 Specification for Nylon Injection and Extrusion Materials[3]

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method[4]

2.2 *ANSI Standard:*

B1.1 Standard for Unified Screw Threads[5]

3. Significance and Use

3.1 This test, when applied to laminated plastics, is a measure of the interlaminar or intralaminar strength, whichever is smaller. When applied to nonlaminated plastics, the test is a measure of the cohesive strength of the material. The property determined is of fundamental aspect and has not yet been correlated with the results of any other method for bond strength.

3.2 The test may be found to be useful as (*1*) a research test when studying the effects of changes in independent variables, (*2*) a specification test, or (*3*) a referee test.

3.3 For many materials, there may be a specification that requires the use of this test method, but with some procedural modifications that take precedence when adhering to the specification. Therefore, it is advisable to refer to that material specification before using this test method. Table 1 of Classification System D 4000 lists the ASTM materials standards that currently exist.

TABLE 1 Precision Data

Materials	Average Strength, MPa (psi)	Coefficient of Variation	
		ν_r Within[A] Laboratories	ν_R Between[B] Laboratories
BMC	12.7 (1840)	7.1	7.1
SMC	14.0 (2030)	5.4	8.8

[A] ν_r is the within-laboratories standard deviation of the mean, expressed as a percentage of the listed average.

[B] ν_R is the between-laboratories standard deviation of the mean, expressed as a percentage of the listed average.

4. Apparatus and Materials

4.1 *Testing Machine*—Any suitable tensile testing machine capable of crosshead movement at a constant rate of 1.3 mm/min.

4.2 *Loading Fixtures*—The loading fixtures shall be self-aligning and shall not apply eccentric loads.

4.3 *Metal Blocks*—A pair of 51-mm (2-in.) square metal blocks each having a maximum height of 51 mm (2 in.). Each block shall contain a hole to permit attachment to the loading fixture (see Fig. 1).

NOTE 1—Blocks constructed from heat-treated aluminum alloy, each having a hole in one end tapped ⅞ in. in accordance with ANSI B1.1, to accommodate threaded ⅞-in. studs of convenient length, have been used successfully.

4.4 *Adhesive*—Any adhesive that is found to perform satisfactorily under this test may be used provided that it will not influence the specimen behavior by physical or chemical effects.

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[1] This test method is under the jurisdiction of ASTM Committee D-20 on Plastics and is the direct responsibility of Subcommittee D20.10 on Mechanical Properties.

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[2] *Annual Book of ASTM Standards*, Vol 08.01.

[3] *Annual Book of ASTM Standards*, Vol 08.02.

[4] *Annual Book of ASTM Standards*, Vol 14.02.

[5] Available from American National Standards Institute, 11 West 42nd St., 13th Floor, New York, NY 10036.

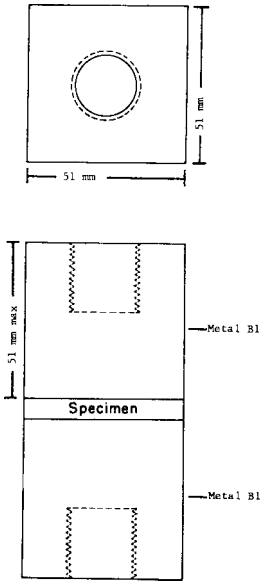

FIG. 1 Test Assembly for Bond Strength Test

NOTE 2—Redux[6] has been found satisfactory for use with certain thermoset materials. Cyanoacrylate cement and room-temperature-curing epoxy can be used for both thermoplastic and thermoset materials.

5. Test Specimen

5.1 The test specimen shall consist of sheet material 51 mm (2 in.) square, prepared in such a manner as to produce smooth edges. The thickness of the specimen shall be the thickness of the material.

5.2 At least five specimens shall be tested for each sample.

5.3 For testing the material specified, this test method is so designed that failure between the adhesive and the metal should not occur. If failure does occur between the adhesive and the metal blocks, or between the adhesive and the specimen, discard the result and test another specimen.

6. Conditioning

6.1 *Conditioning*—Condition the test specimens at 23 ± 2°C (73.4 ± 3.6°F) and 50 ± 5 % relative humidity for not less than 40 h prior to test in accordance with Procedure A of Practice D 618, for those tests where conditioning is required. In cases of disagreement, the tolerance shall be ± 1°C (±1.8°F) and ±2 % relative humidity.

6.1.1 Note that for some hygroscopic materials, such as nylons, the material specifications (for example, Specification D 4066) call for testing "dry as-molded specimens." Such requirements take precedence over the above routine preconditioning to 50 % relative humidity and require sealing the specimens in water vapor-impermeable containers as soon as molded and not removing them until ready for testing.

6.2 *Test Conditions*—Conduct tests in the standard laboratory atmosphere of 23 ± 2°C (73.4 ± 3.6°F) and 50 ± 5 % relative humidity, unless otherwise specified in the test method. In cases of disagreements, the tolerances shall be ±1°C (±1.8°F) and ±2 % relative humidity.

7. Specimen Preparation

7.1 Determine the cross-sectional area of the test specimen in a plane parallel to the surface. Gently rub both sides of the specimen with 00 emery cloth. Do not rub the specimen on the cloth since the corners will then be abraded more than other parts of the surface. Clean the bond areas of the specimen and metal blocks with a suitable solvent which does not chemically affect the surfaces. Do not touch the cleaned surfaces with the hands. Apply a coating of adhesive to the cleaned surfaces of the blocks.

7.2 Place the specimen between the coated blocks being certain that the blocks are aligned. If pressure or temperature, or both, is (are) necessary to cure the adhesive, insert the assembly into a properly adjusted press. The bonding pressure shall not be greater than the pressure used in the construction of the material. The bonding temperature shall be room temperature or at least 50°C below the temperature at which the material was constructed. In any case, the bonding procedure shall not alter the material. Permit specimens to condition in accordance with 6.1.

8. Procedure

8.1 Attach the assembly to the loading fixtures and determine the tensile load required to break the specimen at a speed of 1.3 mm ± 0.33 mm (0.05 ± 0.01 in.)/min.

NOTE 3—To prepare the metal blocks for reuse, grind the remaining portions of the test specimen and adhesive from the surfaces of the blocks by using a surface grinder. An abrasive wheel 178 mm (7 in.) in diameter and having a 12.7-mm (½-in.) face, running at 2900 r/min, has been found to be satisfactory.[7] In order to maintain a truly plane surface, it is recommended that the metal blocks be finished on a flat emery surface.

9. Calculation

9.1 Calculate the bond strength of each specimen in megapascals (or pounds-force per square inch) by dividing the load by the area of the test specimen.

9.2 Calculate the arithmetic mean of all values obtained to three significant figures and report as the "average value."

9.3 Calculate the standard deviation (estimated) and report to two significant figures.

10. Report

10.1 Report the following information:

10.1.1 Complete identification of the material tested, including type or grade, nominal thickness, source, principal dimensions, previous history, etc.,

10.1.2 The adhesive used,

10.1.3 The atmospheric conditions in the test room,

10.1.4 The total load, in newtons (or pounds-force), required to break each specimen,

10.1.5 The average unit stress for all tests, in megapascals (or pounds-force per square inch), the standard deviation, and

10.1.6 Description of failure: whether progressive or sudden, adhesive or cohesive.

11. Precision and Bias

11.1 Table 1 is based on an interlaboratory test conducted in

[6] Redux is available from the Shur-Lok Bonded Structures, Ltd., 1300 E. Normandy Place, Santa Ana, CA.

[7] Aloxite-AA-46-G6-V60, of the Carborundum Co., Niagara Falls, NY, has been found suitable for this purpose.

1979 involving two materials tested by three laboratories (see Note 4). Each test result was the average of five specimens. Each laboratory obtained four test results for each material.

NOTE 4—**Caution:** With such limited testing, the standard deviations in Table 1 are likely to have a high degree of error. Therefore, the usual statistics for repeatability and reproducibility are not warranted.

NOTE 5—A questionnaire circulated in May 1988 generated only one response from a user of this test method as well as one nonuser, both of whom would vote negative on any ballot to withdraw this test method. There were 19 other responses.

11.2 The data in Table 1 should not be applied to acceptance or rejection of material, as those data are specific to the round robin and may not be representative of other lots, conditions, materials, or laboratories. Users of this test method should apply the principles outlined in Practice E 691 to generate data specific to their laboratory and materials, or between specific laboratories.

11.3 *Bias*—There are no recognized standards by which to estimate bias of this test method.