



Designation: D 896 – 97

## Standard Test Method for Resistance of Adhesive Bonds to Chemical Reagents<sup>1</sup>

This standard is issued under the fixed designation D 896; 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 approval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the Department of Defense. This test method replaces Method 2011.1 of Federal Test Method Standard No. 175a*

### 1. Scope

1.1 This test method provides a uniform procedure for the exposure of adhesively bonded substrates to selected environments. This test method also provides for a qualitative measure of the adhesive bond strength using existing standard methods after exposure.

1.2 *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. For specific precautions, see Section 8.*

1.3 Values stated in SI units are to be regarded as the standard.

### 2. Referenced Documents

#### 2.1 ASTM Standards:

- B 117 Practice for Operating Salt Spray (Fog) Apparatus<sup>2</sup>
- D 471 Test Method for Rubber Property—Effect of Liquids<sup>3</sup>
- D 543 Test Method for Resistance of Plastics to Chemical Reagents<sup>4</sup>
- D 907 Terminology of Adhesives<sup>5</sup>
- D 1151 Test Method for Effect of Moisture and Temperature on Adhesive Bonds<sup>5</sup>

### 3. Terminology

3.1 *Definitions*—Many terms in this test method are defined in Terminology D 907.

### 4. Summary of Test Method

4.1 Specimens are immersed in selected reagents for a specified time and temperature. The specimens are recovered, dried, and tested in accordance with selected methods.

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee D-14 on Adhesives and is the direct responsibility of Subcommittee D14.80 on Metal Bonding Adhesives.

Current edition approved March 10, 1997. Published April 1998. Originally published as D 896 – 46. Last previous edition D 896 – 92.

<sup>2</sup> *Annual Book of ASTM Standards*, Vol 03.02.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 09.01.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 08.01.

<sup>5</sup> *Annual Book of ASTM Standards*, Vol 15.06.

### 5. Significance and Use

5.1 This test method is designed to determine the general effects of chemical reagents on the strength of the bonded system. It cannot distinguish between adsorption in the bulk adhesive or penetration at the adhesive/substrate interface.

### 6. Apparatus

6.1 The apparatus shall consist of containers for test specimens and a cabinet for maintaining a temperature of  $23 \pm 1.1^\circ\text{C}$  ( $73.4 \pm 2^\circ\text{F}$ ). Other suitable apparatus will be required for conducting immersion tests above and below room temperature.

NOTE 1—Exercise care in the choice of materials with respect to adherend and containers. Confirm that they are unaffected by the chemicals and solvents used in this test method.

6.2 Apparatus for making strength tests is specified in the method for the property to be measured.

### 7. Reagents

7.1 Directions for preparations of reagents are for approximately 1-L quantities. All percentages are by weight.

7.2 Standard chemical reagents are selected from the list given in Test Method D 543. Standard oils and fuels are selected from the list given in Test Method D 471.

7.3 *Distilled Water*—Freshly prepared distilled water is used wherever water is specified in this test method.

### 8. Supplementary Reagents (see 7.1)

#### 8.1 Hydrocarbon Mixture No. 1:

Isooctane (2,4-trimethylpentane)	600 mL
Toluene	200 mL
Xylene	150 mL

#### 8.2 Standard Jet Fuel No. 1:

Toluene	300 mL
Cyclohexane	600 mL
Isooctane (2,4-trimethylpentane)	100 mL
n-Butyl disulfide	10 mL
n-Butyl mercaptan (equivalent to 0.005 weight % of mercaptan sulfur)	0.125 g

#### 8.3 Standard Jet Fuel No. 2:

Toluene	300 mL
Cyclohexane	600 mL
Isooctane (2,4-trimethylpentane)	100 mL

<i>n</i> -Butyl disulfide	1 mL
<i>n</i> -Butyl mercaptan (equivalent to 0.004 weight % of mercaptan sulfur)	0.010 g

8.4 *Silicone Fluid (Polydimethylsiloxane)*, having a viscosity of 200 cSt (mm<sup>2</sup>/s) at 25°C.

8.5 *Engine Antifreeze (Ethylene Glycol)*, (inhibited).

8.6 *n-Butyl Alcohol (Butanol-1)*.

8.7 *Brake Fluid*.

8.8 *Automotive Power Steering Fluid*.

NOTE 2—**Caution:** The supplemental reagents may be toxic or flammable.

NOTE 3—Reagent substitution is acceptable provided such reagents are within the general scope of this test method.

## 9. Test Specimens

9.1 The test specimens are identical with those required in ASTM test methods for the strength properties to be measured, and the conditioning period before exposure shall correspond to the conditioning period before testing as given in the specified ASTM test method.

9.2 Select matched specimens for control and exposure treatments.

## 10. Procedure

10.1 Place each specimen in a separate container and totally immerse in a sufficient quantity of the reagent for seven days at a temperature of  $23 \pm 1.1^\circ\text{C}$  ( $73.4 \pm 2^\circ\text{F}$ ) (Note 4). Place the specimen on edge in the container in the case of flat specimens so that it is supported at an angle from the bottom and side wall of the container. Stir the reagent every 24 h by moderate manual rotation of the container. Maintain the strength of the chemical solutions constant. Use completely closed containers to minimize outgassing or any change in concentration (for example, due to hygroscopicity). Where the reagent-specimen combination may result in vaporizing or outgassing, select the container to withstand the pressure resulting from the test temperature so that the test reagent stays liquid.

10.1.1 The volume of reagent used is ten times the volume of the specimen.

NOTE 4—Selection of an alternative test temperature and immersion time is permissible upon agreement between the purchaser and the manufacturer. The alternative test temperature may be selected from the table in Test Method D 1151.

10.2 A short time test is permissible for the purpose of eliminating those materials that are unsuitable or unduly affected by the reagents, performed on films or suitable specimens of the adhesive prepared in accordance with the manufacturer's instructions with regard to drying time, cure, etc.

10.3 Remove the individual specimen from the reagent. Rinse aqueous reagents off the specimen with distilled water. Rinse off other reagents with a suitable organic solvent. Blot the specimen dry with a clean dry cloth or blotting paper.

Determine the strength of the specimen immediately at a temperature of  $23 \pm 1.1^\circ\text{C}$  ( $73.4 \pm 2^\circ\text{F}$ ) in accordance with the specified method (see Note 6).

10.4 Using air as the contact medium, condition the control specimens at  $23 \pm 1.1^\circ\text{C}$  and  $50 \pm 2\%$  relative humidity during the same seven days that the test specimens are exposed to the chemical treatment. Determine the strength of the control specimens, testing in accordance with the specified method and at a temperature of  $23 \pm 1.1^\circ\text{C}$ , and calculate the average control strength.

10.4.1 When an alternative temperature is selected for exposure of test specimens (see Note 4 and Note 6), hold the control specimens in a closed container for the seven-day period at the same temperature as the test specimens. Return the controls to  $23 \pm 1.1^\circ\text{C}$  before testing.

NOTE 5—Adhesives may be subjected to salt spray (fog) testing. Use Test Method B 117.

NOTE 6—Selection of an alternative temperature for determining the strength of the specimen is permissible upon agreement between the purchaser and the manufacturer. The alternative temperature is selected from the table in Test Method D 1151.

## 11. Report

11.1 Report the following information:

11.1.1 The individual and average strength property values of the control specimens and the temperature at which the values were determined.

11.1.2 Report the following information for each adhesive tested in all the standard reagents and any specified supplementary reagents:

11.1.2.1 Immersion time and temperature,

11.1.2.2 Strength property value of each specimen and temperature at which value was determined,

11.1.2.3 Percentage change in average strength resulting from the immersion test, calculated to the nearest 1 % taking the average strength property value of control test specimens as 100 %,

11.1.2.4 General appearance and behavior of each specimen during and after immersion,

11.1.2.5 Type of specimen,

11.1.2.6 Trade name and type of adhesive used,

11.1.2.7 ASTM designation of materials and test procedure used, and

11.1.2.8 Application, drying, and curing conditions used in preparing the specimens.

## 12. Precision and Bias

12.1 This is a comparative test of adhesive strength after exposure. No precision and bias are needed.

## 13. Keywords

13.1 absorption; adhesive bonds; chemical; compatibility; exposure; reagents; resistance



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