Designation: D896 – 04 (Reapproved 2010)ε1

Standard Practice for Resistance of Adhesive Bonds to Chemical Reagents[1]

This standard is issued under the fixed designation D896; 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.

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

ε[1] NOTE—Editorial corrections were made throughout in October 2010.

1. Scope

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

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

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. For specific warnings, see Section 8.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

B117 Practice for Operating Salt Spray (Fog) Apparatus
D471 Test Method for Rubber Property—Effect of Liquids
D543 Practices for Evaluating the Resistance of Plastics to Chemical Reagents
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)
D1151 Practice for Effect of Moisture and Temperature on Adhesive Bonds
D3164 Test Method for Strength Properties of Adhesively Bonded Plastic Lap-Shear Sandwich Joints in Shear by Tension Loading

3. Terminology

3.1 *Definitions*—Many terms in this practice are defined in Terminology D907.

4. Summary of Practice

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, such as Test Methods D1002 or D3164.

5. Significance and Use

5.1 This practice 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 consists of containers for test specimens and a cabinet for maintaining a temperature of 23 ± 3°C (73 ± 5°F). Other suitable apparatus is required for immersing specimens 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 practice.

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 Practices D543. Standard oils and fuels are selected from the list given in Test Method D471.

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

[1] This practice is under the jurisdiction of ASTM Committee D14 on Adhesives and is the direct responsibility of Subcommittee D14.80 on Metal Bonding Adhesives.

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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.

8. Supplementary Reagents (see 7.1)

8.1 *Hydrocarbon Mixture No. 1:*

*Iso*octane (2,4-trimethylpentane)	600 mL
Toluene	200 mL
Xylene	150 mL

8.2 *Standard Jet Fuel No. 1:*

Toluene	300 mL
Cyclohexane	600 mL
*Iso*octane (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
*Iso*octane (2,4-trimethylpentane)	100 mL
n-Butyl disulfide	1 mL
n-Butyl mercaptan (equivalent to 0.004 weight % of mercaptan sulfur)	0.010 g

8.4 *Silicone Fluid (Polydimethysiloxane),* having a viscosity of 200 mm^2/s (200 cSt) 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.* (**Warning**—The supplemental reagents may be toxic or flammable.)

NOTE 2—Reagent substitution is acceptable provided such reagents are within the general scope of this practice.

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 corresponds 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 ± 3°C (73 ± 5°F) (Note 3). 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 3—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 Practice D1151.

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 ± 3°C (73 ± 5°F) in accordance with the specified method (see Note 5).

10.4 Using air as the contact medium, condition the control specimens at 23 ± 3°C and 50 ± 5 % 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 ± 3°C, and calculate the average control strength.

10.4.1 When an alternative temperature is selected for exposure of test specimens (see Note 3 and Note 5), 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 ± 3°C before testing.

NOTE 4—Adhesives may be subjected to salt spray (fog) testing. Use Test Method B117.

NOTE 5—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 Practice D1151.

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 method 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. Precision and bias is a function of the test methods selected. No precision and bias are needed.

13. Keywords

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