Designation: D 2294 – 96 (Reapproved 2002)

Standard Test Method for Creep Properties of Adhesives in Shear by Tension Loading (Metal-to-Metal)[1]

This standard is issued under the fixed designation D 2294; 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 creep properties of adhesives for bonding metals when tested on a standard specimen and subjected to certain conditions of temperature and tensile stress in a spring-loaded testing apparatus.

1.2 This test method is applicable to the temperature range from −55 to +260°C (−67 to +500°F).

1.3 The values stated in SI units are to be regarded as standard. The inch-pound units 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 638 Test Method for Tensile Properties of Plastics[2]

D 907 Terminology of Adhesives[3]

D 1002 Test Method for Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens By Tension Loading (Metal-to-Metal)[3]

2.2 *ASTM Adjuncts:*

Tension Creep Test Apparatus[4]

3. Terminology

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

4. Significance and Use

4.1 This test method is useful in research and development for comparison of creep properties of adhesives, particularly as those properties are affected by changes in adhesive formulation or expected service conditions, including temperature, moisture level, and duration of loading.

4.2 The relative size and simplicity of design of the spring-loaded apparatus permits easy portability and transfer from one environment to the next without disturbing static loads.

4.3 The relative simplicity of design with inexpensive materials permits replication of creep tests at relatively low costs.

5. Apparatus

5.1 *Tension Creep Test Apparatus*, as shown in Fig. 1.[4] It shall consist of a hollow loading chamber, a solid extension rod with provisions for attachment of test specimens, and a high-temperature-resistant spring.[5] A testing machine conforming to the requirements of Test Method D 638 is required to apply the static load.

5.2 *Microscope*, calibrated, having 100× magnification.

6. Test Specimens

6.1 Test specimens shall conform to the shape and dimensions shown in Fig. 2. These specimens are similar to the tension lap shear specimens described in Test Method D 1002, except for the holes as shown in Fig. 2.

6.2 Test at least three specimens for each set of standard conditions of load, time, and temperature.

6.3 A complete description of these specimens and the method of preparation is given in Sections 6, 7, and 8 of Test Method D 1002.

6.4 For creep measurements, polish the 12.7-mm (½-in.) edges of the bonded area of each test specimen, and scribe with three fine lines across the bondline (Fig. 1).

7. Procedure

7.1 Attach the test apparatus to a testing machine and condition to a prescribed test temperature. Place a specimen within the load chamber of the test apparatus (Fig. 2), and attach to the chamber and load shaft by means of pins.

7.2 Apply the load by the test machine at a rate of 80 to 100 kgf/cm^2/min (1200 to 1400 psi/min). After reaching the desired

[1] This test method 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] *Annual Book of ASTM Standards*, Vol 08.01.

[3] *Annual Book of ASTM Standards*, Vol 15.06.

[4] Detailed working drawings for the construction of the tensile creep test apparatus are available at a nominal cost from ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. Request Adjunct No. ADJD2294.

[5] Springs suitable for this apparatus may be obtained from the W. D. Gibson Co., Chicago, IL.

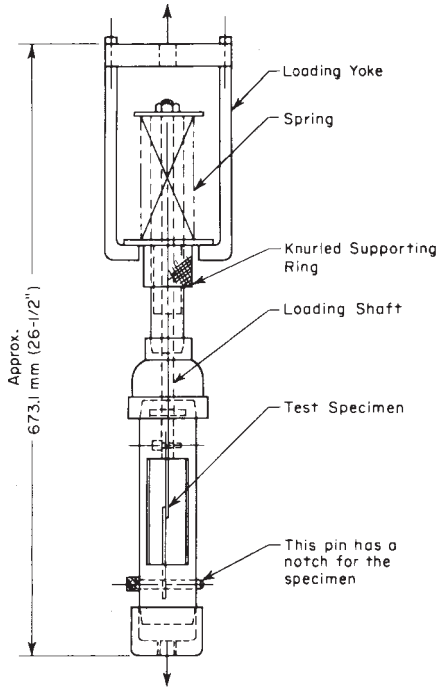

FIG. 1 Tension Creep Test Apparatus

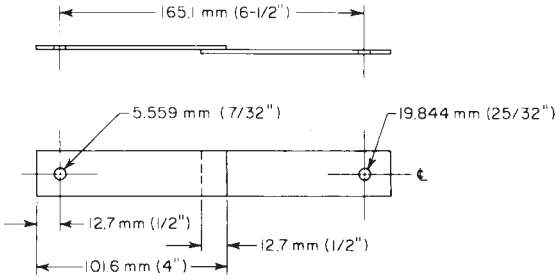

FIG. 2 Form and Dimensions of Test Specimen

load, turn up the knurled supporting ring to make contact with the disk (that is, touch plus ¼ turn) supporting the compressed spring. Unload the testing machine, remove the entire creep test apparatus (except the loading yoke) from the testing machine, and place it in the desired environment.

7.3 To measure total deflection, observe the displacement of fine razor marks across both sides of the bond area with a calibrated microscope having 100× magnification.

7.4 To measure deflection at various times during the test, especially when the environment is other than room temperature, fine scribe lines may be added periodically adjacent to the original mark across the edge of the joint. Make a final mark just before the specimen is removed from the temperature-conditioned area and the load removed. The relative displacement measurements, which may then be made at any time thereafter, will indicate the amount of creep deflection at the various time intervals. Suggested time intervals are 1, 3, 5, 10, 30, 50, 100, 300, 500, 1000, and so forth, minimum, as these yield approximately equally spaced points when plotted on a log scale. If desired, readings of the changes in displacement can be continued even after the specimen is unloaded. These provide a measure of the relaxation.

7.5 Record the deflection at periodic intervals during the test, the total deflection, the magnitude and duration of the tensile stress, and the test temperature for each specimen. Express all loads in kilograms per square centimetre (or pounds per square inch) and, if possible, report to three significant figures.

8. Report

8.1 Report the following information:

8.1.1 Complete identification of the materials and procedures used and dimensions of the bond area including width and length ±2.54 mm (0.01 in.) and bondline thickness ±0.0127 mm (0.0005 in.),

8.1.2 Creep deflection of the specimens shown as total measured deflection,

8.1.3 Magnitude and duration of the tensile stress, test temperature, and any environmental conditions,

8.1.4 Conditioning procedure used for specimens prior to testing,

8.1.5 Number of specimens tested, and

8.1.6 Nature of the failure (that is, percent adhesive or cohesive) if it occurs before the creep test is completed.

9. Precision and Bias

9.1 At the present time, there is no basis for a statement of precision and bias concerning the reproducibility of results among laboratories.

9.2 The precision and bias of this test method is a function of the properties of the cured bondline. Report precision as standard deviation of the data and standard error of the mean.

10. Keywords

10.1 creep; metal-to-metal bonds; shear by tension loading