Designation: D4562 – 01 (Reapproved2007)

Standard Test Method for Shear Strength of Adhesives Using Pin-and-Collar Specimen[1]

This standard is issued under the fixed designation D4562; 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.

1. Scope

1.1 This test method covers the determination of the shear strength of curing liquid adhesives used for retaining cylindrical assemblies or for locking and sealing threaded fasteners.

1.2 The values stated in inch-pound 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.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

A108 Specification for Steel Bar, Carbon and Alloy, Cold-Finished

D907 Terminology of Adhesives

D2651 Guide for Preparation of Metal Surfaces for Adhesive Bonding

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Terminology

3.1 *Definitions*—Many of the terms in this standard are defined in Terminology D907.

4. Summary of Test Method

4.1 This test method consists of bonding a metal pin inside a metal collar and determining the force required to shear the adhesive joint.

5. Significance and Use

5.1 This test method provides reasonably accurate information with regard to the ability of an adhesive to withstand shearing forces. It may also be used to determine degree of cure and the effect of environment on shear strength.

6. Apparatus

6.1 *Universal Test Machine,* or equivalent, for applying force to the specimen. Details of the test specimen (pin-and-collar) are given in Fig. 1.

6.2 *Specimen Curing Rack,* as shown in Fig. 2, or equivalent.

7. Preparation of Test Specimens

7.1 Assemble five specimens for each test as described in the following paragraphs:

7.1.1 Each specimen is comprised of a pin 0.498 to 0.499 in. (12.65 to 12.675 mm) in diameter and a slip collar 0.500 to 0.501 in. (12.7 to 12.725 mm) inside diameter by 0.435 to 0.439 in. (11.05 to 11.15 mm) wide, both components finished to 32 to 64 µin (0.8 to 1.6 µm) with 0.001 to 0.003 in. (0.025 to 0.075 mm) diametrical clearance between the pin and collar (see Fig. 1). The pin and collar, by agreement, may be made of any material (see Appendix X1), but the most common material is steel, as specified in Specification A108.

7.1.2 Degrease all pins and collars (refer to Guide D2651), store in an atmosphere of low humidity (20 % relative humidity), and keep them clean. Use degreased specimens within four days or discard. (Oxidation affects the test results after this time. Prior to vapor degreasing, it is permissible to soak or wash hard-greased or waxed parts in solvent.) Do not prime or activate unless specified for the material to be tested.

7.1.3 To apply the adhesive, assemble the parts to be sure that there are no nicks that will cause them to stick or drag. Disassemble the parts. Apply sufficient adhesive to the circumference of the pin, beginning at one end, to completely cover an

[1] This test method is under the jurisdiction of ASTM Committee D14 on Adhesives and is the direct responsibility of Subcommittee D14.60 on Adhesive Material Classification System.

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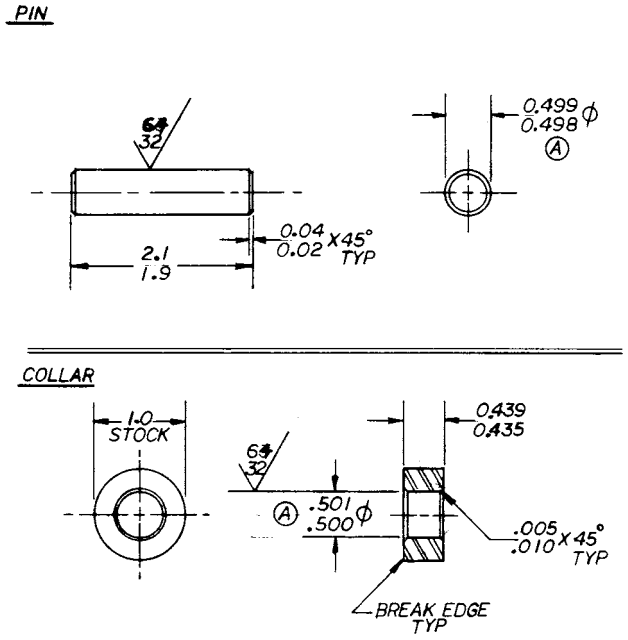
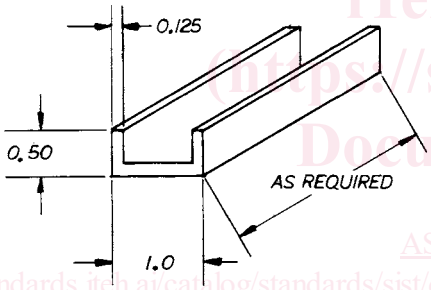
[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.



NOTE 1—ALL DIMENSIONS ARE IN INCHES
NOTE 2—MATERIAL: AISI 12L14 OR UNSG 12144
NOTE 3—DIMENSIONS MARKED "A" TO HAVE A CLEARANCE OF .001 TO .003

FIG. 1 Pin-and-Collar Assembly



NOTE 1 — MATERIAL: EXTRUDED SHARP CORNER ALUM. CHANNEL
NOTE 2 — BREAK SHARP EDGES
NOTE 3 — ALL DIMENSIONS ARE IN INCHES
NOTE 4 — CAN BE PURCHASED AS SHARP CORNER STANDARD CHANNEL

FIG. 2 Specimen Rack

area the width of the collar in its final position. Also apply sufficient adhesive to completely cover the interior of the collar 360°. Slip the collar over the coated end of the pin with at least 180° of rotation as the collar travels over the adhesive. Repeat a back-and-forth rotation three times, or until the collar exhibits a smooth, consistent resistance to rotation.

7.1.4 Rack the assembly with the fillet up so that the collar does not slip out of the bond area. Take care that the rack is at the required temperature and do not place onto a hot or cold surface. There should be excess material on the leading edge of the collar; if not, apply sufficient adhesive to create a fillet.

7.1.5 Cure the specimens in accordance with the manufacturer's instructions.

7.1.5.1 For primed or activated surfaces, when specified or recommended, use the manufacturer's primer. Apply the primer and adhesive according to the manufacturer's instructions. Assemble and cure the specimens for a time and temperature in accordance with the manufacturer's recommendation.

8. Procedure

8.1 After allowing for cure and any planned environmental conditioning, determine the static shear strength as follows:

8.1.1 Place the pin and collar assembly on the universal test machine as shown in Fig. 3. Load the specimen smoothly at about 500 lb/s (2200 N/s) using a free crosshead speed of 0.05 in./min (1.3 mm/min). Record the maximum load in pounds (Newtons). Calculate the static shear strength by dividing the breakaway load by the bond area as follows:

$$\text{Shear Strength} = \text{Maximum Load/Diameter} \times 3.14 \times \text{Width}$$

9. Report

9.1 Report the following information:

9.1.1 Complete identification of the adhesive tested, including type, source, date manufactured, manufacturer's code numbers, and form.

9.1.2 Complete identification of the metal used and the method of cleaning and preparing its surfaces prior to bonding.

9.1.3 Application and bonding conditions used in preparing the specimens.

9.1.4 Conditioning procedure used for specimens prior to testing.

9.1.5 Number of specimens tested.

9.1.6 Maximum, minimum, and average values for failing load, and shear strength.

10. Precision and Bias

10.1 *Precision*—An interlaboratory study of the shear strength of anaerobic adhesives was run in 1989. Each of six

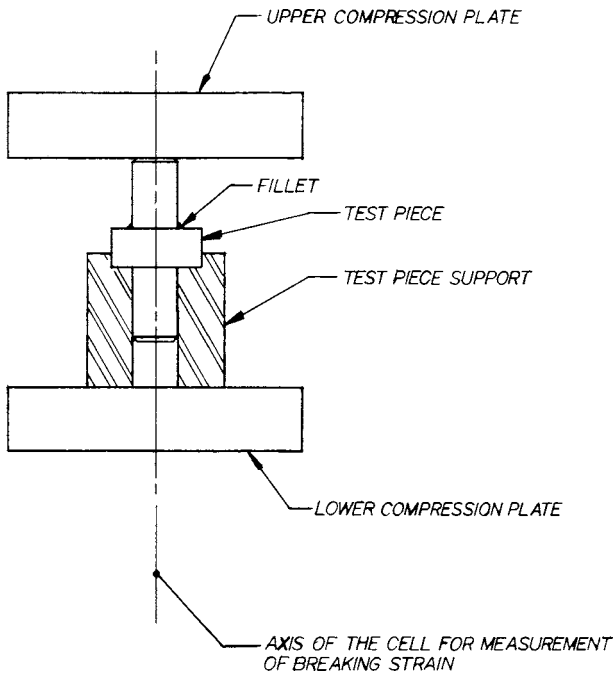


FIG. 3 Test Device