

SEMI G69-0996 (Reapproved 0823) TEST METHOD FOR MEASUREMENT OF ADHESIVE STRENGTH BETWEEN LEADFRAMES AND MOLDING COMPOUNDS

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1 Purpose

- 1.1 This Standard describes procedures for measuring adhesive strength between leadframes and molding compounds for semiconductor packages.
- 1.2 The procedures include shear test, pull test, and three-point bending techniques.

2 Scope

- 2.1 This Standard may be used on all types of semiconductor leadframe and molding compound.
- 2.2 The methods help leadframe manufacturers, molding compound manufacturers and their customers in evaluating leadframes, and molding compounds as a guideline.
- 2.3 The methods in this Standard use SI units.

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3 Referenced Standards and Documents

- 3.1 None.

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

4 Terminology

- 4.1 None.

5 Summary of Method

- 5.1 *Shear Method* — A frustum-shaped button of molding compound on the surface of a leadframe sample is sheared off the leadframe surface using a tensile tester (refer to Figure 1).
- 5.2 *Pull Method* — A sample of leadframe material molded into the side of a block of a molding compound is pulled out using a tensile tester (refer to Figure 2).
- 5.3 *Three-Point Bending Method*¹ — Molding compound is molded onto the surface of a leadframe sample such that part of the leadframe is free of molding compound adherence to the surface. Using a bending technique, the adherent

¹ Nishimura, A., Hirose, I., and Tanaka, N. “A New Method for Measuring Adhesion Strength of IC Molding Compounds.” ASME Journal of Electronic Packaging, Vol. 114 (1992): pp. 407–412.

molding compound is cracked away from the surface. This process is repeated from both sides of the sample in order to calculate the true adhesive strength (refer to Figure 3).

6 Equipment

6.1 Tensile Tester

6.1.1 *Measurement Range* — Maximum 980 N (100 kgf).

6.1.2 *Accuracy* — $\pm 1\%$.

6.1.3 *Crosshead Speed* — 2 to 10 mm/min. (recommended), constant speed.

6.1.4 Fixtures suitable for holding the samples, shearing the molding compound, pulling the leadframe, and applying bending load.

6.2 Chart Recorder

6.3 Transfer molding machine or suitable replacement that can encapsulate individual samples with required pressure and temperature.

6.4 *Pre-Heater* — High frequency heater for molding compounds.

6.5 *Molds* — Suitable to mold the samples as shown in Figures 1, 2, and 3.

6.6 *Recirculating Air Oven* — With controller in range of 170°C to 180°C.

6.7 Equipment to pre-treat the leadframe sample, as required.

6.8 Ultrasonic inspection apparatus for three-point bending method.

7 Configuration and Dimension of Sample

7.1 The sample configuration and dimensions for measurement are shown in Figures 1, 2, and 3.

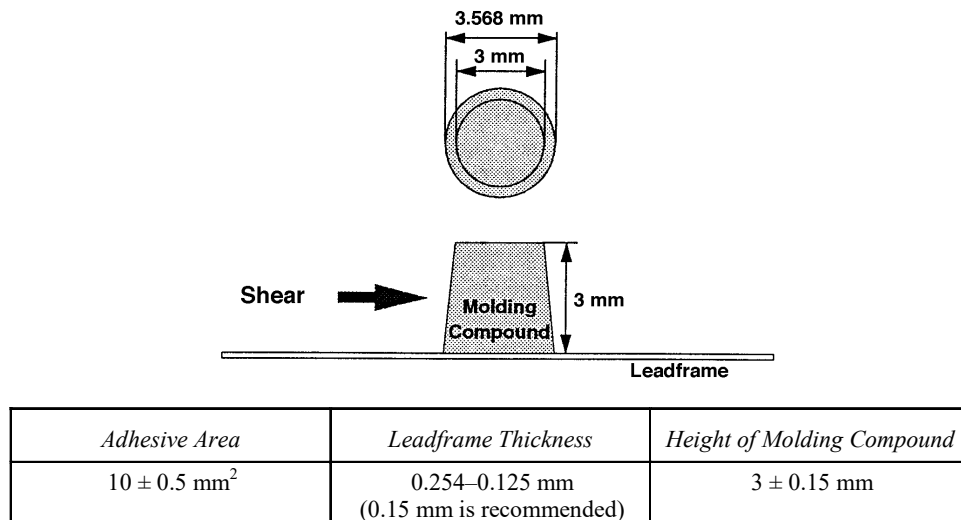


Figure 1
Sample for Shear Method

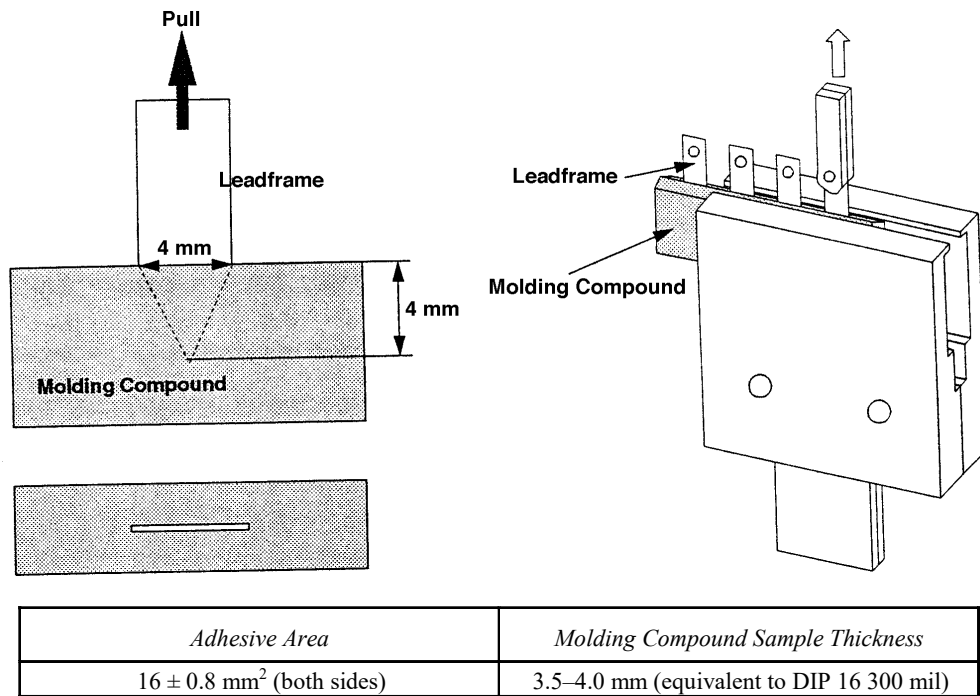


Figure 2
Sample for Pull Method

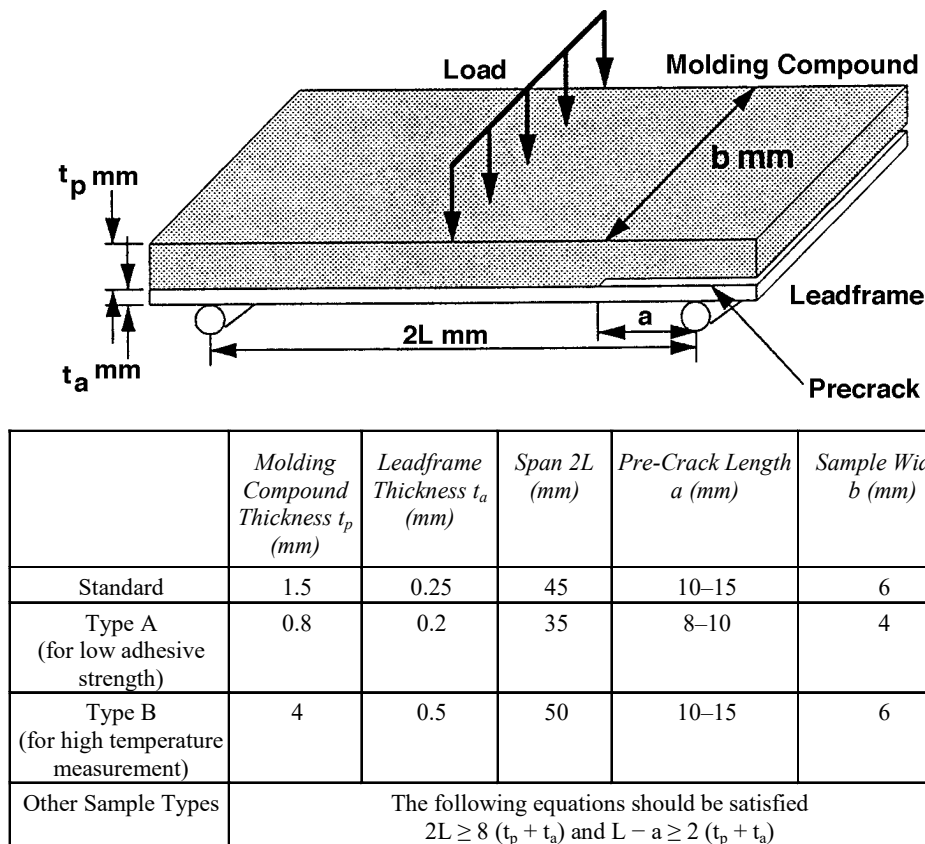


Figure 3
Sample for Three-Point Bending Method

8 Sampling Plan

8.1 The sampling plan shall be in agreement between customer and vendor. It is recommended that the following minimum sample sizes are used:

- *Shear Method* — Four samples.
- *Pull Method* — Four samples.
- *Three-Point Bending Method* — Three samples in each direction.

NOTE 1: Three-point bending method needs at least two samples to obtain adhesive strength.

9 Materials

9.1 Leadframe or appropriated sample from strip meeting dimensions for test.

9.2 Molding compound.

10 Sample Preparation

10.1 Leadframe Sample Preparation

10.1.1 Process the leadframe samples through the various cleaning and heat cycles that would be normal for the leadframe under consideration as required.

NOTE 2: When this method is applied to copper leadframes, copper oxide on the surface shall be considered when results are interpreted.

10.2 Clean and condition the molds to provide well-formed samples as required.

10.3 Set the molds to the specified temperature and record the temperature.

10.4 Set the transfer molding pressure, transfer time, and cure time to the following recommended molding conditions. If the condition is not suitable for the material, the condition should be agreed between customer and vendor.

10.4.1 Molding Condition

- *Cure Temperature* — 170°C to 180°C.
- *Cure Time* — 12 seconds.
- *Molding Pressure* — 6.8 to 7.8 MPa (70 to 80 kgf/cm²).

10.5 Mold all the required samples.

10.6 Remove the samples from the molds.

NOTE 3: After removing the samples from the molds, natural cooling of the samples is recommended.

10.7 Post mold cure the samples at the following recommended conditions:

- *Temperature* — 175 ± 5°C.
- *Time* — 4 to 8 hours.

10.8 Store the samples and record the storage conditions.

10.9 Three-Point Bending Samples

10.9.1 In addition to the treatment mentioned in ¶ 10.1.1, and to facilitate cracking during the three point bending method, apply a thin layer of mold release to one end of the leadframe sample in order to form a ‘pre-crack’ condition (i.e., the molding compound will not adhere to this section of the sample, refer to Figure 3).

NOTE 4: It is recommended that toluen-based thermosetting silicone be used as a mold release agent to prevent molding process contamination.

11 Calibration

11.1 Tensile Tester Calibration

11.1.1 Calibrate the tensile tester in accordance with the manufacturer’s instructions.

12 Test Procedure

12.1 Shear Method

12.1.1 Attach the sample to the tensile test such that shear may be applied.

12.1.2 Place the shear tool against the molding compound formation and initiate a load at a constant speed between 2 to 10 mm/min. while recording the load and displacement.

12.1.3 Record the peak load before the sudden drop in applied load as the sample shears off the leadframe or the molding compound breaks.

NOTE 5: Disregard any results which have the appearance of sample slipping or shear tool riding over the molding compound.

12.2 Pull Method

12.2.1 Attach the sample to the tensile tester such that the leadframe may be pulled out of the molding compound with a vertical pull action.

12.2.2 Attach the pulling grips to the leadframe and initiate a load at a constant speed between 2 to 10 mm/min. while recording the load and displacement.

12.2.3 Record the peak load before the sudden drop in applied load as the sample is pulled from the molding compound samples.

NOTE 6: Disregard any results which have the appearance of slippage of the sample or pulling grips.