

SEMI G69-0996 (Reapproved 1104)

TEST METHOD FOR MEASUREMENT OF ADHESIVE STRENGTH BETWEEN LEADFRAMES AND MOLDING COMPOUNDS

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1 Purpose

1.1 This document 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 document 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 document use SI units.

NOTICE: This standard does not purport to address safety issues, if any, associated with its use. It is the responsibility of the users of this standard to establish appropriate safety and health practices and determine the applicability of regulatory or other limitations prior to use.

3 Terminology

3.1 None.

4 Summary of Method

4.1 *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 (see Figure 1).

4.2 *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 (see Figure 2).

4.3 *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 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 (see Figure 3).

5 Equipment

5.1 Tensile Tester

5.1.1 *Measurement Range* — Maximum 980 N (100 kgf)

5.1.2 *Accuracy* — $\pm 1\%$

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

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

5.2 Chart Recorder

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

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

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

5.6 *Recirculating Air Oven* — With controller in range of 170–180°C.

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

5.8 Ultrasonic inspection apparatus for three-point bending method.

6 Configuration and Dimension of Sample

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

¹ A. Nishimura, I. Hirose and N. Tanaka, "A New Method for Measuring Adhesion Strength of IC Molding Compounds", ASME Journal of Electronic Packaging, Vol. 114, pp 407-412, 1992

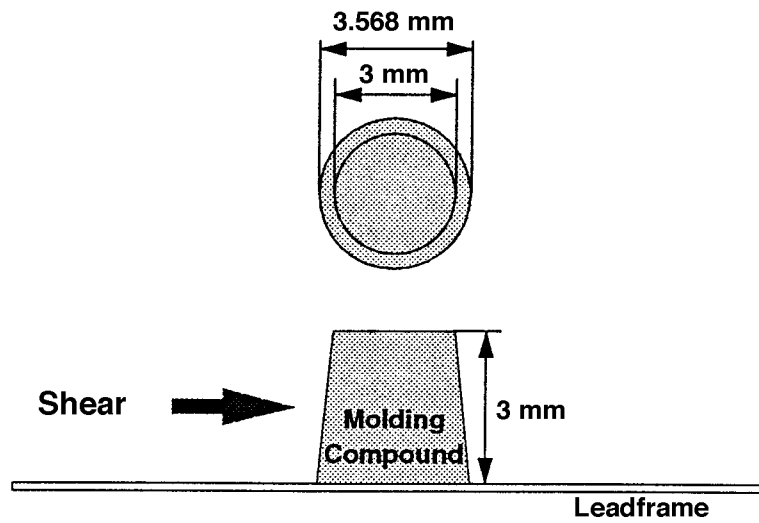


Figure 1
Sample for Shear Method

<i>Adhesive Area</i>	<i>Leadframe Thickness</i>	<i>Height of Molding Compound</i>
$10 \pm 0.5 \text{ mm}^2$	$0.254\text{--}0.125 \text{ mm}$ (0.15 mm is recommended)	$3 \pm 0.15 \text{ mm}$

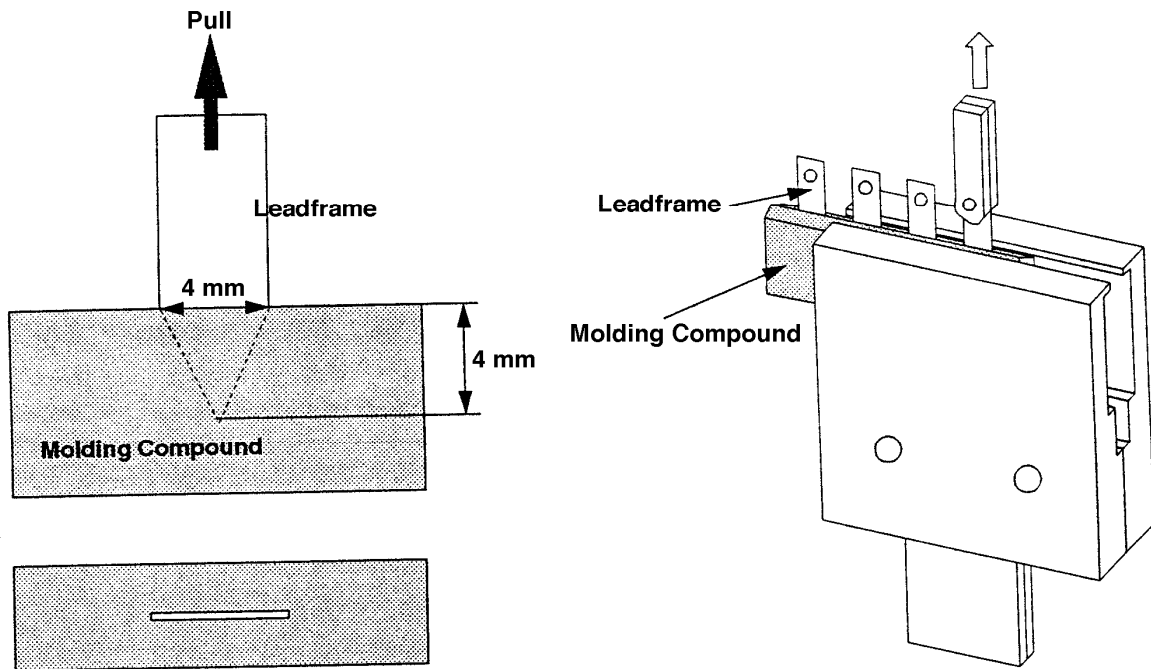


Figure 2
Sample for Pull Method

<i>Adhesive Area</i>	<i>Molding Compound Sample Thickness</i>
$16 \pm 0.8 \text{ mm}^2$ (both sides)	3.5–4.0 mm (equivalent to DIP 16 300 mil)

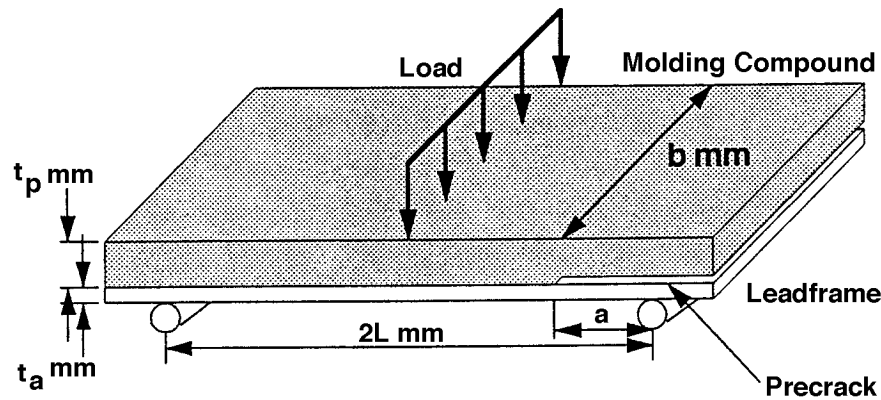


Figure 3
Sample for Three-Point Bending Method

	Molding Compound Thickness t_p (mm)	Leadframe Thickness t_a (mm)	Span $2L$ (mm)	Pre-Crack Length a (mm)	Sample Width b (mm)
Standard	1.5	0.25	45	10–15	6
Type A (for low adhesive strength)	0.8	0.2	35	8–10	4
Type B (for high temperature measurement)	4	0.5	50	10–15	6
Other Sample Types	The following equations should be satisfied $2L \geq 8(t_p + t_a)$ and $L - a \geq 2(t_p + t_a)$				

7 Sampling Plan

7.1 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 (4) samples
- *Pull Method* — Four (4) samples
- *Three-Point Bending Method* — Three (3) samples in each direction

NOTE 1: Three-point bending method needs at least 2 samples to obtain adhesive strength.

8 Materials

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

8.2 Molding compound

9 Sample Preparation

9.1 Leadframe Sample Preparation

9.1.1 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.

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

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

9.4 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.

Molding condition	
Cure temperature	170–180°C
Cure time	120 sec.
Molding pressure	6.8–7.8 MPa (70–80 kgf/cm ²)

9.5 Mold all the required samples.

9.6 Remove the samples from the molds.

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

9.7 Post mold cure the samples at the following recommended conditions.

Post-cure condition	
Temperature	175 ± 5°C
Time	4–8 hours

9.8 Store the samples and record the storage conditions.

9.9 Three-Point Bending Samples

9.9.1 In addition to the treatment mentioned in Section 10.1.1, and to facilitate cracking during the three point bending method, apply a thin layer of mold release to on 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, see Figure 3).

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

10 Calibration

10.1 Tensile Tester Calibration

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

11 Test Procedure

11.1 Shear Method

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

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

11.1.3 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.

11.2 Pull Method

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

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

11.2.3 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.

11.3 Three-Point Bending Method

11.3.1 Measurement of the pre-crack length

11.3.1.1 Measure the pre-crack length using an ultrasonic inspection technique (see Figure 4).

NOTE 7: The sample, in this case, is placed in the vessel with the leadframe side up, and then secured with an adhesive tape so that the water cannot penetrate into the interface area created by the mold release.