void, dielectric — An absence of screen printed ceramic from a designated area greater than 0.76 mm (0.003") in diameter.

void, metallization — An absence of refractory metallization, braze, or plating material from a designated area greater than 0.076 mm (0.003") in diameter.

8.2 *Visual Criteria* — (10× magnification) (See Section 8.1.)

8.2.1 *Ceramic* — Unmetallized Surfaces

8.2.1.1 *Cracks* — None allowed per MIL-M-38510, Method 1014.

8.2.2 *Chips*

8.2.2.1 *Corner* — 0.762 mm (0.030") × 0.762 mm (0.030") × one tape layer thickness, maximum.

8.2.2.2 *Edge* — 2.54 mm (0.100") × 0.762 mm (0.030") × one tape layer thickness, maximum.

8.2.2.3 Chips cannot encroach upon seal area, or contact pad, or expose any buried metallization.

8.2.3 *Burrs, Projections, and Blisters*

8.2.3.1 *Top Plane, Excluding Seal Area* — 0.102 mm (0.004") maximum.

8.2.3.2 *Seal Area* — 0.025 mm (0.001") maximum.

8.2.3.3 *Heat Exchanger Attach Area* — 0.076 mm (0.003") maximum (if designated).

8.2.3.4 *Contact Surface* — 0.051 mm (0.002") maximum.

8.2.3.5 *Edges* — 0.152 mm (0.006")

8.2.3.6 Burrs, projections, and blisters must fit within the outline tolerances.

8.2.4 *Camber* — Ceramic of 0.1 mm/25.4 mm (0.004 inch/inch), maximum. None to be specified less than 0.076 mm (0.003") along any planar dimension of the part.

8.2.5 *Flatness* — See table below:

Table 1 Flatness

Flatness: Seal Area: Seal Ring Size	*Flatness (TIR)*
0–6.35 mm (0"–0.250")	0.051 mm max. (0.002")
6.37–12.7 mm (0.251"–0.500")	0.076 mm max. (0.003")
12.72 –25.4 mm (0.501"–1.000")	0.101 mm max. (0.004")
25.42 mm and up (1.001")	0.004 in/in

8.3 *Ceramic Metallized Surfaces*

8.3.1 *Voids*

8.3.1.1 *Seal Area* — maximum of 3 voids permitted. No more than two voids per side of 0.010" diameter maximum each. Any two voids must be separated by 0.030" (0.762 mm) minimum, not to degrade the seal width by more than 25%.

8.3.1.2 *Footprint* — Two voids per pad 0.254 mm (0.010") diameter maximum. A contiguous path must never be reduced by more than 1/3 the minimum design width.

8.3.1.3 *Wire Bond Fingers* — A void-free area 0.254 mm (0.010") × 0.254 mm (0.010") or as defined by the customer drawing.

8.3.1.4 *Heat Exchange Attach Area* — (if designated) The major dimension of a void shall not exceed 0.508 mm (0.020") and all voids must be separated by 0.762 mm (0.030"). Total void area to be equal or less than 10%.

8.3.1.5 *Die Attach Surface* — Three voids of 0.010" diameter are the maximum allowed separated by 0.030" minimum.

NOTE: Voids within 0.015" of a cavity wall 0.381 mm are excluded from this requirement.

Table 2 Die Attach Area Flatness Limits

Die Attach Pad Dimension	*TIR Flatness*
0-12.7 mm (0–0.500")	0.51 mm (0.002" max.)
12.72–19.5 mm (0.501"–0.750")	0.088 mm (0.0035" max.)

8.3.1.6 *Internal Metallization* — Voids shall not break continuity between wire bond fingers and the corresponding contact pad. The user may specify additional resistance and capacitance parameters for each application.

8.3.2 *Burrs and Projections* — Shall not exceed the specification of Table 3.

Table 3 Maximum Height of Burrs and Projections

	Maximum Inches	*Height mm*
Wire Bond Finger Area	0.001	(0.025)
Seal Area	0.001	(0.025)
Die Attach Surface	0.001	(0.025)
Contact Pad	0.002	(0.051)
Heat Exchanger Attach Area	0.003	(0.076)

8.3.3 Pattern Definitions (Cavity Packages) — (See Figure 4.)

8.3.3.1 *Seal Plane Rundown* — internal cavity — Not to exceed 25% of the cavity layer thickness.

8.3.3.2 *External to the Cavity* — Separation shall not be less than 0.254 mm (0.010") or 50% of the design width, whichever is less.

8.3.3.3 *Wire Bond Finger Pullback* — Not to exceed maximum from the cavity edge. The minimum exposed lead length must meet the dimension per applicable drawing.

8.3.3.4 *Wire Bond Finger Rundown* — Not to exceed 25% of the ceramic layer thickness or 0.127 mm (0.005"), whichever is smaller.

8.3.4 *Pattern Separation* — Minimum shall not be reduced by more than 50% of the design.

8.4 *Lead Attachment*

8.4.1 *Voids in Braze* — 66% of the braze fillet must be void-free.

8.4.2 *Lead Alignment* — Misalignment leads to braze pads — The leads shall not overhang braze pads.

8.4.2.1 *Lead Offset* — To be specified on user drawing. Lead center lines must be aligned to within .178 mm (.007").

8.4.2.2 *Lead-to-Lead Misalignment* — To exceed ± 10% of nominal lead spacing.

8.4.2.3 *Dimensional Criteria* — To be specified on user drawing.

9 Sampling

Sample sizes must meet requirements of MIL-STD-105 or MIL-M-38510 as agreed to between vendor and customer. Single, double, or multiple samples may be used.

10 Test Methods

10.1 *Mechanical, Electrical, and Thermal Test Methods* — Per MIL-STD-883, unless otherwise noted.

10.1.1 Gold plating thickness shall conform to MIL-STD-45204. Gold thickness may be determined using the Beta Backscatter Radiation Method or X-Ray Fluorescence.

10.1.2 Nickel plating shall conform to MIL-STD-45204. Nickel thickness may be determined using the Beta Backscatter Radiation Method.

10.1.3 *Seal Ring Flatness* — See SEMI G6.

10.1.4 *Electrical Trace Resistance* — See SEMI G25.

10.1.5 *Gold Plating Quality* — See SEMI G8.

10.1.6 *Die Shear* — Destructive — Method 2019.

10.1.7 *Wire Bond* — Method 2011, Condition D. Reject for bonds which cause plating to lift from the base metal of the die attach surface or bonding fingers.

10.1.8 *Temperature Cycle* — Method 1010, Condition C.

10.1.9 *Thermal Shock* — Method 1011, Condition C.

10.1.10 *Constant Acceleration* — Method 2001, Condition E.

10.1.11 *Mechanical Shock* — Method 2002, Condition B.

10.1.12 *Insulation Resistance* — Method 1003.

10.1.13 *Internal Water Vapor Content* — Method 1018.

10.1.14 *Hermeticity* — Method 1014, Conditions A, B, and C. The hermetic integrity of the package must be maintained after all environmental testing.

10.1.15 *Lead Integrity* — Method 2004, Condition B.

10.1.16 *Solderability* — 2003.

10.1.17 *Moisture Resistance Testing* — Method 1004.

11 Packaging and Marking

11.1 *Packaging* — Containers selected shall be strong enough, and suitably designed, to provide maximum protection against crushing, spillage, and other forms of damage to the container or its contents. Containers shall afford protection of the contents to contamination from exposure to excessive moisture or oxidation by gases. Packaging materials shall be so selected to prevent any contamination of the ceramic component parts with paper fibers or organic particles. Regardless of packaging, all parts should be cleaned before testing or use.

11.2 *Marking* — The outer containers shall be clearly marked identifying:

1. Vendor Part #
2. Customer Part #
3. Quantity
4. Date
5. Vendor Lot #
6. User P.O. number (optional)
7. Drawing number (optional)

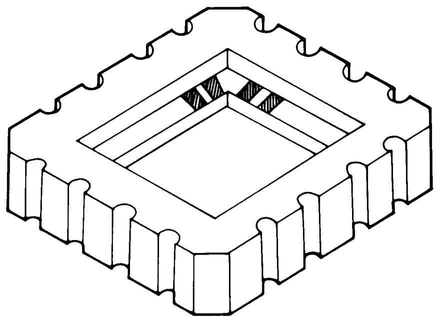

Figure 1
Castellations

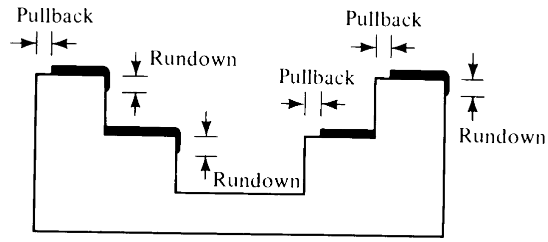

Figure 4
Metallization Misalignment

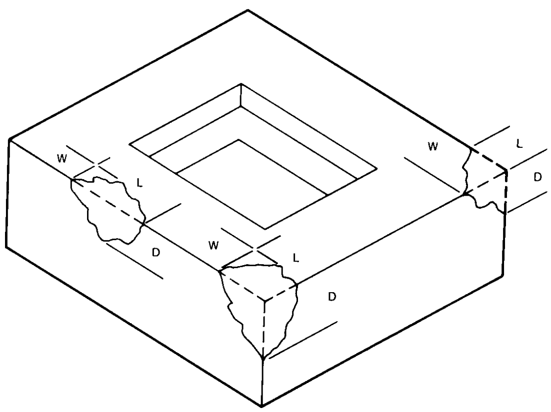

Figure 2
Chip Illustration

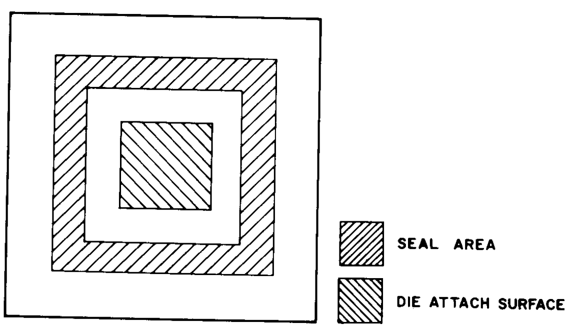

Figure 3
Die Attach Surface and Seal Area

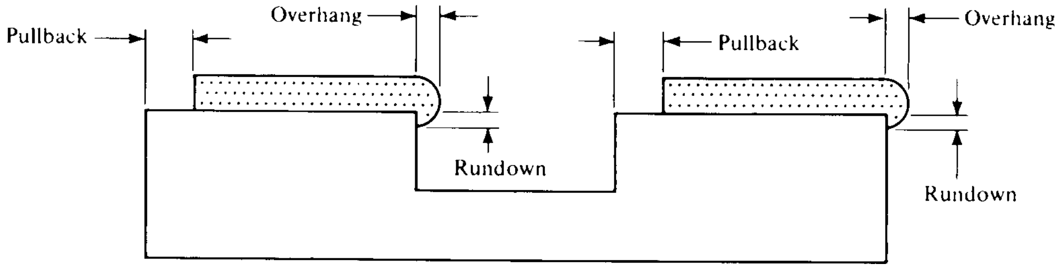

Figure 5
Glass Misalignment

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SEMI G6-89
TEST METHOD FOR SEAL RING FLATNESS

1 Purpose

This specification covers the method for determining the maximum deviation between the seal ring and a reference plane defined by three fixed points on the seal ring. This method will not work on parts smaller than 0.330" × 0.330".

2 Equipment

2.1 Flat plate (black granite calibrated at ± 0.000025" (± 0.000835 mm) or equivalent).

2.2 *Fixture Clamps* — Three required (See Figure 1).

2.3 *Fixture Base* — (See Figure 1).

2.4 *Test Indicator* — (Hamilton Kwik Check or equivalent).

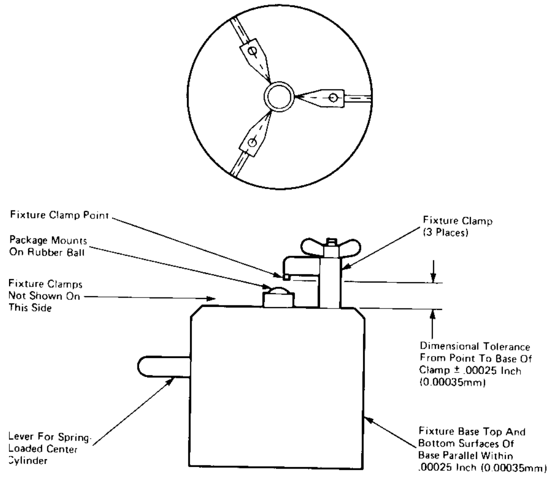


Figure 1
Fixture Base and Clamp Assembly

3 Preparation

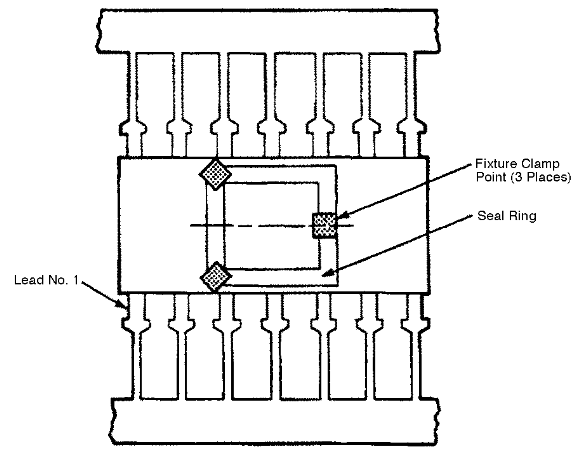
3.1 Fixture clamps shall be adjusted for part to be measured (see Figure 2).

3.2 The gaging fixture is to be calibrated with a precision ground gage block before each sample is measured.

3.2.1 Place gage block under the three fixture clamp points and release center cylinder to hold in place.

3.2.2 Position fixture base so the point of the test indicator is on the gage block.

3.2.3 Move fixture base so the point of the test indicator traverses the entire surface of the gage block. The total deviation read on the test indicator shall not exceed 0.0005" (0.013 mm).



Fixture clamp points aligned on seal ring diagonals on end closest to lead No. 1 and on ceramic center line opposite end.
Points aligned on diagonals shall not extend beyond the outside corners of the seal ring. Point aligned on the centerline shall not extend beyond the outside edge of the seal ring.

Figure 2
Fixture Clamp Orientation

4 Procedure

4.1 Place the package under the three fixture clamp points and release cylinder to hold in place (see Figure 2) for orientation of package seal ring and fixture clamp points.

4.2 Position fixture base so the point of the test indicator is on the package seal ring.

4.3 Move fixture base so the point of the test indicator traverses the length of the seal ring.

4.3.1 Move fixture base so the point of the test indicator stays in the middle of the seal ring.

4.3.2 Test indicator shall be relocated twice to get around fixture points.

5 Evaluation

If material buildup on the seal ring is visible with the unaided eye, the part shall not be used for this measurement.

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SEMI G8-94
TEST METHOD FOR GOLD PLATING

1 Preface

1.1 *Purpose* — This test method describes procedures to determine gold plating quality.

1.2 *Scope* — These methods apply to gold plating on cofired ceramic or metal packages. The grade, hardness, and thickness of the gold plating shall be specified per MIL-G-45204 unless otherwise agreed between vendor and customer.

Note 1: The gold plate may be over refractory metal on cofired ceramic packages or over an underplate on metal packages.

2 Applicable Documents

2.1 *Referenced Documents*

2.1.1 *SEMI Specifications* — All SEMI package specifications

2.1.2 *ASTM Specifications*[1]

B 384 — Standard Test Method for Microhardness of Materials

B 487 — Test Method for Measurement of Metal and Oxide Coating Thicknesses by Microscopic Examination of a Cross-Section

B 567 — Method for Measurement of Coating Thickness by the Beta Backscatter Method

B 568 — Method for Measuring Coating Thickness by X-Ray Spectrometry

F 1269 — Test Methods for Destructive Shear Testing of Ball Bonds

2.1.3 *Military and Federal Specifications*[2]

MIL-STD-750 — Test Methods for Semiconductor Devices

MIL-STD-883 — Test Methods and Procedures for Microelectronics

MIL-G-45204 — Gold Plating, Electrodeposited

2.2 *Related Documents*

Military and Federal Specifications

MIL-STD-105 — Sampling Procedures and Tables for Inspection by Attributes

MIL-STD-202 — Test Methods for Electronic and Electrical Componenet Parts

MIL-STD-19500 — General Specification for Semicondutor Devices

MIL-M-38510 — General Specification for Microcircuits

3 Summary of Method

Various test methods are described or referenced to determine gold plating quality for the following items:

Visual Appearance

Plating Thickness

Plating Adhesion

Functional tests

Salt Atmosphere

Hardness

4 Significance and Use

4.1 *Significance* — Poorly plated components result in lowered yields during package assembly operations or to reliability problems.

4.2 *Use* — The methods described in this document may be used by vendors to test gold plated components as part of their process control program, or by customers at incoming inspections.

The methods are to used in conjunction with individual component specifications.

5 Terminology

5.1 *blister (metal)* — An enclosed, localized separation of a metallization layer from its base material (such as ceramic or another metal layer) that does not expose the underlying layer.

5.2 *discoloration* — The change in color of any plated metallization, gold, silver, aluminum, etc., as detected by the unaided eye after the application of heat to the metallization. The metallization may be over base metal, another plated layer, or on refractory metal.

5.3 *peeling (flaking)* — Any separation of the plated, vacuum deposited or clad metal from the base metal of a leadframe, lead, pin, heatsink, or seal ring, from an underplate, or from refractory metal on a ceramic package. Peeling exposes the underlying material. Also called flaking.

1 American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohoken, PA 19428-2959

2 Military Standards, Naval Publications and Form Center, 5801 Tabor Avenue, Philadepphia, PA 19120

5.4 *pitting (plated metal layer)* — Unspecified depressions in the plated layer, not the underlying layer(s). Such pits may be caused by incorrect plating conditions.

5.5 *resin bleed-out (die attach)* — The surface creep of a resin used for die attach beyond the outer perimeter of the bulk of the resin (filler). For a given resin formulation, the resin creep may be exacerbated by the microstructure and cleanliness of the die attach surface.

5.6 *scratch* — An abrasion in the surface of a metallization layer which exposes the base material.

6 Interferences

6.1 Avoid contaminating the gold plated surface (e.g., with finger oils), prior to performing the tests. Such contamination may effect visual appearance, and die attach, wire bond, and solderability functional tests.

7 Equipment

7.1 Beta Backscatter system

7.2 Die Attach equipment

7.3 Eutectic Die Attach heater block or lot plate capable of 450 °C ± 10 °C.

7.4 Microscope 10-30× magnification with vertical lighting.

7.5 Micro Cross-Section equipment

7.6 Wire Bond equipment

7.7 X-Ray Fluorescence System

8 Sampling

8.1 Sampling plans shall be agreed between vendor and customer.

9 Test Sequence

When the test methods are used at incoming inspection the sequence of test shall be as follows:

9.1 *Visual Appearance* — See Section 10.1.

9.2 *Plating Thickness* — See Section 10.2.

9.3 *Plating Adhesion* — See Section 10.3.

9.4 *Functional Tests (Die Attach, Wire Bond, and Lead Solderability)* — See Section 10.4.

9.5 *Salt Atmosphere Test* — See Section 10.5.

9.6 *Plating Hardness* — See Section 10.6.

10 Test Procedures

10.1 *Visual Inspection*

10.1.1 Components shall be visually inspected according to the appropriate component specification for plating requirements.

10.1.2 *Surface Structure* — The gold plate shall be smooth matte to semi-bright in appearance. Minor variations in color are not cause for failure at this stage unless there is evidence of corrosion, peeling, or pitting in the plating layer.

Note 2: For the purposes of this test method, particular attention shall be observed in relation to blisters and adhesion problems with the plating layer.

10.2 *Plating Thickness*

10.2.1 Plating thickness shall be measured at locations agreed upon between vendor and customer.

10.2.2 Plating thickness may be measured by one of the following techniques, which are listed in order of preference.

ASTM Method B 568

ASTM Method B 567

ASTM Method B 487

Note 3: Method B 487 shall only be used for thicknesses greater than 100 microinches (0.0025 mm).

10.3 *Plating Adhesion*

10.3.1 Submit samples to 450 °C ± 10°C for two (2) minutes in air on a die attach heater block or hot plate.

10.3.2 Visually inspect the plating under the microscope set at 10× magnification for blistering, peeling, and discoloration.

Note 4: Discoloration after the heat testing is only allowable if the gold plate thickness is less than 20 micro-inches (508 micro mm) by design. Amount and type of discoloration shall be agreed upon between vendor and customer.

Note 5: 30× magnification may be used for confirmation.

10.3.3 *Adhesion Tape Test — Flat Surface*

10.3.3.1 Place a strip of tape across the plated area. Press firmly with finger tips or another smooth object.

10.3.3.2 Peel the tape quickly off the plated surface. If there is any plating on the tape the component shall be rejected.

10.3.4 *Lead Finish Adherence — Bend Test*

10.3.4.1 Bend the leads once through a 90° angle on a diameter equal to the lead diameter or thickness.

10.3.4.2 Visually inspect the plating under the microscope set at 10× magnification for evidence peeling or cracking of the plated layer.

10.4 *Functional Tests*

10.4.1 *Die Attach and Wire Bond*

10.4.1.1 Die Attach and Wire Bond tests shall be performed using materials and conditions agreed between vendor and customer.

10.4.1.2 Die Attach shall be evaluated for shear strength per MIL-STD-883, Method 2019 or by a method agreed between vendor and customer.

Resin bleed-out shall also be evaluated when the extent of the bleed may affect subsequent wire bonding processes.

10.4.2 *Solderability*

10.4.2.1 Solderability testing, with or without aging, shall be agreed between vendor and customer. Solderability testing shall be performed per MIL-STD-883, Method 2003.

10.5 *Salt Atmosphere Test*

10.5.1 *Salt Atmosphere Testing Requirements* — Applicability and condition shall be agreed between vendor and customer. Salt atmosphere testing shall be performed per MIL-STD-883, Method 1009 or MIL-STD-750, Method 1041 as appropriate.

10.6 *Plating Hardness*

10.6.1 If specified, the plating hardness shall be determined by one of the following methods as appropriate:

ASTM B 384

ASTM E 10

Note 6: Hardness testing for thin plating is difficult and not very reliable. The hardness specification shall be agreed between user and supplier.

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SEMI G9-89
SPECIFICATION FOR STAMPED LEADFRAMES FOR PLASTIC MOLDED DUAL-IN-LINE SEMICONDUCTOR PACKAGES

1 Preface

This specification is a guideline for the stamping manufacture of leadframes for plastic molded dual-in-line semiconductor packages. It is a design guideline for packaging engineers, leadframe stampers and mold manufacturers, and has been developed to meet the requirements of automatic bonding.

2 Applicable Documents

2.1 This document specifically refers to:

SEMI G4 — Specification for Integrated Circuit Leadframe Materials Used in the Production of Stamped Leadframes

SEMI G10 — Standard Method of Mechanical Measurement

SEMI G21 — Specification for Plating Integrated Circuit Leadframes

2.2 Related information may also be found in:

MIL-STD-105[1] — Sampling Procedures and Tables for Inspection by Attributes

MIL-STD-883 — Test Methods and Procedures for Microelectronics

3 Selected Definitions

burr — A fragment of excess material either horizontal or vertical attached to the leadframe.

camber — Curvature of the leadframe strip edge (see Figure 1).

coil set — Longitudinal bowing of the leadframe strip length (see Figure 2).

coined area — Reference lead flat surface.

crossbow — Transverse bowing of the leadframe (see Figure 3.)

functional area — The die attach pad and the lead tips.

lead flat surface — Area on the lead tips that is suitable and available for wire bonding. This is generally achieved by coining on stamped leadframes and is also known as the coined area on such leadframes.

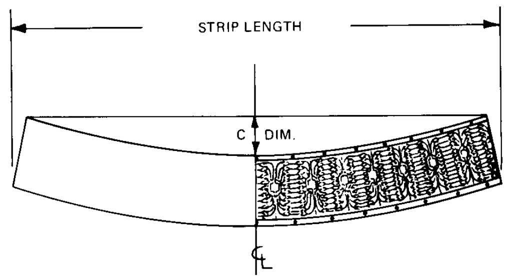

Figure 1
Camber

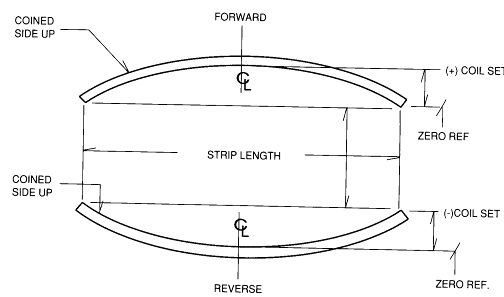

Figure 2
Coil Set

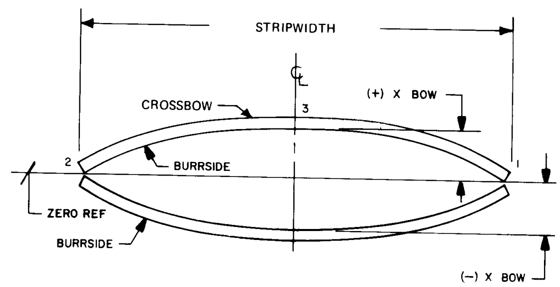

Figure 3
Crossbow

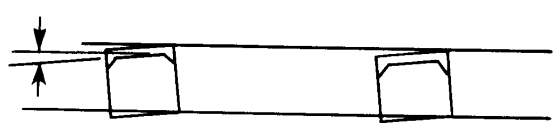

Figure 4
Lead Twist

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1 Military Standards, Naval Publications and Form Center, 508 Tabor Ave., Philadelphia, PA 19120

(insert on received)

Figure 5
Stamped Leadframe Terminology

lead twist — Angular rotation on bonding fingers (see Figure 4).

pits — Shallow surface depressions or craters in the leadframe material.

slug marks — Random dents in the leadframe caused by foreign material in the stamping die.

stamped leadframe terminology — See Figure 5.

Z plane — Lead and pad planarity require a reference in the Z dimensions. The recommendation for the reference plane, hereafter called the “Z” plane, is the average of the two dambars when measured at their geometric center. This reference method is incorporated into SEMI G10.

4 Ordering Information

Purchase orders for leadframes for plastic molded dual-in-line semiconductor packages furnished to this specification shall include the following items:

1. Part Specification
2. Material
3. Number of Leads
4. Material Certification
5. Packaging and Marking (see Section 8)

5 Dimensions

See applicable part specification as referred to in Ordering Information, Section 4.

6 Defect Limits and Parameters(See SEMI G10 to Measure)

6.1 *Bond Targets*

6.1.1 Minimum area for bonding to allow placement of true position target of diameter taken (See Table below); 100% within the lead flat area and recommended to be 0.025" (0.63 mm) length from the tip, where plane geometry allows. (See SEMI G10, Section 14.)

Design Lead Width	*Design Lead Space*	*Minimum Lead Space*	*Minimum True Position Target*
≥ 0.011	≥ 0.011	0.006	0.007 Diameter
0.010	0.010	0.005	0.006 Diameter

NOTE: Tolerances for lead designs smaller than 0.010 should be negotiated between vendor and user.

6.1.2 Minimum metal to metal clearance to be as follows:

Material gage 0.010" (0.25 mm) – 0.006" (0.15 mm)

Material gage 0.008" (0.20 mm) – 0.004" (0.10 mm)

(See SEMI G10, Section 14)

6.1.3 Depth of coining on stamped leadframes to be no greater than 30% of material gage. (See SEMI G10, Section 15.)

6.1.4 Lead twist is not to exceed 3° 30' (0.0006" per 0.010" (0.016 mm per 0.25 mm)). (see SEMI G10, Section 3).

6.1.5 Lead tip will exhibit maximum 0.006" (0.15 mm) radius measured in the x-y plane at the lead flat surface (see Figure 6).

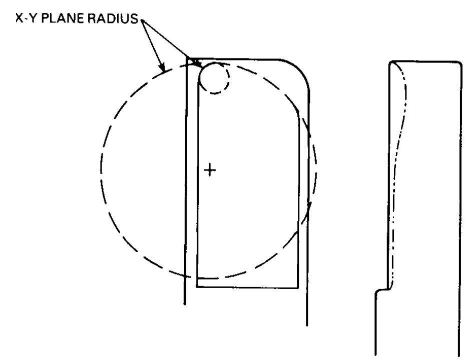

Figure 6
Lead Flat Radius

6.2 *Die Attach Pad Surface*

6.2.1 Die attach pad x-y axis location to be as follows:

rail-pad tie bar length	0.50" (12.5 mm) ± 0.002" (0.05 mm)
rail-pad tie bar length	0.50" (12.5 mm) ± 0.003" (0.08 mm)

from nominal drawing location. (See SEMI G10, Section 14.)

6.2.2 Die attach pad tilt to be as follows:

depressed pad — maximum 0.002" (0.05 mm) per 0.100" (2.5 mm)

undepressed pad — maximum 0.001" (0.025 mm) per 0.100" (2.5 mm) (see SEMI G10, Section 5)

6.2.3 Die attach pad flatness to be within 0.0002" (0.005 mm) T.I.R. per 0.100" (2.5 mm).

6.3 *Die Attach Pad Downset*

6.3.1 Die attach pad downset to be maximum ± 0.002" (0.05 mm) of nominal specified downset (see SEMI G10, Section 9).

6.4 *Lead and Die Attach Pad Planarity*

6.4.1 *Lead Planarity* — (See SEMI G10, Section 8)

6.4.1.1 Allowable tolerance is given by the following:

Strip Width	*Material Gage, 0.010" (0.25 mm)*	*Material Gage, 0.008" (0.20 mm)*
less than 1.000" (25.4 mm)	± 0.004" (0.10 mm)	± 0.003" (0.08 mm)
1.00" (25.4 mm) to 2.00" (50.8 mm)	± 0.005" (0.13 mm)	± 0.004" (0.10 mm)
greater than 2.00" (50.8 mm)	± 0.010" (0.25 mm)	± 0.008" (0.20 mm)

(See SEMI G10, Section 8.)

6.4.2 Die attach pad planarity (see SEMI G10, Section 11).

6.4.2.1 Allowable pad planarity tolerance, downset pad condition is given by the following:

Strip Width	*Tolerance*
Less than 0.75" (18.75 mm)	± 0.002" (0.05 mm)
0.75" (18.75 mm) to 1.00" (25.4 mm)	+0.003" (0.08 mm) to –0.005" (0.13 mm)
Greater than 1.00" (25.4 mm)	+0.006" (0.15 mm) to –0.003" (0.08 mm)

(See SEMI G10, Section 11.)

6.4.2.2 Allowable pad planarity tolerance, undepressed pad condition will not be specified in this document and is subject to vendor/customer negotiation.

6.5 *Material Tolerance*

6.5.1 Material dimensional tolerances are to be given by SEMI G4.

6.6 *Coil Set*

6.6.1 Coil set shall not exceed 0.020" over nominal length of the cut strip (see SEMI G10, Section 10).

6.7 *Crossbow*

6.7.1 Crossbow shall not exceed 0.5% of nominal strip width (see SEMI G10, Section 7).

6.8 *Camber*

6.8.1 Camber shall not exceed 0.002" (0.05 mm) over gage length of 6.00" (150 mm) (see SEMI G10, Section 6).

6.9 *Strip Pitch*

6.9.1 Strip pitch tolerance shall be ± 0.002" (0.05 mm) over the maximum measurable progression within the nominal strip length (see SEMI G10, Section 4).

6.10 *Burrs*

6.10.1 Burrs shall be firmly attached and able to withstand a probe force of 10 grams. Vertical burrs inside the dambar shall not exceed 0.001" (0.025 mm). Vertical burrs outside the dambar and horizontal burrs in any location shall not exceed 0.002" (0.051 mm) (see SEMI G10, Section 12).

6.11 *Pits (Indentations)*

6.11.1 Within function area and on external leads, there shall be no measurable slug marks. Pits shall not exceed 0.0003" (0.008 mm) in depth and 0.0005" (0.013 mm) in largest surface dimension in these areas (see SEMI G10, Section 13).

APPLICATION NOTE: There is a question regarding the ability of material suppliers to meet this specification. Revision of this specification is under review.

6.11.2 In other areas, pits and imperfections shall not affect leadframe strength regardless of size and shall not exceed 0.002" (0.051 mm) in depth and 0.005" (0.127 mm) in largest surface dimensions (see SEMI G10, Section 13).

6.12 *Plating*

6.12.1 All plating related characteristics shall be specified by SEMI G21.

6.13 *Strip Length and Cutoff* — (See SEMI G10, Section 14.)

6.13.1 Strip cutoff location shall be ± 0.003" (0.08 mm) of specified nominal location.

6.13.2 Overall strip length shall be ± 0.003" (0.08 mm) of specified nominal length.

6.14 *Lead Fatigue* — Number of cycles to be determined between customer and supplier. (See SEMI G10, Section 16.)

7 Sampling

Sampling will be determined between supplier and purchaser.

8 Packaging and Marking

8.1 *Packaging* — Leadframes must be packaged in containers designed and constructed to prevent damage and/or contamination. Specific protection must be provided against foreseeable mechanical and environmental hazards.

8.2 *Marking* — The outer containers shall be clearly marked identifying the user stock number, user purchase order number, drawing number, and vendor lot numbers within the carton.

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SEMI G10-96
STANDARD METHOD FOR MECHANICAL MEASUREMENT OF PLASTIC PACKAGE LEADFRAMES

1 Purpose

This method outlines standard mechanical measurement techniques for cut strip leadframes.

2 Scope

This method applies to all facilities that perform mechanical measurements on leadframes. Information is provided herein to enable the use of the following specifications: SEMI G9, SEMI G27, and SEMI G28.

3 Referenced Documents

None.

4 Terminology

None.

5 Equipment

1. Surface illuminated optical comparator with x-y grid
2. Toolmaker's microscope with depth ("z") reading capability, 100×, 400×, obtained with 10× objective, and 40× objective lens with 0.0002" resolution.
    a. Digital readout 0.0002" resolution on x-axis (optional)
    b. Closed circuit TV and camera (optional)
3. Surface plate
4. Gage pins
5. Universal leadframe fixture (see Figure 16)
    a. Fixture shall be perpendicular to optics within the resolution of the instrument and parallel to x and y travel axes.
    b. Leadframe strip shall be placed lead-flat surface up and clamped at rails to fixture base.
    c. The reference plane for measurement, hereinafter called the "z" plane, is the average of the height of the two dambars when measured at their geometric center.
    d. Z-plane cannot be established by this method if the dambar height measurement difference is greater than 0.003". Therefore, units that exhibit greater than 0.003" difference are not acceptable for z-axis measurement.
6. Leadframe camber fixture
    a. Nominal strip orientation defined in Figure 8.
7. Lead fatigue tester
8. Metal-to-metal clearance step gage (see Figure 13)
9. 0-1", 0.0001" reading micrometer
10. Overlay (see Figure 17)
    a. Overlay reference point shall be based on strip pilot holes. If pilot holes are off screen, x-y offsets of overlay pilot position to actual pilot position shall be specified.
    b. True position targets shall be placed on nominal lead center line 0.0065" (0.163 mm) back from nominal lead tip.
    c. Overlay will contain nominal pad location outline.
    d. Overlay will contain nominal strip cutoff position and required x-axis traverse for alignment.

6 Procedure for Lead Twist (Z-Axis) (See Figure 1)

Equipment — Toolmaker's microscope (400× magnification), leadframe fixture.

6.1 Fixture leadframe and establish z-plane as described in Section 5, items 5a and 5b.

6.2 Focus microscope on the edge of the coined surface 0.010" back from the end of the lead tip on the lead to be measured. Ensure that the focus is done on the flat-coined surface and not on the rolled edge. Zero the focal height (z-axis).

6.3 Using the micrometer drum, move the stage the specified distance and refocus the microscope. Ensure that both focus points are on the flat-coined surface, and not on the rolled edge. Focal height difference is the lead twist measurement.

7 Procedure for Strip Pitch (X-Axis) (See Figure 2)

Equipment — Optical comparator (20× lens), piece part drawing.

7.1 All measurements will be taken from the pilot holes referred to on the piece part print unless otherwise noted.

7.2 Line up the pilot holes at each end of the strip so that they are in the same horizontal plane. Center the pilot hole by rotating the comparator screen 45° (Figure 3). Ensure that the vertical and horizontal lines (now at 45°) are tangent to the edge of the pilot hole. Zero the readout, move the stage (horizontal travel) to the proper pilot hole at the end of the strip. Center the specified pilot hole on the strip. Read the horizontal readout for the strip pitch measurement.

8 Procedure for Pad Tilt (Z-Axis) (See Figure 4)

Equipment — Toolmaker's microscope (100× magnification), leadframe fixture.

8.1 Fixture leadframe and establish z-plane as described in Section 5, items 5a and 5b.

8.2 All targets are to be located .005" (.127 mm) in from cut edge, ensuring that the target is not located on the rolled edge.

8.3 Focus the toolmaker's microscope on one target crossbow (A), zero focal height (z-axis).

8.4 Use the barrel micrometer to move to the second target (B) of the die-attach pad. Note traverse distance for extrapolation of specification. Refocus the microscope. The focal height (z-axis) difference is the tentative pad tilt measurement.

8.5 Repeat at targets shown in Table 1.

Table 1 Measurement Targets

	A	B
2 Tie bars	1	2
	3	4
3 or more	1	2
Tie bars	3	4
	1	3
	2	4

8.6 Pad tilt is worst case of tentative measurements taken per Table 1.

9 Procedure for Camber (See Figure 5)

Equipment — Camber fixture

9.1 Place the part to be measured in the camber fixture on the comparator table. Ensure the strip rests against the gage pins.

9.2 Place the horizontal center line on the strip edge then down at the aperture.

9.3 This dimension, less gage distance, is the camber measurement. Traverse the stage to bring the horizontal center line to the reference edge.

10 Procedure for Crossbow (See Figure 6)

Equipment — Toolmaker's microscope (100× magnification), leadframe fixture.

10.1 Fixture leadframe and establish z-plane as described in Section 5, items 5a and 5b.

10.2 Focus the toolmaker's microscope on the center of top rail above the dambar (1). Zero focal height (z-axis).

10.3 Move to the center of the opposite rail above the dambar (2) and refocus. Average these two focal heights to establish the base zero focal height.

10.4 Move to the center of the dambar (3) and refocus. Focal height difference to base zero focal height is the crossbow measurement.

11 Procedure for Lead Planarity (See Figure 7)

Equipment — Toolmaker's microscope (100× magnification), leadframe fixture.

11.1 Fixture leadframe and establish z-plane as described in Section 5, items 5a and 5b.

11.2 Focus the toolmaker's microscope on the center of the dambar (1), then zero the focal height (z-axis).

11.3 Move to the center of the opposite dambar (2) and refocus. Average these two focal heights to establish the base zero focal height.

11.4 Move to subject lead (3) and refocus .010" (.254 mm) back from the lead tip. Note z-axis difference to base zero focal height. Subtract measured coin depth to give actual planarity measurement. Repeat above procedure for all leads to be measured. Be sure to record the plus (+) or minus (–) sign for each reading.

12 Procedure for Downset (See Figure 9)

12.1 Fixture leadframe and establish z-plane as described in Section 5, items 5a and 5b.

12.2 Focus the toolmaker's microscope at the location numbered in Column A of Table 2 and zero the focal height (z-axis). Move the workholder so that the corresponding location from Column B is under the microscope and refocus. The difference in readings is the downsett measurement.

Table 2

	A	*B*	*Destination*
P-dip	1	2	Bottom
	3	4	Top
Quad	1	2	1st Quad
	3	4	2nd Quad
	5	6	3rd Quad
	7	8	4th Quad

12.3 Repeat this for all tie bars indicated in Table 2.

12.4 All measurements must fall within the specification that applies.

13 Procedure for Coil Set (See Figure 10)

Equipment — Surface plate, gage pins

13.1 Place the strip on the surface plate, bond target side down, depressed pad up.

13.2 Slip gage pins under until you find the largest size that will fit under freely at possible locations shown. Pin diameter is the coil set measurement, noting the + or designation of coil set direction per Figure l0.

14 Procedure for Pad Planarity (Z-Axis) (See Figure 11)

Equipment — Toolmaker's microscope (100× magnification), leadframe fixture.

14.1 Fixture leadframe and establish z-plane as described in Section 5.5.

14.2 Move to the center of the die-attach pad (3) and refocus. The focal height difference is the pad planarity measurement.

15 Procedure for Burrs (X, Y, Z-Axis)

15.1 *Vertical Burrs* — (See Figure 12.)

Equipment — Toolmaker's microscope (400× magnification), leadframe fixture.

15.1.1 Fixture leadframe lead flat down and establish z-plane as described in Section 5, items 5a and 5b.

15.1.2 Focus the toolmaker's microscope on point A. Zero the focal height (z-axis).

15.1.3 Move to the top of the burr (Point B) and refocus the toolmaker's microscope. The focal height difference is the height of the vertical burr.

15.2 *Horizontal Burrs (X, Y-Axis)* — (See B, Figure 12.)

Equipment — Toolmaker's microscope (400× magnification).

15.2.1 Measure the horizontal burrs using the toolmaker's microscope in a similar manner to that described in 15.1.2 and 15.1.3.

15.2.2 Line up the cut edge (Point C) with the 0 center line on the toolmaker's microscope. Record the number on micrometer drum.

15.2.3 Move the stage to align the centerline with the end of the burr (Point D). The lateral movement (difference between start/end micrometer reading) will be the burr dimension.

16 Procedure for Pits, Slug Marks, Tool Marks (X, Y, Z-Axis), and Horizontal Burrs (See Figure 14)

16.1 *Depth (Z-Axis)*

Equipment — Toolmaker's microscope (400× magnification), leadframe fixture.

16.1.1 Fixture leadframe and establish z-plane as described in Section 5, items 5a and 5b.

16.1.2 Focus the toolmaker's microscope on the base of the material near the defect, then zero the focal height (z-axis).

16.1.3 Move to the pit, slug mark, or tool mark. Refocus on the deepest portion. The focal height difference (z-axis) is the depth of the pit, tool mark, or slug mark.

16.2 *Surface Dimension, Length, Width (X,Y-Axis)*

Equipment — Toolmaker's microscope (400× magnification), leadframe fixture.

16.2.1 Fixture leadframe and establish z-plane as described in Section 5, items 5a and 5b.

16.2.2 Line up to edge of the pit, slug mark, or tool mark on the cross hair. Note the micrometer drum reading.

16.2.3 Move to the opposite side of the pit, slug mark, or tool mark. The lateral movement (difference between start/end micrometer readings) is the pit, slug mark, or tool mark surface dimension.

17 Procedure for X-Y Dimensional Measurement

Equipment — Surface lit optical comparator, true position overlay, metal-to-metal step gage.

17.1 Align overlay to travel axes within the resolution of the instrument.

17.2 Position leadframe to overlay by optical methods.

17.3 Overlay targets will now be positioned to inspect lead-flat location.

17.4 Pad outline will be positioned to inspect pad location.

17.5 Metal-to-metal clearance is evaluated by use of step gage against leadframe image on comparator screen.

17.6 Traverse to specified distance to inspect cutoff position.

18 Method for Coin-Depth Measurement (See Figure 15)

18.1 Bend sample lead up for accessibility.

18.2 Measure material thickness beyond lead flat.

18.3 Measure material thickness within lead flat. Difference between two readings is depth of coining.

19 Procedure for Measuring Lead Fatigue

Equipment — Automatic or manual lead fatigue tester with 8 oz. ± .5 oz. weight.

19.1 Clamp leadframe strip on dambar of test frame (see Figure 18).

19.2 Clamp 8 oz. weight on bottom-half of lead (see Figure 19). Clamp must be at least L/2 from lead shoulder.

NOTE: If lead is clamped too close to shoulder, a reduction in measured lead strength will result, caused by twisting of weight.

19.3 Turn on lead fatigue machine and set all counters at zero.

19.4 Activate lead fatigue machine such that clamp arm rotates through 90° ± 5° (see Figures 20 and 21). This will result in actual bend of lead slightly less than 90°, depending on strength of metal.

19.5 Set machine to a two-to-five second cycle. One cycle defined to be a 90° rotation and back.

19.6 Count number of complete cycles until metal lead breaks and weight drops into pan.

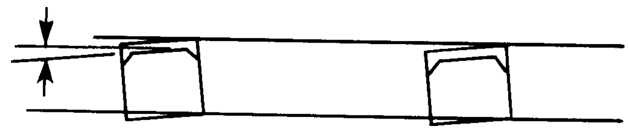


Figure 1
Lead Twist

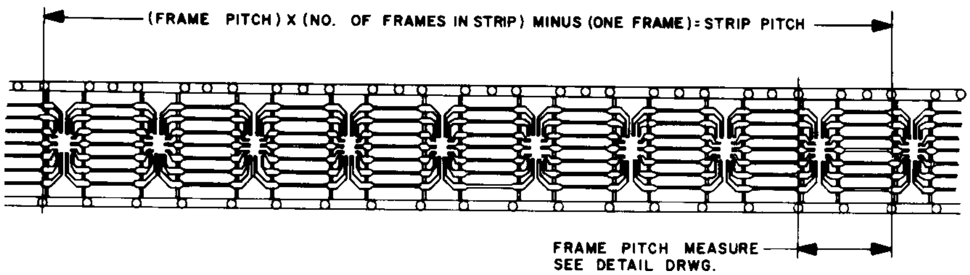


Figure 2
Strip Pitch

Strip Pitch

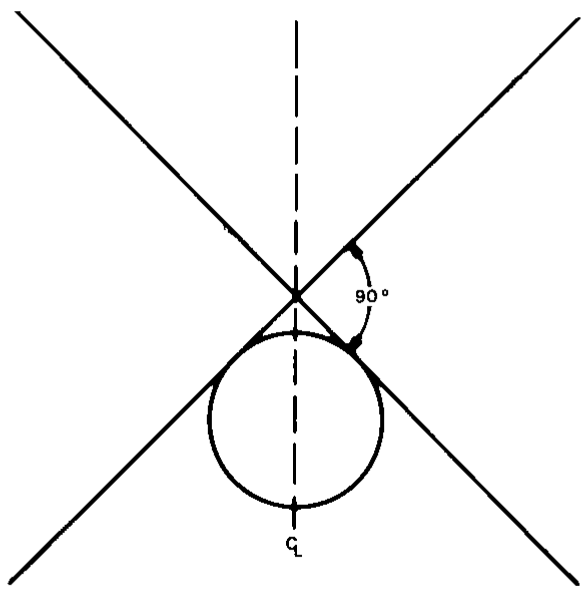


Figure 3
Pilot Hole

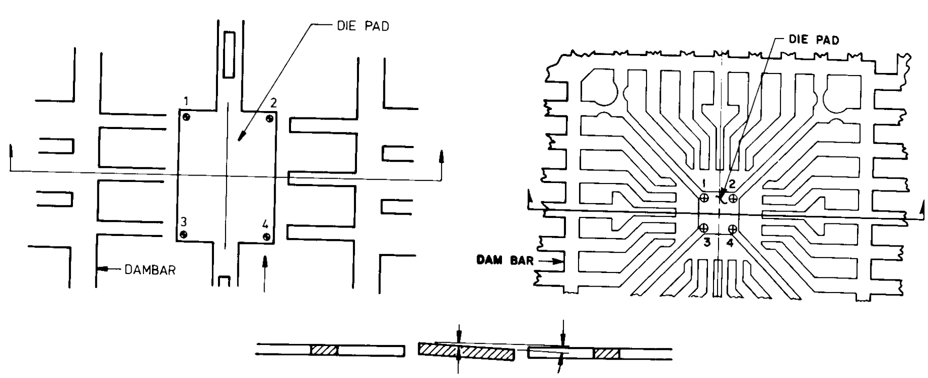
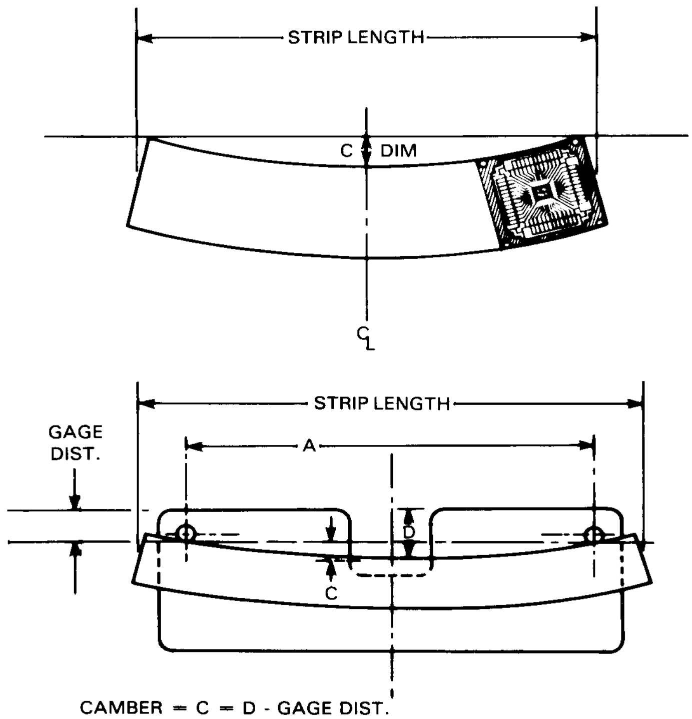


Figure 4
Pad Tilt



CAMBER IS REFERENCED TO DIMENSION A, NOT STRIP LENGTH.
STRIP LENGTH MUST BE LONGER THAN A.

Figure 5
Camber

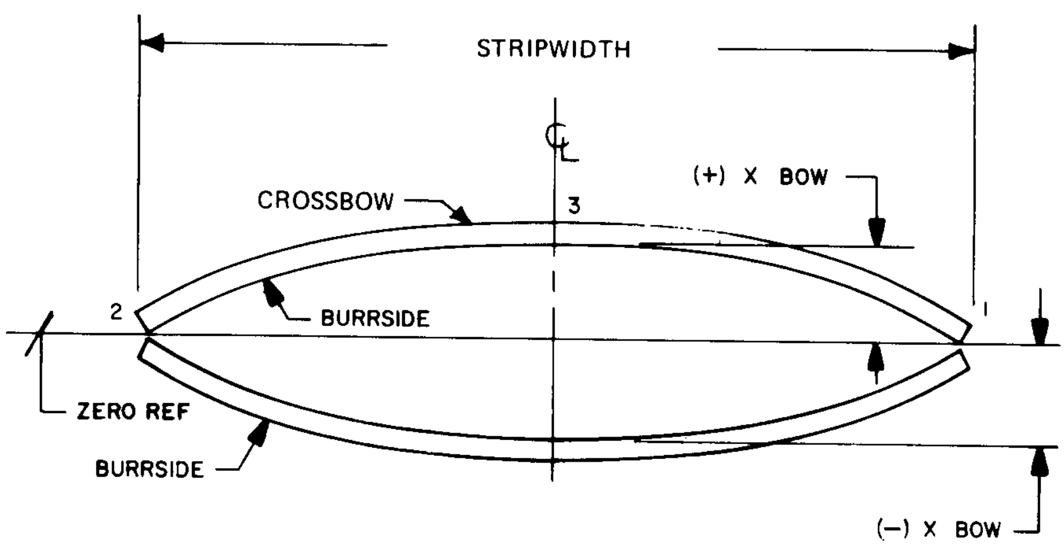


Figure 6
Crossbow

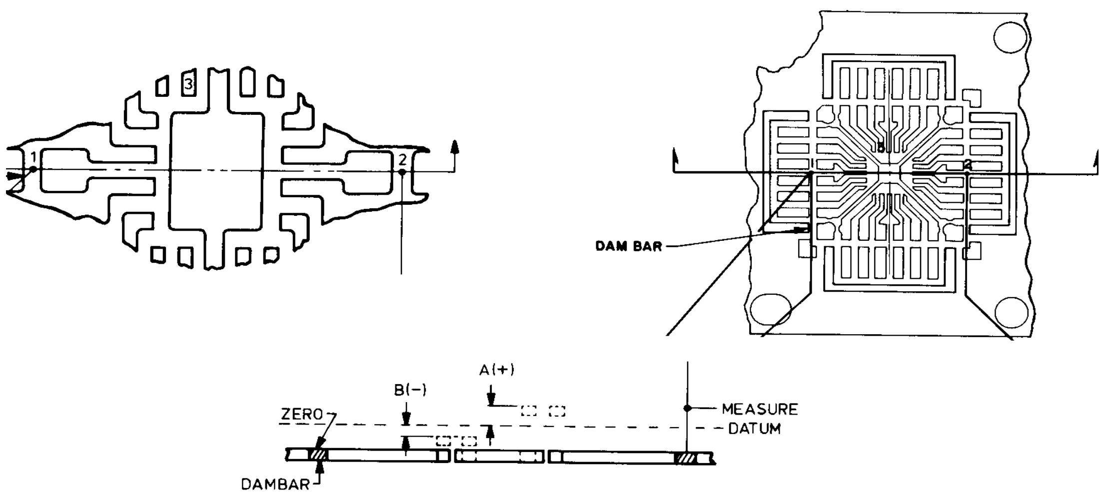


Figure 7
Lead Planarity

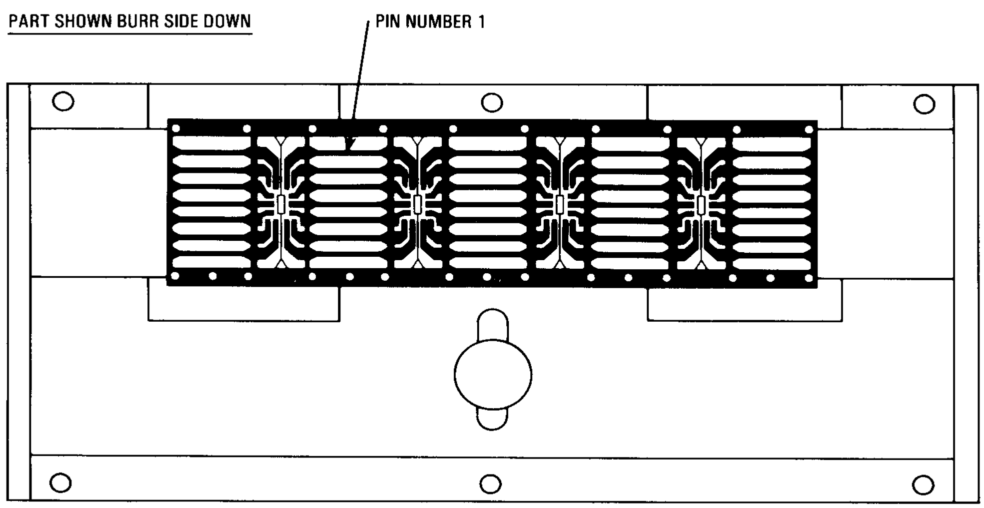


Figure 8
Strip Nominal Orientation

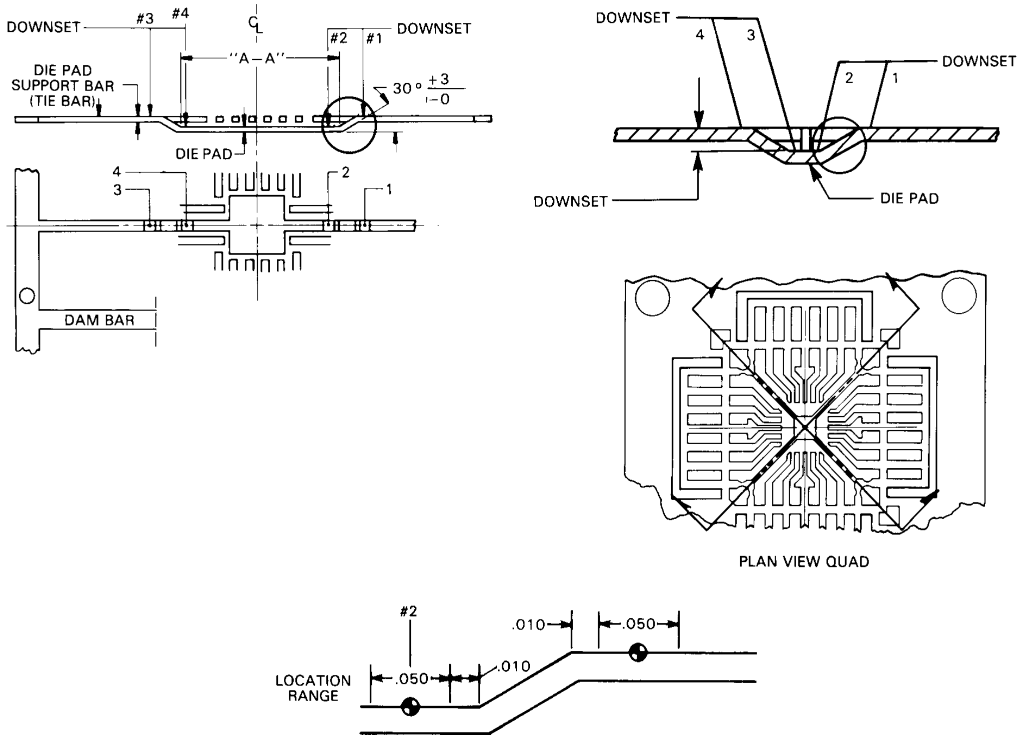


Figure 9
Downset

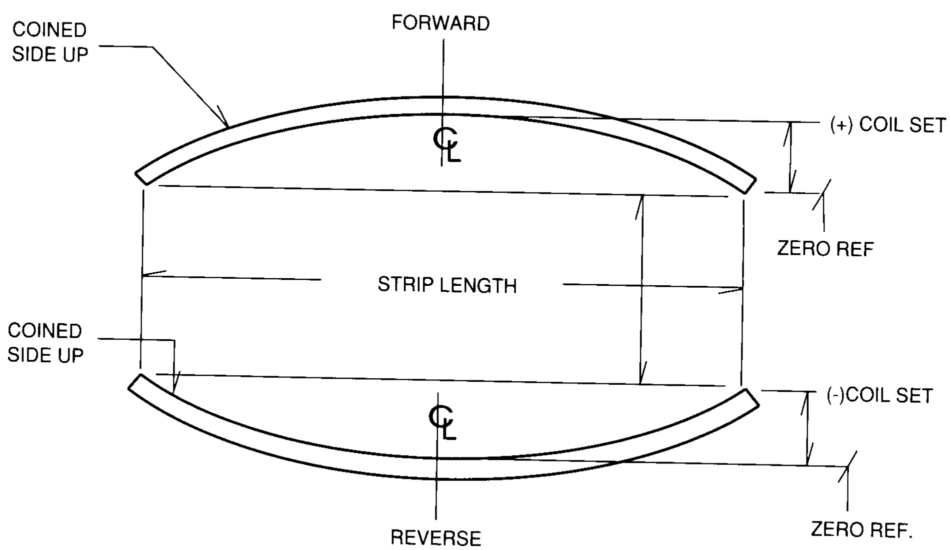


Figure 10
Coil Set

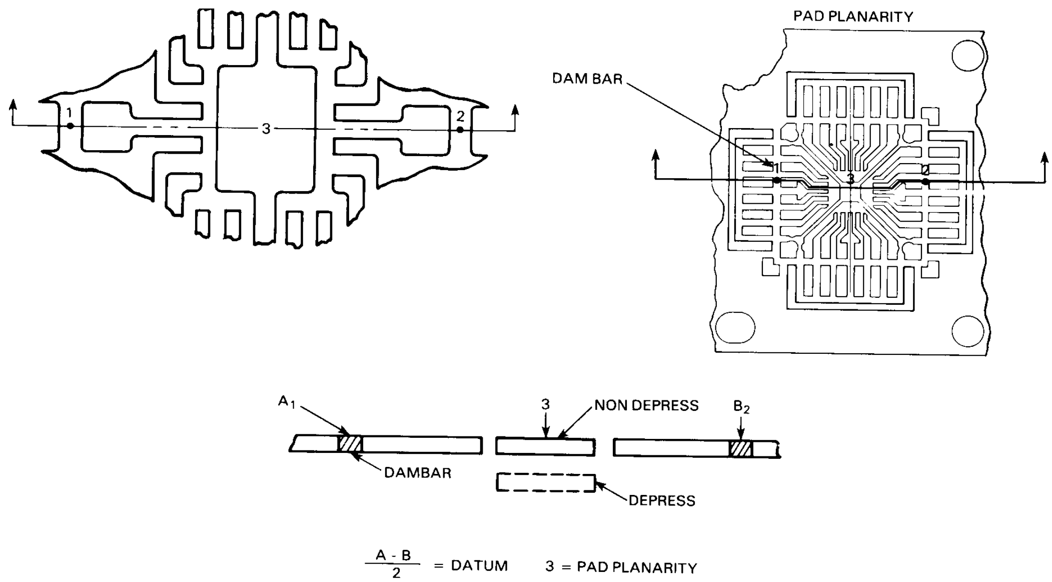


Figure 11
Pad Planarity

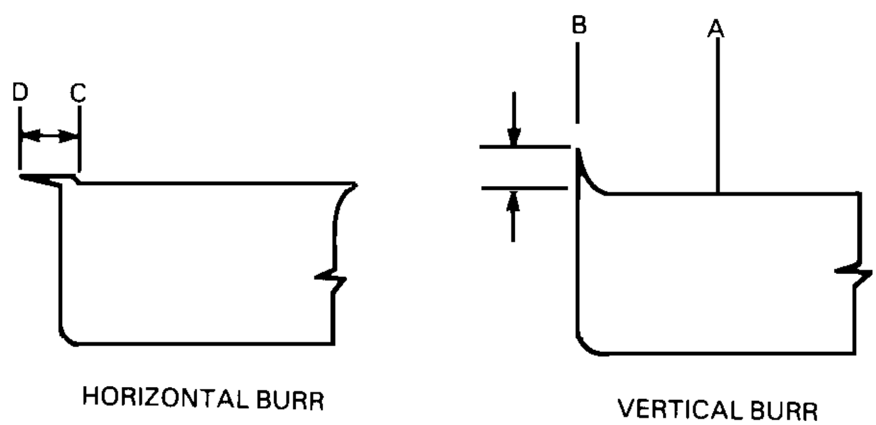


Figure 12
Cutting Burrs

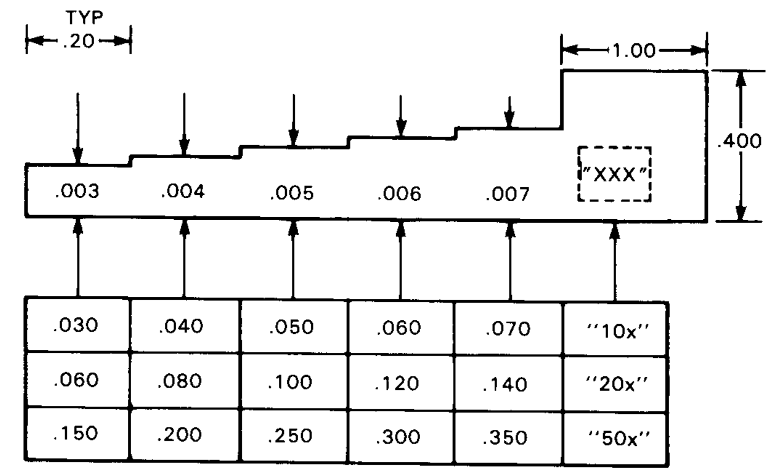


Figure 13
Step Gage

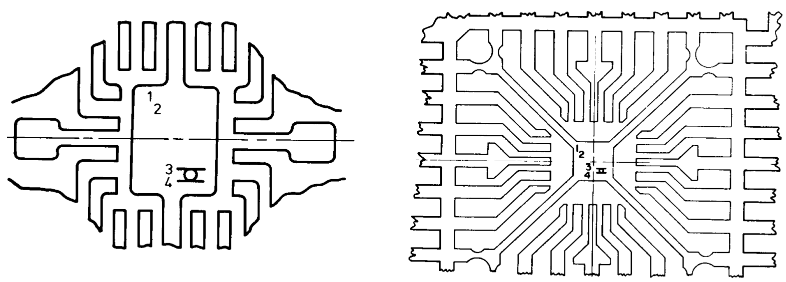


Figure 14
Pits, Slug Marks, Tool Marks

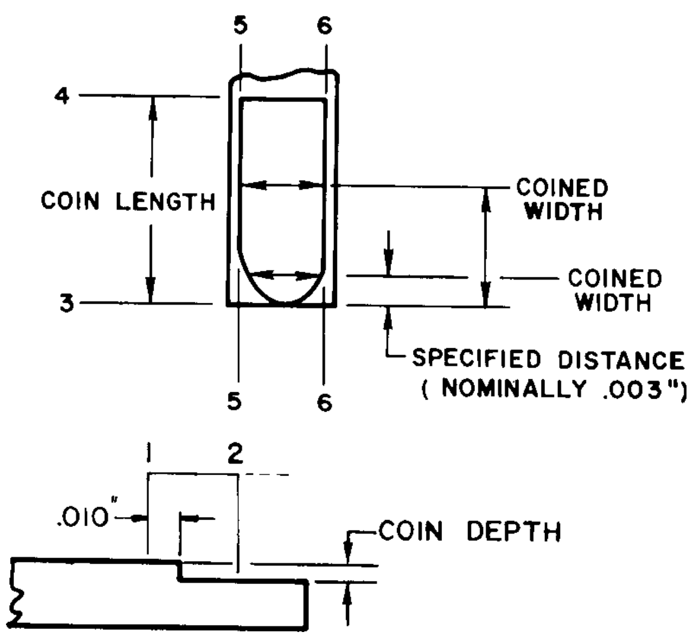


Figure 15
Coined Area

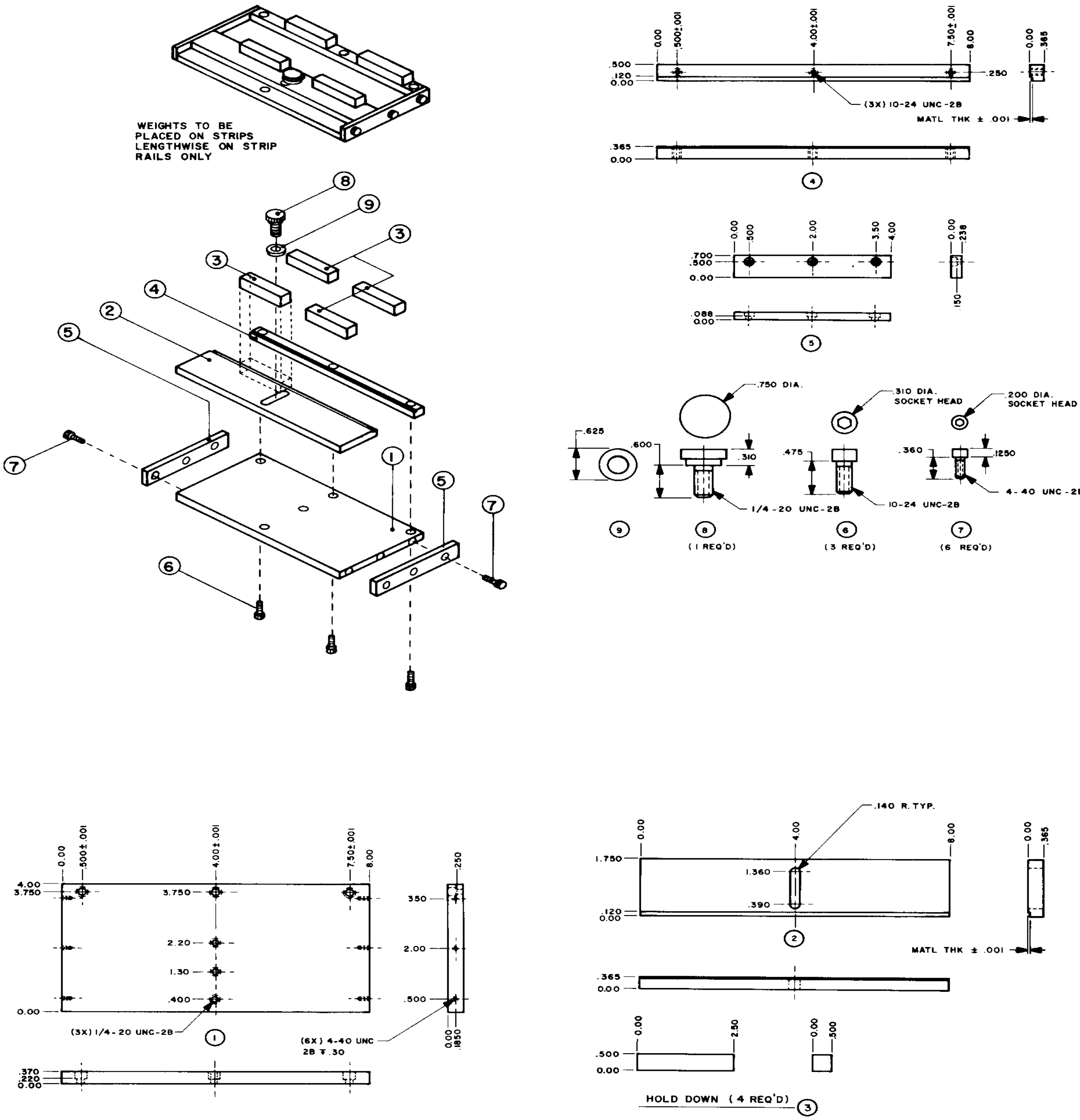


Figure 16
Universal Leadframe Fixture

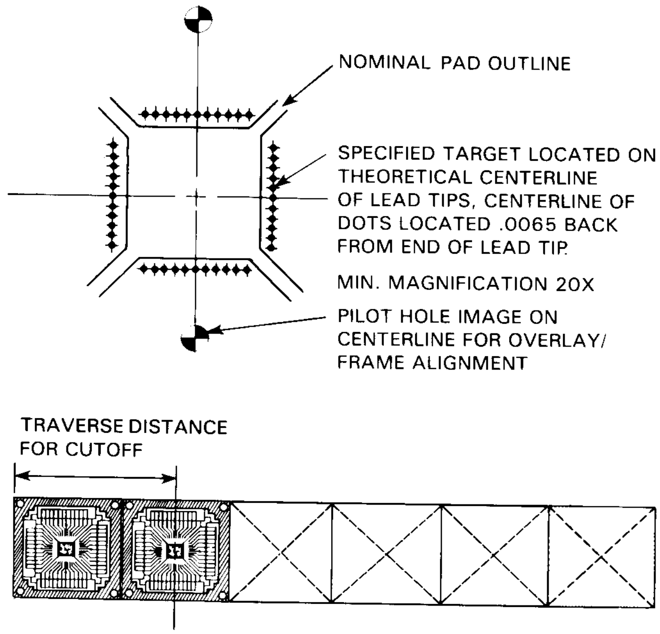


Figure 17
Lead Location

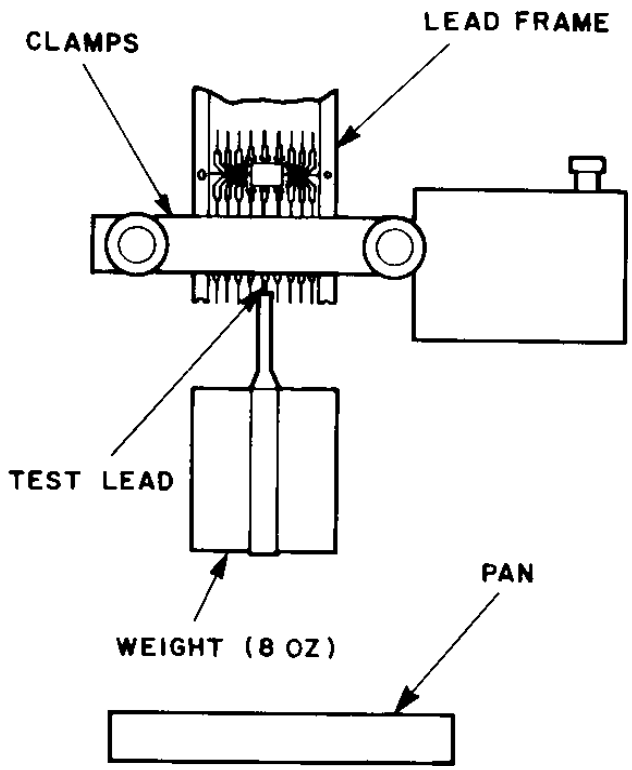


Figure 18
Frame Location on Lead Fatigue Testing Machine Front View

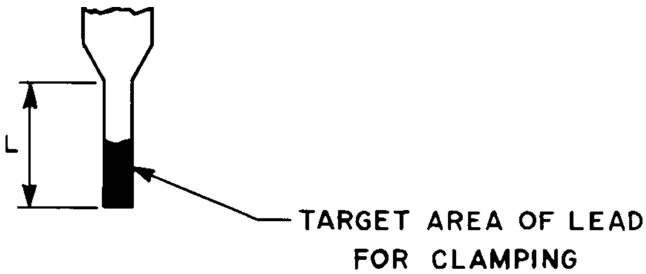


Figure 19
Frame Location on Lead Fatigue Testing Machine
Front View

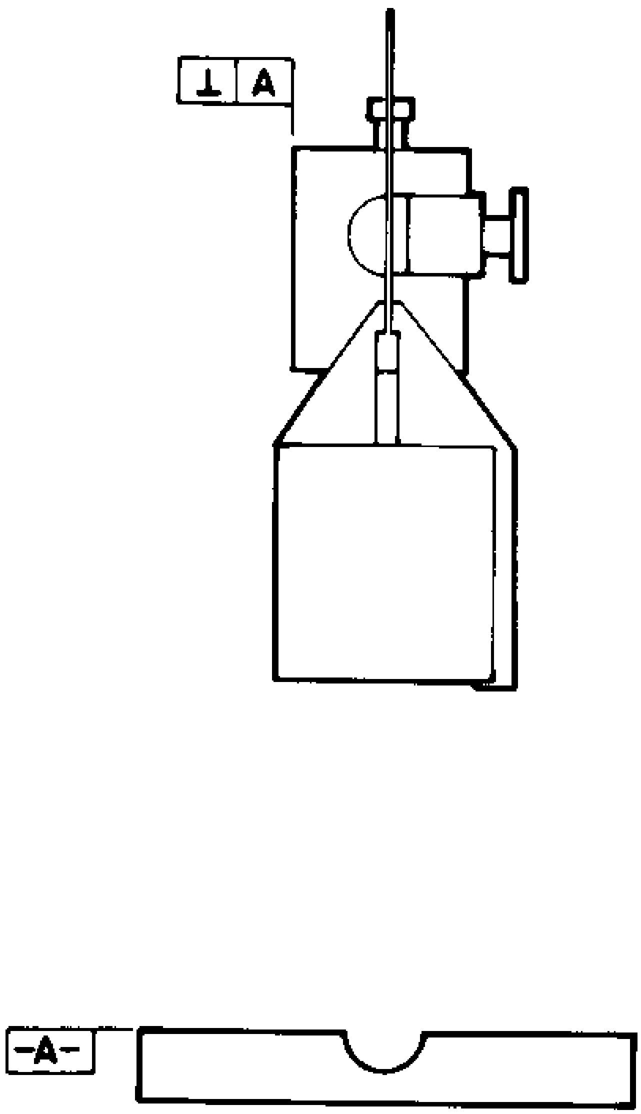


Figure 20
Frame Location on Lead Fatigue Testing Machine
Side View

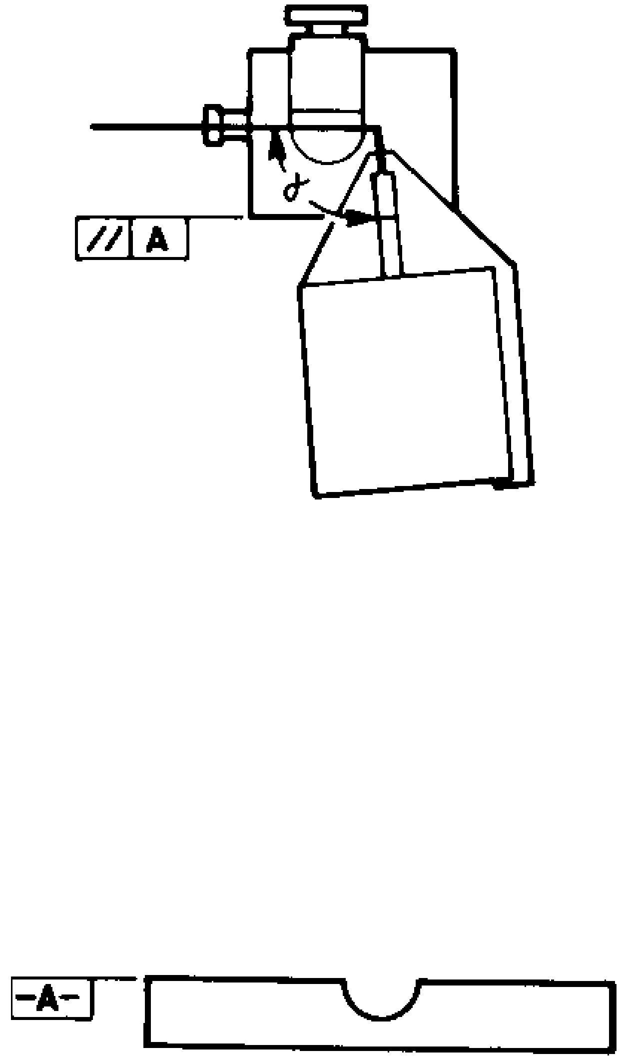


Figure 21
Frame Location on Lead Fatigue Testing Machine
Side View with 90° Rotation

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SEMI G11-88
RECOMMENDED PRACTICE FOR RAM FOLLOWER GEL TIME AND SPIRAL FLOW OF THERMAL SETTING MOLDING COMPOUNDS

1 Scope

This method describes a procedure for measuring the flow and gel characteristics of semiconductor grade transfer molding compounds using a ram follower device.

2 Applicable Documents[1]

ASTM D 3123 — Plastics, Molding, and Extrusions

3 Significance

3.1 The flow of a molding compound depends on the interaction of several variables, and is a measure of the combined characteristics of speed of gelation and melt viscosity of the particular compound under the specified conditions. The test is not a valid method for comparing the moldability of different compounds since a spiral flow test cannot duplicate actual molding conditions in different types of molds.

3.2 The moldability of thermosetting molding compounds has generally been defined by a single spiral flow number. The ram follower device follows graphically the molding compound as it melts and the rate of flow increases, as viscosity builds up due to resin polymerization, and as the flow of the compound ceases. Thus, it measures the gelation point of the compound, or the point where the material ceases to flow. This information can be an aid in characterizing the rheological behavior of the molding compound.

4 Apparatus

4.1 *Transfer Molding Press* — With a platen area sufficient to maintain a uniform mold temperature and having (1) a transfer piston pressure potential of 1000 psi on the material; (2) sufficient clamping pressure to prevent flashing of the molding compound; and (3) a minimum plunger speed of 25.4 mm (1 inch) per second without load. The pot diameter shall be 31.75 to 44.45 ± 0.635 mm (1.250 to 1.750 ± 0.025 inch) and the clearance between pot and ram shall be sufficiently small that flashing does not occur above the first sealing groove on the ram.

4.2 *Standard Spiral Flow Mold* — Per ASTM D 3123.

4.3 *Ram Following Apparatus* — Consisting of a displacement transducer attached to the transfer ram of the press in such a way as to accurately record its movement, suitable power supply for the displacement transducer, and a recorder capable of recording the signal from the displacement transducer and preferably having a chart speed of at least 10 mm per second. An optional velocity transducer can also be used as a means of directly measuring ram velocity and verifying the starting and ending of the flow process. In this case, a 2-channel recorder is needed.

4.4 *Thermocouple and Potentiometer* — Calibrated in the 149° to 177°C (300° to 350°F) range. (Calibration to be checked every six months.)

5 Test Conditions

5.1 *Molding Compound* — Refrigerated shipment and storage of some molding compounds is necessary. The molding compound is to be at room temperature before the container is opened. Once the compound has equilibrated to room temperature, the test should be run within 16 hours. Care must be taken to preserve the original moisture content. The material should be in powdered form, unless otherwise specified.

NOTE: Room temperature defined to be 23° ± 5°C.

NOTE: Refer to manufacturers' recommendations regarding shelf life differences which may exist between molding compounds.

5.2 *The Spiral Flow Mold* — Shall be clean and free from any mold release agents or lubricants. A standard mold cleaning compound can be used to insure mold cleanliness.

5.3 *Molding Conditions*

5.3.1 The temperature of the mold shall be measured using a thermocouple inserted in the mold. The ram shall be kept at the mold temperature. Molding temperature is to be as recommended by the material specification unless otherwise specified. Temperature must be maintained within ± 3°C (± 5°F) of the specified temperature.

NOTE: Flow duration is strongly influenced by temperature. For critical determinations, the temperature should be maintained as close to the nominal temperature as practical, preferably within ± 0.5°C (± 1°F).

5.3.2 The weight of the charge shall be adjusted to give a molded cull thickness of 3.302 ± 0.254 mm (0.130 ± 0.010 in.), excluding vertical flash.

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5.3.3 The free running ram speed shall be at least 25.4 mm/sec (1"/sec). Recommended speed is 100 ± 25 mm/sec into the pot and application of pressure on the charge shall not exceed 5 seconds.

5.3.4 The transfer pressure measured under the transfer plunger is to be 6.895 ± 0.177 mpa (1000 ± 25 psi) unless otherwise specified.

5.3.5 Unless otherwise specified, a minimum of 1.5 minutes close and cure time shall be used.

5.4 *Flow Length* — Read the spiral flow length directly from the molded specimen at the point of farthest continuous flow to the nearest 6.35 mm (0.25 in).

5.5 *Flow Duration* — The flow duration or gel time is defined as the time interval between the moment when the ram contacts the charge and the time the ram stops moving. The contact and gelation points are determined from the ram follower trace.

6 Procedure for Spiral Flow

6.1 Thoroughly clean the ram, pot, and mold of any cured compound, or other foreign matter.

6.2 Heat the mold and ram to within (± 3°C) of the specified temperature.

6.3 At the beginning of each series of tests and at each change of compound, check and set the transfer pressure using the force gage. The proper force gage setting can be determined from the formula:

$$F = \frac{\pi D^2 P}{4}$$

where F is the force in pounds, P is the desired pressure on the material in psi and D is the ram diameter in inches.

6.4 For each material change, make at least three “clean out” runs using the material to be tested before recording data. These runs may be used to determine the charge weight.

6.5 Weigh out the compound to the nearest 0.1 g as previously determined to yield a cull of 3.302 ± 0.254 mm (0.130 ± 0.010 in.).

6.6 Raise the ram, add the compound to the pot, and immediately activate the transfer cycle. If the recorder does not have a remote on-off that is activated by the cycle start, then it should be started before the cycle starts. After the ram motion ceases, the chart may be stopped.

6.7 Open mold and remove cured material. Measure cull thickness. If the cull is not within 3.302 ± 0.254 mm (0.130 ± 0.010 in.), discard run and repeat the test, adjusting the charge weight as necessary.

6.8 Read the flow length to the nearest 6.35 mm (0.5 in.).

6.9 Mark the point on the chart where the ram contacts the charge. This point is identified on the displacement trace as the point at which the rate of displacement initially changes.

6.10 Mark where the ram stopped moving. Caution should be exercised where significant flashing occurs. Count the number of divisions between the two points and divide by the chart speed. The result is the flow duration or gel time in seconds. Record this time to the nearest second.

6.11 If the optional velocity trace is available, mark point on the chart where the ram contacts the charge. This point is identified on the velocity trace as the point at which the transfer velocity transducer initially detects a significant reduction in velocity output.

6.12 Mark where the ram stopped moving. In order to detect the point of zero (0) velocity, the signal must be of sufficient magnitude. Count the number of divisions between the two points and divide by the chart speed. The result is the flow duration or gel time in seconds. Record this time to the nearest second.

6.13 If both displacement and velocity transducers are used, the starting and ending points should agree, therefore yielding the same gel time.

6.14 Repeat step 6.5 at least 3 times for repeatability.

7 Reporting of Results

7.1 Report the material designation and lot number.

7.2 Report the average and standard deviation of the flow length and gel time.

7.3 Report the temperature and pressure used for the tests.

NOTICE: These standards do not purport to address safety issues, if any, associated with their use. It is the responsibility of the user of these standards to establish appropriate safety and health practices and determine applicability of regulatory limitations prior to use. SEMI makes no warranties or representations as to the suitability of the standards set forth herein for any particular application. The determination of the suitability of the standard is solely the responsibility of the user. Users are cautioned to refer to manufacturer's instructions, product labels, product data sheets, and other relevant literature respecting any materials mentioned herein. These standards are subject to change without notice.

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SEMI G13-88
STANDARD TEST METHOD FOR EXPANSION CHARACTERISTICS OF MOLDING COMPOUNDS

1 Scope

1.1 This specification describes the procedure for measuring the Coefficient of Thermal Expansion (CTE) and Glass Transition Temperature (T_g) of thermosetting molding compounds.

2 Apparatus

2.1 *Mold* — Producing 0.1–0.2" cubes or equivalent with an aspect ratio of 0.8–1.

2.2 *Transfer Press*

2.3 *Micrometer* — (0.0001 accuracy)

2.4 *Thermomechanical Analyzer* — (TMA) (Dupont Model 943, Perkin-Elmer TMS-1, or equivalent)

2.5 *Recorder and Power Supply* — (Dupont Model 990, Perkin-Elmer UUI, or equivalent)

2.6 *Oven* — (200° ± 5°C capability)

3 Materials

3.1 *Nitrogen (Gas)*

3.2 *Nitrogen (Liquid)*

4 Sampling

4.1 Mold samples according to product specifications.

4.2 Postcure the specimen in accordance with the material specification, and allow two (2) hours for cooling in a desiccator.

5 Procedure

5.1 Select a sample, making certain that all sides are flat and smooth. Measure the height of the sample with a micrometer to the nearest 0.0001 inch.

5.2 Place the sample into the TMA sample holder and bring the expansion probe down slowly until it just makes contact with the sample. Place sample on fixture per Instruction Manual. Add 3.0–5.0 grams to weight tray. Adjust the Linear Variable Differential Transformer (LVDT) to bring the recorder pen on scale. The LVDT is then zeroed with the zero switch. Readjust LVDT, if necessary, to bring pen on scale.

5.3 In a nitrogen atmosphere, heat the sample at a rate of 20°C/min. to its post-cure temperature.

5.4 Without changing LVDT or probe position, use liquid nitrogen to cool the sample to a temperature at least 100°C below the deviation from α_1.1.

5.5 Heat the sample at a rate of 5°C/min. to at least 200°C.

5.6 Calculate α(CTE), using the formula:

$$CTE = \left[\frac{(DL)(DY)}{(DT)(L)}\right]$$

where: $L_{(T+10°)}$=Length at Temperature 10° higher than temperature at which CTE is being measured. $L_{(T-10°)}$=Length at Temperature 10° lower than temperature at which CTE is being measured

ΔY = Y axis sensitivity in mils./in.

ΔT = change in temperature (20°C)

L = initial sample height (mils)

$$K = \frac{\text{LIT CTE}}{\text{EXP.CTE}} \text{ for aluminum standard}$$

5.7 Run two (2) samples for each lot and record the average.

5.8 An aluminum standard should be run to determine the calibration factor K for the Y (length) axis per 5.4 above, as necessary to insure the accuracy of the instrument's calibration.

5.9 Temperature readings should be calibrated periodically per manual instructions.

6 Report

6.1 Data is to include the orientation for which the sample is measured (e.g., perpendicular to flow).

6.2 CTE is reported as a function of temperature. CTE is to be reported every 10°C increments.

6.3 Report molding conditions and post-mold cure conditions.

6.4 Report specimen size.

NOTE: For many materials, the Glass Transition Temperature (Tg) may be determined by drawing tangents to the curve at the points of minimum and maximum slope. The point at which the tangents intersect is the T_g. The slopes of the lines are referred to as α 1 (below T_g) and α2 (above T_g).

7 References

ASTM D 696[1] — Coefficient of Linear Thermo Expansion Plastic

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SEMI G14-88
GUIDELINE FOR SPECIFYING THE DIMENSIONS AND TOLERANCES USED TO MANUFACTURE PLASTIC MOLDED DIP PACKAGE TOOLING

1 Preface

1.1 This document is a guideline for the ordering of tooling required to mold and form plastic molded DIP semiconductor packages. It is to be used by packaging engineers, mold manufacturers, and end-of-line tool makers as the basis for defining the limits of manufacturing tolerances.

2 Applicable Documents

2.1 This document specifically refers to:

JEDEC Publication No. 95[1] — JEDEC Registered and Standard Outline for Semiconductor Devices

2.2 Related information may also be found in:

MIL-STD-100[2] — General Engineering Drawing Practices

ANSI Y14.5[3] — Dimensioning and Tolerancing

NOTE 1: As listed or revised, all documents cited shall be the latest publications of adopted standards.

3 Selected Definitions — Product Criteria Tolerance Limits

3.1 *mismatch and offset* — Defined with respect to package only. All statements will be equally applicable in two (2) axes. All mismatch and offset measurements are made after molding and prior to trimming.

3.1.1 *cavity to frame offset* — Will be measured prior to any trimming operation. Offset will be defined as the difference in bottom cavity position with respect to a leadframe datum. The offset measurement will exclude leadframe tolerances. (See Figure 1.)

3.1.2 *top to bottom cavity mismatch* — Characterized by the fact that the top and bottom cavities in the mold are not aligned properly, causing a mismatch condition. The measurement shall be stated as the difference in the top cavity position relative to the bottom cavity position. (See Figure 2.)

3.2 *parting line protrusions* — Those plastic excesses which remain as a normal characteristic after normal trimming and molding operations. (See Figure 4.)

3.3 *top or bottom protrusions* — Those plastic excesses (includes ejector pin "crowns") which remain as normal characteristics extending from the smooth surface of the molded package.

3.4 *variations in lead position* — Defined with respect to a 90° angle from the top or bottom of the smooth surface of the molded package as viewed on the end or side projections. (See Figure 4.)

3.5 *shoulder width intrusions/protrusions* — Any variations in straightness along the defined shoulder width caused by dambar removal. (See Figure 4.)

3.6 *package warpage* — Any non-linear dimensional change from the mold cavity characteristic, usually caused by incorrect package design or molding practices. (See Figure 5.)

3.7 *shoulder bend location* — Measured from the outermost point of the inner shoulder bend radius. (See Figure 6.)

4 Ordering Information

Purchase orders for tooling for plastic molded DIP semiconductor packages furnished to this specification shall include the following items:

1. A package tooling outline drawing showing all required dimensions listed in 5. Package surface finish to be included.
2. A list of any tolerance limits which differ from the SEMI standards detailed in 6.
3. The type of tooling steel required.
4. The type of leadframe material to be used, including a drawing.
5. The type of plastic to be molded (if proprietary, a statement of its shrinkage characteristics).
6. Sampling plan for compliance to 7.
7. The number of spare parts or expendable parts desired.
8. Type of molding press to be used, including power requirements.

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1 JEDEC, 20001 Eye Street N.W., Washington, D.C. 20006

2 Military Standards, Naval Publications and Form Center, 5801 Tabor Ave., Philadelphia, PA 19120

3 ANSI, 1430 Broadway, New York, NY 10018

9. Applicable leadframe drawing, showing all dimensions.

5 Dimensions

Drawing must show dimensions for the following items, if applicable:

1. Package length
2. Package width
3. Top cavity thickness
4. Bottom cavity thickness
5. Frame thickness
6. Top ejector pin locations from notch end
7. Bottom ejector pin locations from notch end
8. Ejector size (top and bottom)
9. Ejector depth (top and bottom), draft angle top side (bottom, side, and end)
10. End notch shape, depth, width, length
11. Pin 1 ID location from package center
12. Pin 1 ID shape and size
13. Corner radius on sides
14. Corner radius on ends
15. Lead spread (nominal) (see Figure 3)
16. Shoulder bend location
17. Shoulder width

6 Product Criteria Dimensional Tolerance Limits for DIPS

In recognition that every manufacturing process is subject to variation, the following list details the acceptable limits of this variation.

8 - 64 LEAD

(unless otherwise noted)

MISMATCH (see Figure 2)

	± 0.002"

PACKAGE/FRAME OFFSET (see Figure 1) (excludes leadframe tolerances)

8-64	± .002"

PROTRUSIONS (see Figure 4)

Parting line Side and End	0.006"(For reference use only)
Top Protrusion	0.001"
Bottom Protrusion	0.001"

INTRUSIONS (Ejector Pins)

	0.010" maximum

VARIATIONS IN LEAD POSITION (see Figure 4)

	0.007" True position non-accumulative

SHOULDER WIDTH PROTRUSIONS/INTRUSIONS (see Figure 4)

	+ 0.003"/- 0.002"

PACKAGE WARPAGE (see Figure 5)

Warp factor	2.5

SHOULDER BEND LOCATION (see Figure 6)

	JEDEC Publication No. 95 outline minus lead thickness. (Based on balanced plastic.)

LENGTH AND THICKNESS

	± 0.002" (see Figure 5) (Excluding protrusions)

7 Sampling

7.1 Samples used to determine compliance to Section 6 shall be determined between vendor and supplier.

8 Packaging

8.1 Tooling must be packaged in containers designed and constructed to prevent damage and/or contamination. Specific protection must be provided if tooling is to be shipped any great distance.

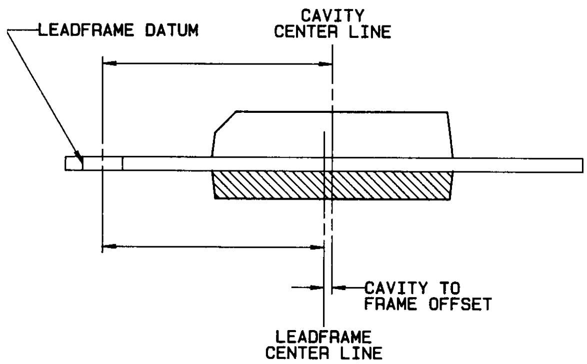

Figure 1

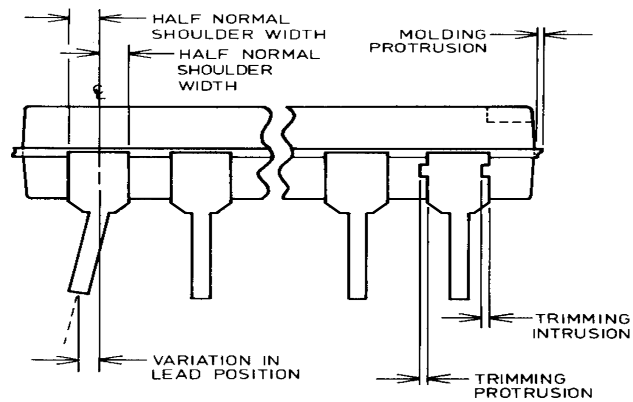

Figure 4
Parting Line Protrusions and Variation in Lead Position

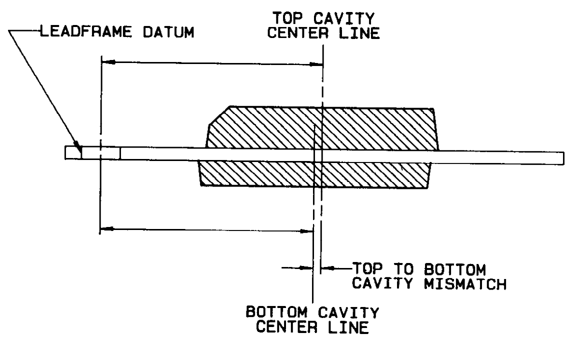

Figure 2

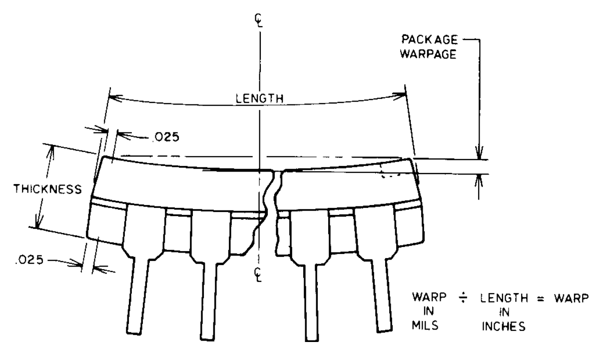

Figure 5
Package Warpage and Thickness

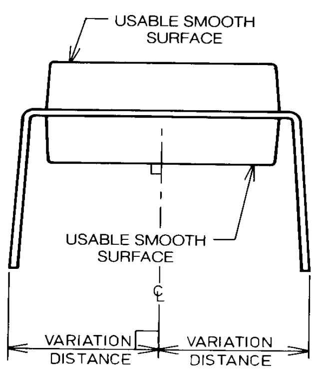

Figure 3
Variations from Nominal Lead Location

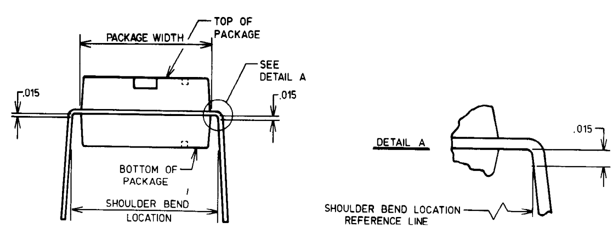

Figure 6
Shoulder Bend Location and Package Width

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SEMI G15-93
STANDARD TEST METHOD FOR DIFFERENTIAL SCANNING CALORIMETRY OF MOLDING COMPOUNDS

1 Preface

1.1 *Scope* — This document describes procedures for evaluating epoxy molding compounds by differential scanning calorimetry (DSC).

1.2 *Units* — This test method uses SI units.

2 Applicable Documents

2.1 *Reference Documents*

2.1.1 *ASTM Specifications*[1]

ASTM E 793 — Test Method for Heats of Fusion and Crystallization by Differential Scanning Calorimetry

ASTM E 967 — Practice for Temperature Calibration of Differential Scanning Calorimeters and Differential Thermal Analyzers

ASTM E 968 — Practice for Heat Flow Calibration of Differential Scanning Calorimeters

2.2 *Related Documents*

2.2.1 *ASTM Specifications*

ASTM E 473 — Standard Definitions of Terms Relating to Thermal Analyses

ASTM E 1269 — Test Method for Determining Specific Heat by Differential Scanning Calorimetry

3 Significance

3.1 DSC provides a rapid method at incoming inspection for evaluating molding compounds for consistency in subsequent molding processes.

4 Interferences

4.1 Very small quantities of material are used in the test. Lack of homogeneity may cause variable results.

4.2 *Gas Purge* — See Section 5.

4.3 *Sample Pans* — See Section 5.

5 Equipment

5.1 *Differential Scanning Calorimeter* — Capable of heating a sample from room temperature to 300°C with a controlled heating rate.

NOTE 1: Gas Purge Considerations — A reactive gas purge affects the material under test. A gas must be chosen that reflects the molding conditions normally used for that material (i.e., air or nitrogen).

5.2 *Sampling Pans for DSC Cell* — (Aluminum with crimping or hermetically sealed.) The pans must not be reactive to the sample under test.

5.3 *Process Controller* — Capable of collecting, calculating, and plotting the data resulting from the calorimeter.

5.4 *Analytical Balance* — Accuracy 0.001 mg.

5.5 *Tweezers and Microspatula*

6 Sampling

6.1 When the method is used to evaluate incoming molding materials, the sampling plan shall be agreed between supplier and customer.

6.2 Powdered or granular molding compounds shall be thoroughly mixed before sampling. If the compound is supplied in a preform, a small section may be cut off the preform with a blade.

7 Preparation of Samples

7.1 Protect samples from moisture absorption while awaiting test.

8 Equipment Setup and Calibration

8.1 *Temperature Calibration* — (Refer to ASTM E 967.)

8.1.1 Follow the manufacturer's operating manual to set up and run a calibration curve using indium (Melting Point 156.6°C) (see Figure 1).

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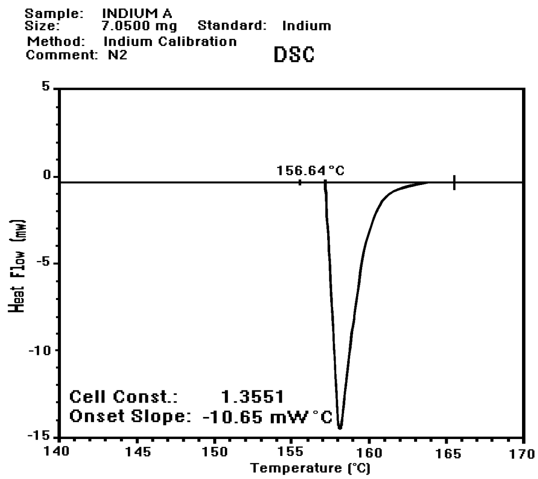

Figure 1

8.2 Determine the onset of melting and refer to the manual for the temperature correction method.

NOTE 2: There are other standard reference materials with higher melting points (see Table 1). Choose the standard which best matches the range of interest for the material under test.

Table 1

Reference Material	*Melting Point (°C)*
Indium	156.6
Tin	232.0
Zinc	419.6

8.2.1 Indium is also used to calibrate the Heat of Fusion for the DSC cell. Table 2 also lists the Standard Heat of Fusion for alternate materials that may be used.

Table 2

Reference Material	*Heat of Fusion (J/g)*
Mercury	11.44
Indium	28.42
Lead	23.16
Tin	59.23
Zinc	112.0

8.2.2 An area calculation of the indium melt provides the Heat of Fusion for DSC cell (see Figure 1).

8.2.3 Refer to the operating manual to obtain the cell constant and its correction.

9 Procedure

9.1 *Sample Size* — 2.000 to 12.000 mg may be used. 8.000 mg is commonly used. A small design of experiments exercise may be used to obtain the optimum sample size for the molding compound under test. Different compound chemistries may have an effect on the results if the sample size is not carefully chosen.

Place the sample in the sample pan.

9.2 Use an empty sample pan with its cover as a reference.

9.3 Carefully place the sample and reference pans onto their respective thermal sensors in the DSC cell. Seal the cell according to the manufacturer's instructions.

9.4 Set the heating rate to the optimum conditions determined for that instrument and the specific material under test. This rate will normally be between 5°C and 25°C per minute.

9.5 Activate the test sequence, and heat the sample from room-temperature to 300°C in order to obtain the DSC curve.

9.6 At the end of the run, remove the sample, and allow the DSC cell to cool to room-temperature in preparation for the next sample.

10 Results Report

10.1 The results report shall contain the following items:

10.1.1 Sample and equipment details

Molding material name/number

Sample weight

Equipment used

Heating rate

Calibration constant

Any pertinent information regarding material or equipment

10.1.2 *Scan Results* — The DSC curve shall indicate the following:

Maximum peak exotherm — units °C

Exotherm onset — units °C

Exotherm — units joules/gram

NOTE 3: The total exotherm is determined by an area calculation of the exotherm profile using a computer drawn baseline.

11 Accuracy and Precision (see ASTM E 968)

11.1 *Repeatability — Single Analyst* — The percent RSD over multiple days was determined to be 4.2%.

11.2 *Reproducibility — Multilaboratory* — The percent RSD was determined to be 8.2%.

12 Alternate Procedures

12.1 *Thermal Kinetic Modeling*

12.2 *Isothermal Differential Scanning Calorimetry* — There is a current lack of interlaboratory correlation to recommend this method.

NOTE 4: Manufacturers' literature may be used to obtain information on these methods.

SEMI G16-88
SPECIFICATION FOR DIMENSIONS AND TOLERANCES USED TO MANUFACTURE PLASTIC CHIP CARRIER TOOLING

1 Preface

This document is a guideline for the ordering of tooling required to mold and form plastic chip carriers. It is to be used by packaging engineers, mold manufacturers and end of line tool makers as the basis for defining the limits of manufacturing tolerances.

2 Applicable Documents

Related information may be found in:

MIL-STD-100[1] — Engineering Drawing Practices

ANSI Y14.5[2] — Dimensioning and Tolerancing

JEDEC Publication No. 95[3] — Outline for Semiconductor Devices

3 Selected Definitions — Production Criteria Tolerance Limits

3.1 *mismatch and offset* — Defined with respect to package only. All statements will be equally applicable in two (2) axes. All mismatch and offset measurements are made after molding and prior to trimming.

3.1.1 *cavity to frame offset* — Will be measured prior to any trimming operation. Offset will be defined as the difference in bottom cavity position with respect to a leadframe datum. The offset measurement will exclude leadframe tolerances. (See Figure 1.)

3.1.2 *top to bottom cavity mismatch* — Characterized by the fact that the top and bottom cavities in the mold are not aligned properly, causing a mismatch condition. The measurement shall be stated as the difference in the top cavity position relative to the bottom cavity position. (See Figure 2.)

3.2 *Molded Protrusions*

3.2.1 *parting line protrusions* — Those plastic excesses which remain as a normal characteristic after normal molding, deflashing, trimming, and singulation. (See Figure 6.)

3.2.2 *top or bottom protrusions* — Those plastic excesses (includes ejector pin "crowns"), which remain as a normal characteristic extending from the smooth surface of the molded package.

3.3 *variations in lead location* — Defined with respect to a 90° angle from the top or bottom of the smooth surface of the molded package as viewed on the end or side projections. (See Figure 6.)

3.4 *lead shoulder protrusions and intrusions* — Any variations in straightness along the defined shoulder width caused by dambar removal. (See Figure 6.)

3.5 *package warpage* — Any non-linear dimensional change from the mold cavity characteristic, usually caused by incorrect package design or molding practices. (See Figure 3.)

3.6 *shoulder bend location* — Measured from the outermost point of the shoulder bend radius. (See Figure 4.)

3.7 *lead co-planarity* — Defined as the vertical lead position with respect to a reference plane measured after forming. (See Figure 5.)

4 Ordering Information

4.1 Purchase orders for tooling for plastic molded quad semiconductor packages furnished to this specification shall include the following items:

1. A package tooling outline drawing showing all required dimensions listed in Section 5. Package surface finish should be included.
2. A list of any tolerance limits which will differ from those detailed in Section 6.
3. The type of tooling steel required.
4. The type of leadframe material to be used.
5. The type of plastic to be molded (if proprietary, a statement of its shrinkage characteristics).
6. Sampling plan for compliance to Section 7.
7. The number of spare parts or expendable parts desired.
8. The type of molding press to be used, including power requirements.
9. Applicable leadframe drawing, including all dimensions.

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1 Military Standards, Naval Publications and Form Center, 5801 Tabor Avenue, Philadelphia, PA 19120

2 ANSI, 1430 Broadway, New York, NY 10018

3 JEDEC, 2001 Eye Street, N.W., Washington, D.C. 20006

5 Dimensions

5.1 Drawing must show dimensions for the following items, if applicable:

1. Package length
2. Package width
3. Top cavity thickness
4. Bottom cavity thickness
5. Frame thickness
6. Ejector top locations from cavity center line
7. Ejector bottom locations from cavity center line
8. Ejector size (top and bottom)
9. Ejector depth (top and bottom, draft angle top side, bottom side, and end)
10. End notch shape, depth, width, length
11. Pin 1 ID location from package center
12. Pin 1 ID shape and size
13. Corner radius or sides
14. Corner radius or ends
15. Lead spread (nominal)
16. Shoulder bend location
17. Shoulder width

6 Product Criteria Dimensional Tolerance Limits for PCCs

6.1 In recognizing that every manufacturing process is subject to variation, the following list details the acceptable limit of this variation:

CAVITY MISMATCH	0.004" (0.101 mm)

PACKAGE/FRAME OFFSET	0.002" (0.05 mm) (excluding leadframe tolerances)

MOLDED PROTRUSIONS

(see Figure 6)	
Parting line	0.006" (0.15 mm)
Top or bottom	0.001" (0.025 mm)

VARIATION IN LEAD POSITION

(see Figure 6)	0.004" (0.101 mm)

SHOULDER INTRUSIONS AND PROTRUSIONS

(see Figure 6) Intrusions	0.002" (0.05 mm)
Protrusions	0.003" (0.08 mm)

PACKAGE WARPAGE

Warp factor	2.5

LEAD CO-PLANARITY	0.003" (maximum)

EJECTOR PIN DEPTH	0.010" (maximum)

7 Sampling

7.1 Samples used to determine compliance to Section 6 shall be determined between vendor and supplier.

8 Packaging

8.1 Tooling must be packed in containers designed and constructed to prevent damage and/or contamination. Specific protection must be provided if tooling is to be shipped any great distance.

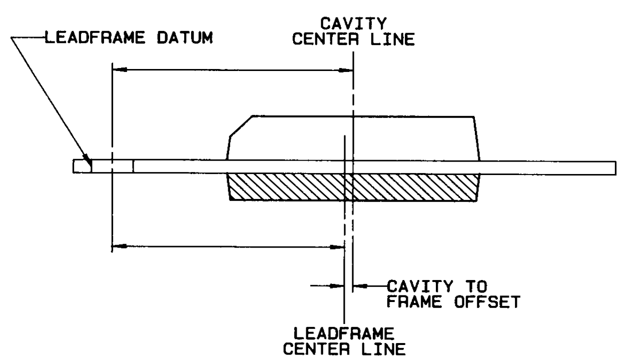

Figure 1

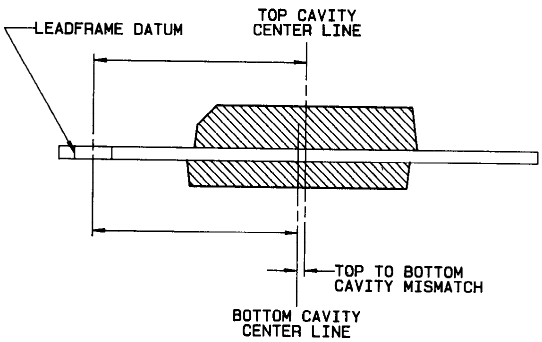

Figure 2

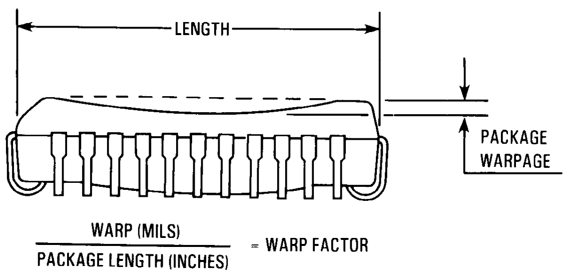

Figure 3

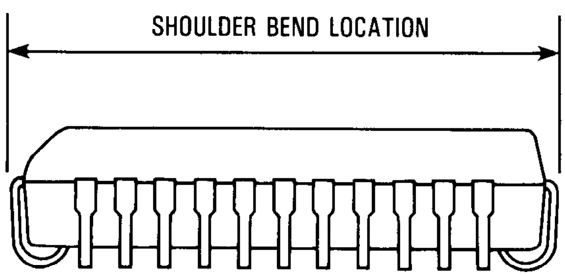

Figure 4
Shoulder Bend Location

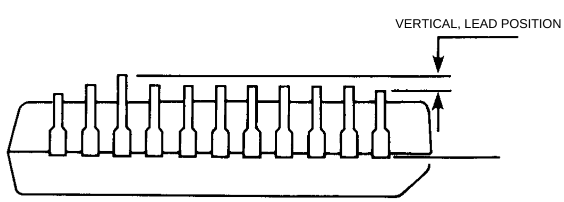

Figure 5
Coplanarity

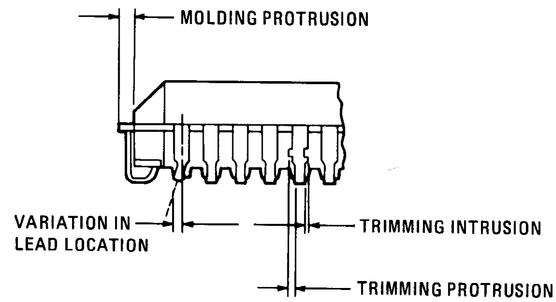

Figure 6
Parting Line Protrusion and Variation in Lead Locations — Vertical Lead Position

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SEMI G18-96
STANDARD FOR INTEGRATED CIRCUIT LEADFRAME MATERIAL USED IN THE PRODUCTION OF ETCHED LEADFRAMES

1 Purpose

This specification is for the leadframe material that will be shipped to an etch house. It is a leadframe specification, but deals with material aspects only.

2 Scope

This specification covers the special requirements for metal strip to be used to fabricate integrated circuit leadframes by etching.

3 Referenced Documents

3.1 *ASTM Specifications*[1]

ASTM B 601 — Recommended Practice for Temper Designations for Copper and Copper Alloys — Wrought and Cast

ASTM E 8 — Methods of Tension Testing of Metallic Materials

ASTM B 193 — Test Method for Resistivity of Electrical Conductor Materials

ASTM B 754 — Standard Test Method for Measuring and Recording the Deviations from Flatness in Copper and Copper Alloy Strip

4 Terminology

None.

5 Ordering Information

5.1 Orders for material under this specification shall include the following information:

1. Quantity of each size
2. Alloy name and number
3. Temper or mechanical properties
4. Dimensions: Thickness and width (see Section 7.3.)
5. How furnished: Coils and coil size or sheet size (see Section 10.)
6. Certification or test report requirements (see Section 11.)
7. Packaging and marking requirements (see Section 12.)

6 General Requirements

6.1 The materials covered by this specification shall conform to the requirements detailed in this specification, unless otherwise agreed upon by supplier and purchaser.

7 Dimension and Tolerances

7.1 The following tests shall be used to determine conformance or non-conformance to this specification.

7.2 *Etched Raw Materials Purchased in Coils* — Samples can be taken from the ID or OD of each coil. If the material does not conform to this specification, remove two wraps from the ID and OD of each coil and test for conformance again. Samples may also be taken from cut sheets.

7.3 *Thickness, Width, and Length* — The tolerances for thickness and width shall be as shown in Table 1. More restrictive tolerances than those shown in Table 1 or tolerances for other thicknesses and widths shall be agreed upon between user and supplier.

Table 1 Thickness and Width Tolerances

Thickness	*Tolerance*
0.005 - 0.010" (0.127 – 0.254 mm)	± 0.0003" (0.008 mm)
0.015" (0.381 mm)	± 0.0004" (0.010 mm)
0.020" (0.508 mm)	± 0.0005" (0.013 mm)
Width	*Tolerance*
2.000 - 8.000" (25.4 - 203.2 mm)	± 0.005" (0.127 mm)
> 8.000" (> 203.2 mm)	to ± 0.010" (0.254 mm)

1 American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohoken, PA 19428-2959

7.4 *Camber (Edgewise Curvature)* — Camber is not critical for material used in the etching process provided the end product (leadframe strip) meets its requirements; ± 0.0625" (1.6 mm) in 36" (91 cm) is considered acceptable.

7.5 *Coil Set* — A three foot long sample shall be obtained from each coil supplied. The measured coil set shall not exceed 1.500" (38.1 mm).

7.6 *Edge Burrs* — Undesirable and, if present, their height shall not exceed 10% of the metal thickness.

7.7 *Crossbow (Dish)* — Crossbow is a function of slitting. Because material for the photo chemical process is generally about 16–20" wide, crossbow is not a critical problem. However, the final product (leadframe strips) must meet maximums, as suggested in Table 2, and crossbow in the sheet form, shall not be present to the extent that this specification cannot be met.

Table 2 Maximum Crossbow

Specified Strip Width	*Maximum Crossbow*
Up to 1.000" (25.4 mm), incl.	0.003" (0.076 mm)
Over 1.000" (25.4 mm)	0.005" (0.127 mm)

7.8 *Oil Can* — When any part of a sheet is pushed, but not bent, and it snaps into a different position or plane other than the original position with no further pressure, oil canning is present. Oil canning shall not be present on materials being used in the photo chemical process (etching) to the extent that the maximum crossbow specification on the finished product (see Table 2) cannot be met.

8 Surface Finish

8.1 The material shall be commercially free of surface imperfections such as pits, nicks, dents, gouges, scratches, laminations, or inclusions.

8.2 Surface defects less than 0.0003" (0.0076 mm) in depth will be acceptable unless otherwise agreed upon between the supplier and purchaser.

APPLICATION NOTE: There is a question regarding the ability of material suppliers to meet this specification. Revision of this specification is under review.

9 Corrosion

9.1 Visual inspection shall be used to determine if objectionable surface oxides are present which would render the product unusable for the intended application. Objectionable conditions, if present, should be reported to the supplier within 60 days after receipt of the material.

9.2 There shall be no visible rust on the surface of Alloy 42 material.

10 Coils

10.1 Unless otherwise specified, coils shall be supplied with an inside diameter that provides for good packing practice without resulting in excessive coil set.

11 Certifications or Test Reports

11.1 Requests for certifications or test reports shall be made at the time of order entry or contract agreement. They shall be furnished by the manufacturer within one week of date of shipment.

11.2 When certifications are required, the following information shall be supplied as a minimum:

1. Vendor name
2. Purchase order number
3. Vendor order number
4. Alloy name and number
5. Chemical analysis
6. Temper designation (reference only)
7. Tensile strength
8. Elongation percent in 2"
9. Electrical conductivity % IACS (for copper base alloys only)

11.3 In the event of a disagreement between supplier and purchaser, an independent test shall be conducted on the strip to verify the data provided in the certification.

12 Packaging and Marking

12.1 The material shall be separated by size, composition, and temper, and prepared for shipment in such a manner as to ensure acceptance by a common carrier for transportation at the lowest applicable rate.

12.2 The material shall be suitably packaged to protect from condensation, contamination, etc., and to afford protection from the normal hazards of transportation.

12.3 Each shipping unit shall be legibly marked with the purchase order number, alloy name or number, temper, size, gross and net weight, and name of the supplier. The specification number shall be shown when specified on the purchase order.

12.4 Any special packaging or shipping requirements shall be agreed upon between supplier and purchaser at the time of purchase.

13 Basis for Rejection

13.1 For the purposes of determining conformance with the requirements prescribed in the specification, any measured value outside the specified limiting values shall be cause for rejection.

13.2 If objectionable material is found and rejected, samples of the questionable material, with the defects identified and marked, should be sent to the supplier along with information as to order number, quantity originally received, date received, and quantity rejected. Rejected material should be held with adequate protection and identification by the purchaser for a reasonable amount of time, pending investigation by the supplier.

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SEMI G19-0997
SPECIFICATION FOR DIP LEADFRAMES PRODUCED BY ETCHING

1 Preface

This specification is a guideline for production of DIP leadframes for plastic molded semiconductor packages produced by the etching process. It is a design guideline for packaging engineers, etchers, and mold manufacturers and has been developed to meet the requirements of automatic bonders.

2 Applicable Documents

2.1 *SEMI Standards*

SEMI G18 — Specification for Integrated Circuit Leadframe Material Used in the Production of Etched Leadframes

SEMI G10 — Standard Method for Mechanical Measurement of Plastic Package Leadframes

2.2 *Other Document*

PCM1 D-300[1] — Standard Specification

3 Selected Definitions

burrs and protrusions — Fragments of excess material, either horizontal or vertical, attached to the lead frame.

camber — Curvature of the leadframe strip edge (see Figure 1).

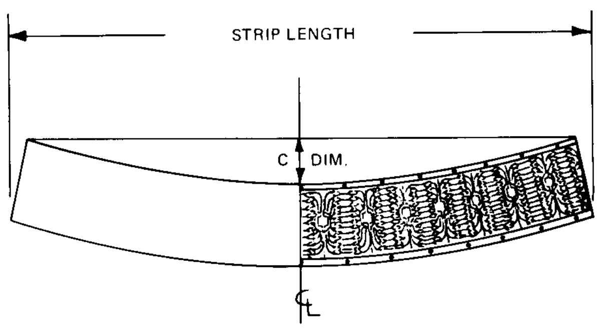

Figure 1
Camber

coil set — Longitudinal bowing of the leadframe (see Figure 2).

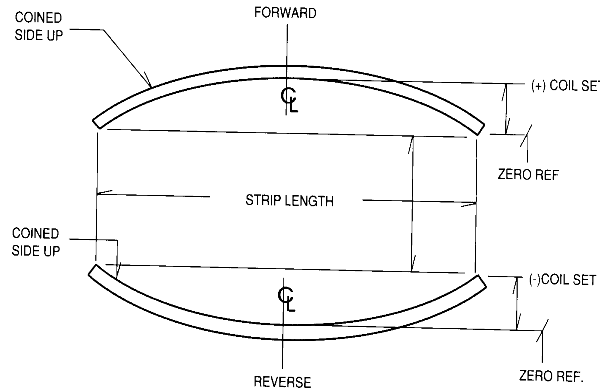

Figure 2
Coil Set

compensation — Changes made in the dimensions on the master artwork other than those specified on the engineering artwork that allow for the process variables (i.e., etch factor, undercut).

crossbow — Transverse bowing of the leadframe (see Figure 3).

(enter graphic when available)

Figure 3
Crossbow

etch factor — The ratio of etched depth to the lateral etch or undercut (see Figure 4).

1 Photochemical Machining Institute, 4113 Barberry, Lafayette Hills, PA 19444

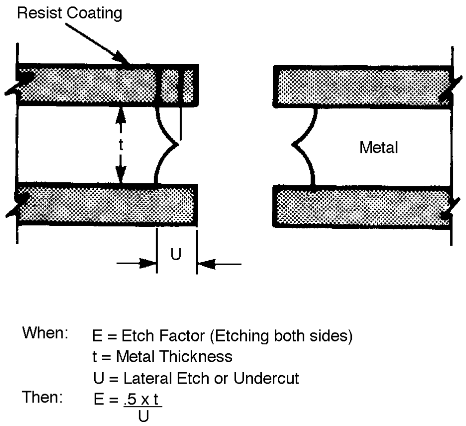

Figure 4
Undercut and Etch Factor

functional area — The die attach pad and wire bond (lead tip) area.

lateral etch or undercut — The allowable bevelled edge caused by the leadframe etchant attacking the metal laterally as well as vertically (see Figure 5).

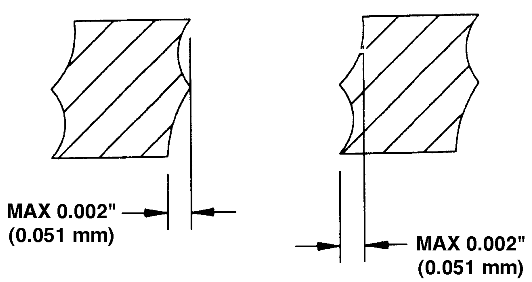

Figure 5
Overetching

lead twist — Angular rotation of the bond fingers (see Figure 6).

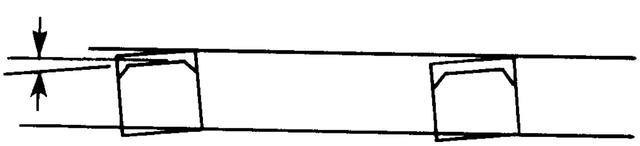

Figure 6
Lead Twist

offset alignment accuracy — The top to bottom alignment accuracy of the etched leadframe operation (see Figure 7).

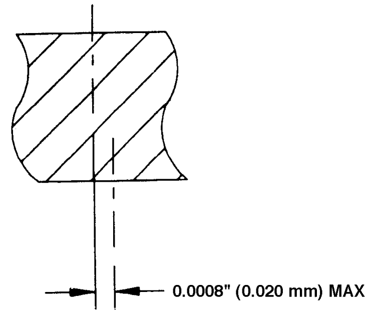

Figure 7
Etched Offset

pits — Shallow surface depressions or craters in the leadframe material (see Figure 8).

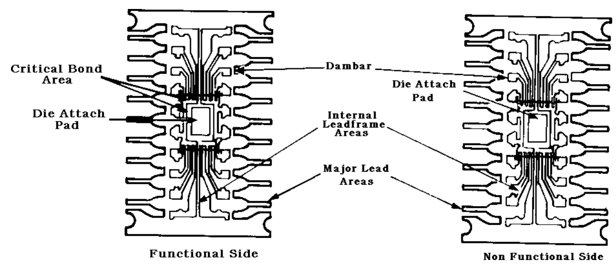

Figure 8
Pits

resist breakdown — Etching under the edges of the resist causing more than a standard undercut.

undercut — Bevelled edge caused by the etchant attacking the metal laterally as well as vertically (see Figure 4).

4 Ordering Information

Purchase orders for leadframes for plastic molded semiconductor packages furnished to this specification shall include the following items:

1. Drawing number and revision level
2. Material
3. Number of leads
4. Material certification
5. Number of units/strip
6. Plating requirements
7. Packaging and marking (see Section 8)

5 Dimensions

See applicable leadframe drawing as referred to in the ordering information.

6 Defect Limits and Parameters (see SEMI G10 to Measure)

6.1 *Minimum Flat Wire Bonding Area* — 0.203 mm (0.008") or 80% of nominal lead width, whichever is greater in width and 0.635 mm (0.025") in length. Undercut is an unavoidable process of etching. The above parameters are applicable only so long as the flat surface area is obtainable using the formula of Figure 4. The "radiusing" effect of the etching process will round off the tips and, therefore, the length of the flat area should be measured by starting back from the tip 0.254 mm (0.010").

NOTE: 0.008" flat is desirable. In order to achieve 0.008" flat, on 0.010" thick material, it is necessary to have a design width of 0.022" center to center, giving a 0.012" wide lead and 0.010" wide space.

6.2 Horizontal Lead Spacing and Location

6.2.1 Spacing between leads to be 0.152 mm (0.006") minimum after plating.

6.2.2 Metal to metal clearance (Dimension "W" Figure 7) minimum clearance shall be the greater of 0.152 mm (0.006") or the drawing dimension "W" minus 0.102 mm (0.004"). In determining dimension "W," the tolerance limits (max. vs. min.) shown on the drawing shall be used in the calculation.

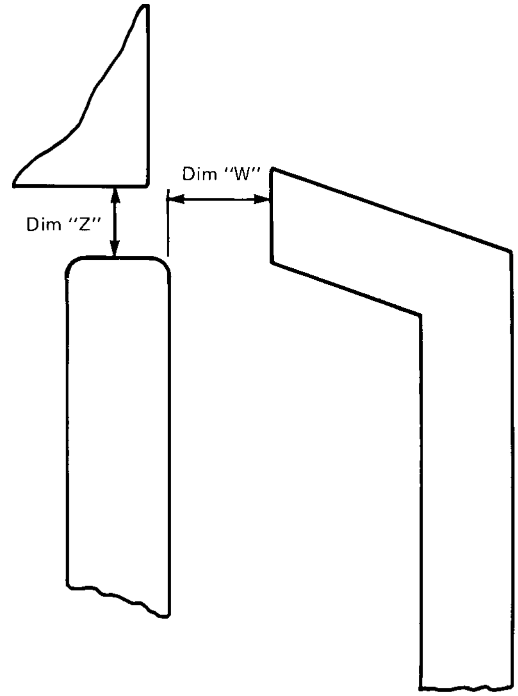

Figure 7
Metal to Metal Clearance

6.3 *Lead Twist* — Not to exceed 2° 30' or 0.0004" (0.010 mm) per 0.010" (0.254 mm) of lead width.

6.4 *Die Attach Pad Tilt & Flatness*

6.4.1 *Tilt* — 0.001" (0.025 mm) maximum per 0.100" (2.54 mm) of length or width in the undepressed state and 0.002" (0.050 mm) max per 0.100" (2.54 mm) of length or width in the depressed state when measuring from corner to corner. The corners are defined as 0.005" (0.127 mm) from each edge.

6.4.2 *Flatness* — 0.0004" (0.010 mm) maximum difference per 0.100" (2.54 mm) of length or width when measuring from center to average of four corners. The corners are defined as 0.005" (0.127 mm) from each edge.

6.5 *Die Attach Pad Offset or Depression* — (if applicable) — ± 0.002" (0.050 mm) as measured from the center of the pad to a point on the bar pad support strip. The nominal recommended offset is 0.015" (0.381 mm).

6.6 *Lead and Die Attach Pad Coplanarity* — See SEMI G10 for measurement procedure.

6.6.1 *Lead Planarity* — The lead tips as measured in the center of the flat wirebonding area must be within the following tolerances of the "Z" plane. Use Table 1 tolerances for untaped frames and Table 2 tolerances for taped frames.

Table 1 Tolerances for Untaped Frames

No. of Leads	*Strip Width*	*Lead Tip Coplanarity*
8 - 16	600"–1.000" (15.24 mm–25.4 mm)	+ 0.004"/-0.004" (0.101 mm)
18 - 22	1.070"– 1.020" (27.18 mm–25.91 mm)	+ 0.005"/-0.005" (0.127 mm)
22	1.270"–1.300" (32.26 mm– 33.02 mm)	+ 0.0065"/-0.0065" (0.165 mm)
24	1.470"–1.500" (37.34 mm–38.10 mm	+ 0.0075"/-0.0075" (0.191 mm)
28	1.670"–1.700" (42.42 m–43.18 mm)	+ 0.0085"/-0.0085" (0.216 mm)
40 & up	2.270"–2.300" (57.66 mm–58.42 mm)	+ 0.015"/-0.007" (+0.381 mm/-0.178 mm)

Table 2 Tolerances for Taped Frames

No. of Leads	*Strip Width*	*Lead Tip Coplanarity*
28	1.670"–1.700" (42.42 mm–43.18 mm)	+0.007"/-0.005" (+187 mm/-0.127 mm)
40 & up	2.270"–2.300" (57.66 mm–58.42 mm)	+0.010"/0.005" (+0.254 mm/-0.127 mm)

NOTE: It is recommended that 40 leads and more be taped prior to bonding.

6.6.2 *Die Attach Pad Planarity*

6.6.2.1 The die attach pad when measured at the center must be within the tolerances of the "Z" plane as shown in Table 3.

Table 3 Pad Planarity Tolerances

No. of Leads	*Pad Planarity*
8 - 16	+0.003"/-0.005" (+0.076 mm/-0.127 mm)
18 - 20	+0.006"/-0.003" (+0.152 mm/-0.076 mm)
22 - 40	+0.006"/-0.003" (+0.152 mm/-0.076 mm)
48	+0.006"/-0.003" (+0.152 mm/-0.076 mm)
64	+0.006"/-0.003" (+0.152 mm/-0.076 mm)

6.6.2.2 Die attach pads utilizing the four point tie design (support bars to both dambars) shall meet ± 0.002" (0.051 mm) of the "Z" plane.

6.7 *Material* — Thickness shall be as shown in Table 4.

Table 4 Material Thickness

Parameters	0.010" (0.254 mm)	0.015" (0.381 mm)	0.020" (0.508 mm)
Thickness	± 0.0003" (0.0076 mm)	± 0.0004" (0.0102 mm)	± 0.0005" (0.0127 mm)
Strip Width			
2.0" (50.8 mm)	± 0.002" (0.051 mm)	± 0.002" (0.051 mm)	± 0.002" (0.051 mm)
2.0" (50.8 mm)	± 0.003" (0.076 mm)	± 0.003" (0.076 mm)	± 0.003" (0.076 mm)

6.8 *Crossbow* — Shall not exceed the dimensions given in Table 5. If a certain width is not shown, 1% of the leadframe width shall apply.

Table 5 Maximum Crossbow Dimensions

No. of Leads	*Strip Width*	*Max. Crossbow*
8	0.600" (15.24 mm)	0.005" (0.127 mm)
14 - 16	0.970"/1.00" (24.64 mm/25.40 mm)	0.005" (0.127 mm)
18	1.070"/1.100" (27.18 mm/27.94 mm)	0.005" (0.127 mm)
20	1.170"/1.200"(29.72 mm/30.48 mm)	0.010" (0.254 mm)
22	1.270"/1.300"(32.26 mm/33.02 mm)	0.010" (0.254 mm)
24	1.470"/1.500"(37.34 mm/38.10 mm)	0.010" (0.254 mm)
28	1.670"/1.700"(42.42 mm/43.18 mm)	0.010" (0.254 mm)
40	2.270"/2.300"(56.66 mm/58.42 mm)	0.010" (0.254 mm)
48+	2.400"/2.670"(60.96 mm/67.82 mm)	0.010" (0.254 mm)

6.9 *Progression* — Progression over the (# of) steps in the strip should be within ± 0.051 mm (0.002") and non-cumulative.

6.10 *Pits (Indentations)* — Pits and imperfections cannot affect leadframe strength regardless of size (see Figure 6).

6.10.1 *Critical Bond Area* — 0.635 mm (0.025") of the finger tips + 0.508 mm (0.020") border of die attach pad; nothing greater than 0.0005" (0.0127 mm) diameter × 0.0076 mm (0.0003") in depth; not more than 1 pit.

Application Note: There is a question regarding the ability of material suppliers to meet this specification. Revision of this specification is under review.

6.10.2 *Die Attach Pad* — Functional side inside 0.508 mm (0.020") border; nothing greater than 0.127 mm (0.005") diameter × 50% metal thickness in depth; not more than 2 pits.

6.10.3 *Die Attach Pad* — Nonfunctional side; nothing greater than .508 mm (0.020") × 50% of metal thickness in depth; not more than 3 pits; cannot affect leadframe strength regardless of size (i.e., pit cannot be located within 0.127 mm (0.50") of pad support bar attachments).

6.10.4 Internal leadframe areas where design width is 0.635 mm (0.025") or more, must be less than 0.381 mm (0.015") × 50% metal thickness in depth; if design width is less than 0.635 mm (0.025"), area must be 50% of design width. Cannot affect leadframe strength regardless of size.

6.10.5 *Major Lead Areas (outside dambar)* — Nothing greater than 0.127 mm (0.005") × 50% of metal thickness in depth; nothing greater than 0.254 mm (0.010") on shoulder above taper. Cannot affect leadframe strength regardless of size.

6.10.6 *Dambar* — Pit cannot extend all the way across the bar.

6.11 *Mold Locating Holes* — Conventional mold damage design dictates that gating is opposite pin #1; therefore, the mold locating holes must be in the rail adjacent to pin #1. In order to minimize gate flashing between the mold and the rail edge, a specific tolerance of ± 0.051 mm (0.002") is required from the centerline of the mold hole to the opposite rail edge.

6.12 *Strip Length* — Strip length cut off shall be within 0.005", lead tip to lead tip centerline (excluding rails). The rail cut off length shall be within + 0.635 mm (0.025") unless otherwise specified by the user.

7 Sampling

Sampling will be determined between supplier and purchaser.

8 Packaging and Marking

8.1 *Packaging* — Leadframes must be packaged in containers designed and constructed to prevent damage and/or contamination. Specific protection must be provided against crushing, exposure to moisture, and mixture gases.

8.2 *Marking* — The outer containers shall be clearly marked to identify the user stock number, user purchase order number, drawing number, supplier lot number, and reel numbers within the carton. Additional information required should be specified by the user.