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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Specification for Format, Physical Properties, and Test Methods for 19 and 35 mm Testable Tape Carrier for Perimeter Tape Carrier-Bonded Semiconductor Devices[1]

This standard is issued under the fixed designation F 637; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

ε1 NOTE—Editorial changes were made throughout in September 1994.

INTRODUCTION

It is the purpose of this specification to facilitate interchangeability of carrier tape produced by various manufacturers. Standardization is also intended to promote efficient utilization of equipment used to test devices on tape and assemble them to hybrid circuits. A complete description of a particular carrier tape requires specification of a considerable number of parameters not covered by this standard. This standard specification includes only elements of format design for which substantial consensus with respect to technically and economically sound commercial practice has been achieved.

1. Scope

1.1 This specification covers standard formats for testable semiconductor lead carrier tape suitable for hybrid applications.

1.2 This standard specifies tape width, configuration, and location of guide perforations ("sprocket holes"), location of lead pattern frames on tape, lead pattern window size, and placement of outer lead bond and electrical test pad areas in the lead pattern.

1.3 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

1.4 The following hazard caveat pertains only to the test method portion, Section 7 of this specification. *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Terminology

2.1 *Definitions:*

2.1.1 *lead pattern window*—in tape carrier bonding, the area in each frame in which plastic backing of plastic/metal composite tape is totally or partially removed to expose appropriate areas of bare conducting leads for attachment to a microelectronic device on the inner end and a mounting substrate on the outer end.

2.1.2 *outer lead bond area*—in tape carrier bonding, that area on each lead which will be connected to a mounting substrate.

2.1.3 *tape format*—in tape carrier bonding, the layout design elements of carrier tape, including the topographical arrangement of lead pattern elements and test contacts in each frame, description of the placement of frames upon the tape, and the specification of tape width and the placement of mechanical handling aids, such as guide perforations.

2.1.4 *testable tape carrier*—in microelectronic fabrication, a continuous length of plastic/metal composite film, superficially resembling motion picture film, which carries at each frame position a repetitive pattern of electrically conducting leads and test contacts.

2.1.4.1 Discussion—The lead arrangement is designed so as to electrically interconnect points on a microelectronic device with contacts on the mounting substrate of the device. The test contacts permit static or dynamic evaluation, or both, of each microelectronic device prior to assembly to a mounting substrate.

2.1.5 *test pads*—in tape carrier bonding, conducting areas in each tape frame position that can be contacted electrically by probes in order to test devices attached to the tape.

3. Classification

3.1 A wide variety of formats are covered under this standard. Tape format style is classified according to the following code:

" Style A–B–C–D–E–F–G–H–I–J"

where:

[1] This specification is under the jurisdiction of ASTM Committee F-1 on Electronics and is the direct responsibility of Subcommittee F01.16 on Tape Automated Bonding.

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A = nominal tape width in millimeters (see Table 1),
B = pattern pitch expressed as an integral multiple of the standard sprocket pitch of 0.1870 inch (for example, 4 = 4 sprocket pitch = 0.7480 inch) (see Table 1),
C = side dimension of square lead pattern window in millimeters (see Table 1),
D = base film material: K = Polyimide M = Polyester,
E = base film thickness expressed in mils (for example, 5 = 0.005 in.),
F = copper type: ED = Electrodeposited AR = As-Rolled,
G = copper thickness expressed in ounces (for example, 1 = 1 oz = 0.0014 in.),
H = lead configuration: P = Planar B = Bumped,
I = lead finish: CU = Copper (no finish) SN = Tin AU = Gold
J = pattern style: S = all leads electrically connected to a common conductor for plating, static grounding, etc. O = all leads electrically isolated.

NOTE 1—Example of a tape format style classification, as follows:
"Style 35–4–7–K–5–ED–1–P–SN–O"
This tape format style identifies a 1.4-in. (35-mm) wide tape carrier with patterns on a 4-sprocket pitch, having a 0.28 by 0.28-in. 7 by 7-mm lead pattern window, fabricated on a polyimide film, 0.005 in.-thick (127-µm) with electrodeposited copper, 1-oz thick (0.0014 in.), (35.6µ m) having planar leads tin-plated with all leads electrically isolated.

4. Ordering Information

4.1 The purchase order or contract shall specify the tape format style classification (see 2.1).

4.2 Additional details of tape design and manufacture not covered by this specification shall be as agreed between the purchaser and the supplier as part of the purchase contract.

5. Dimensions

5.1 Figs. 1-3, and Table 1 specify standard tape widths, frame placement on tape, guide perforation, outer lead bond pad, lead pattern window size, and test pad format options.

6. Sampling

6.1 Unless otherwise agreed to between the purchaser and the supplier, conformance with Section 5 shall be determined by sampling and testing specimens from each lot.

6.1.1 A lot shall consist of all material processed in one essentially continuous production operation, and delivered in one shipment from one supplier against one order description.

6.1.2 *Sampling Plan*:

6.1.2.1 The sampling plan shall be agreed upon between the purchaser and the supplier.

6.1.2.2 Samples chosen shall be representative of the lot.

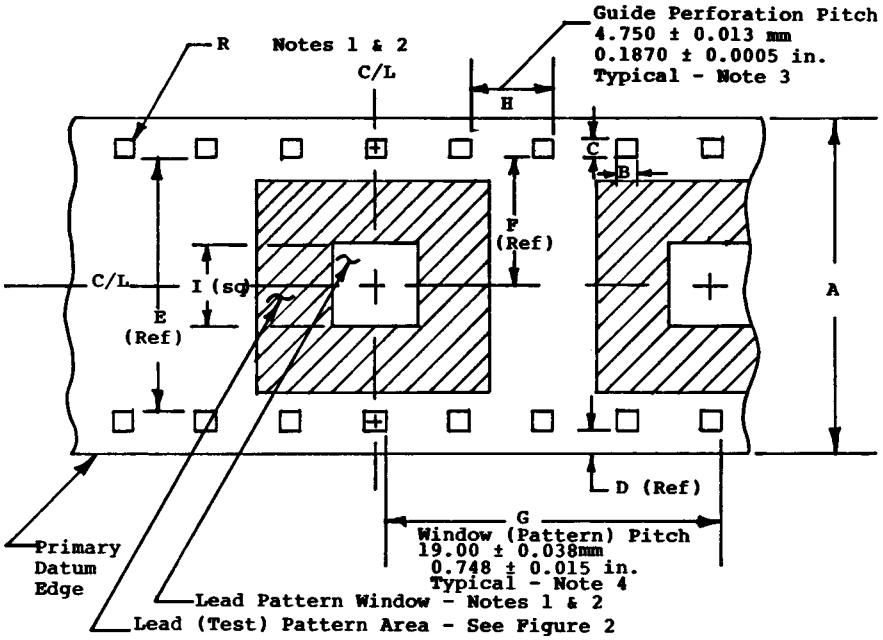
7. Test Methods

7.1 *Dimensional Tolerances*:

TABLE 1 Dimensions for 19 and 35-mm Tape Format (see Fig. 1 and Fig. 2)

NOTE 1—For smaller die or fewer leads, Dimension I may be reduced in increments of 1.000 mm (0.0394 in.). The selection of an appropriate I for any specific die requires consideration of parameters not covered by this Standard such as die size, number and location of leads, assembly equipment and processes, minimum spacing between windows for film strength, etc.

Dimension		19mm Tape		35mm Tape	
		in.	mm	in.	mm
A	Tape width	0.748 ±0.003	19.00 ±0.075	1.377 ±0.003	34.975 ±0.075
B	Perforation length	0.0560 ±0.001	1.422 ±0.025	0.078 ±0.001	1.98 ±0.025
C	Perforation width	0.0560 ±0.001	1.422 ±0.025	0.1100 ±0.001	2.794 ±0.025
D	Tape edge to perforation edge from primary datum edge	0.034 ±0.002	0.86 ±0.05	0.079 ±0.002	2.01 ±0.05
E	Width between perforation edges	0.568 ±0.001	14.427 ±0.025	0.999 ±0.001	25.375 ±0.025
F	Perforation edge to window C/L	0.284 ±0.001	7.21 ±0.025	0.4995 ±0.001	12.69 ±0.025
G	Window pitch (typical)	0.748 ±0.015	19.000 ±0.038	0.748 ±0.015	19.000 ±0.038
H	Guide perforation pitch	0.1870 ±0.0005	4.750 ±0.013	0.1870 ±0.0005	4.750 ±0.013
	100 perforations	18.70 ±0.030	475.0 ±0.762	18.70 ±0.030	475.0 ±0.762
I	Lead pattern window maximum dimension (see Note)	0.394 ±0.002	10.0 ±0.05	0.472 ±0.002	12.0 ±0.05
R	Maximum radius	0.010	0.25	0.021	0.53
Po	Maximum test pad pattern outline (square)	0.498	12.65	0.890	22.50
Ts	Test pad spacing (noncumulative)	0.025	0.64	0.050	1.27
Tw	Test pad width	0.020 ±0.002	0.51 ±0.05	0.040 ±0.002	1.02 ±0.05
Td	Test pad depth (min)	0.018	0.46	0.038	0.97
Os	Outer lead bond C/L spacing (noncumulative)	0.020	0.51	0.020	0.51
Ow	Outer lead bond width (nominal)	0.010	0.25	0.010	0.025
OL	Minimum outer lead bond length:	0.015	0.38	0.015	0.58
	Flat leads	0.045	1.15	0.045	1.15
	Formed leads				
IL	Minimum straight extension of inner lead from edge of silicon die	0.005	0.13	0.005	0.13



NOTE 1—Mislocation of any portion of leads within lead pattern window to transverse C/L of specified guide perforations shall not exceed 0.005 in. true position.

NOTE 2—Mislocation of nominal polymer opening C/L for lead pattern window to C/L of specified guide perforations and tape shall not exceed 0.003 in. true position.

NOTE 3—Tolerance does not include cumulative errors or splices. Error across splices shall not exceed 0.003 in.

NOTE 4—Window (pattern) pitch shall be an integral multiple of the guide perforation pitch and will dictate maximum lead pattern window and maximum test pattern area. Typical frame pitch is 0.7480 ± 0.0015 in., or 19.0000 ± 0.038 mm.

NOTE 5—See Table 1 for dimensions.

FIG. 1 19 and 35-mm Tape Format

7.1.1 Equipment used for these tests shall include an *Optical Comparator, Microscope*, or equivalent piece of apparatus capable of reading to 0.0001 in. (2.54 µm) with a repeatability of 0.0001 in.

7.1.2 Tape tolerances and dimensions shall be in conformance with Table 1.

7.2 *Peel Strength*:

7.2.1 *Apparatus*—Similar to Interconnection Packaging Circuitry IPC/TM-650, Method 2.4.9:

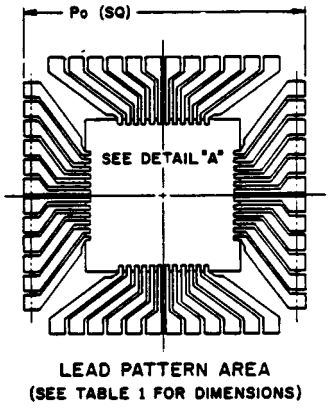
7.2.1.1 *Testing Machine*, power driven, crosshead autographic type, or an equivalent constant speed drive machine,

7.2.1.2 *Bath* suitable for etching copper foils,

7.2.1.3 *Free Wheeling Rotary Drum* (German wheel), 6-i n. (15.2-cm) diameter, and

7.2.1.4 *Solder Pot* capable of maintaining 288 ± 5°C.

7.2.2 *Procedure*—As received samples, prepare four samples 0.125 by 9 in. (3.18 by 229 mm) (0.0625 by 5 in. (1.59 by 127 mm) may be used only if there are space limitations that do not permit use of the 0.125 in. size) using standard commercial practices. Samples to be tested must be etched. Condition samples for 12 h at 23 ± 2°C and 50 % RH (±3 %). Attach specimen to the test fixture with double sided tape, cement, or mechanical clamps. Peel the *conductor from the film* at a crosshead speed of 2 in./min (8.5 mm/s). Peel load shall fall within 15 to 85 % of the range scale used on the test machine. Load shall be continuously recorded and the entire length of the peeled conductor bond value shall be averaged. A minimum of 3 in. (76 mm) or 50 % of the minimum length



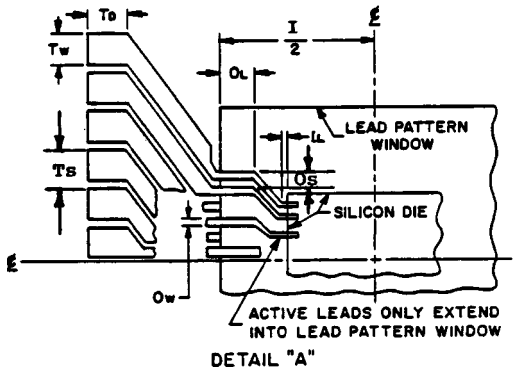


FIG. 2 19 and 35-mm Tape Format (Detail)

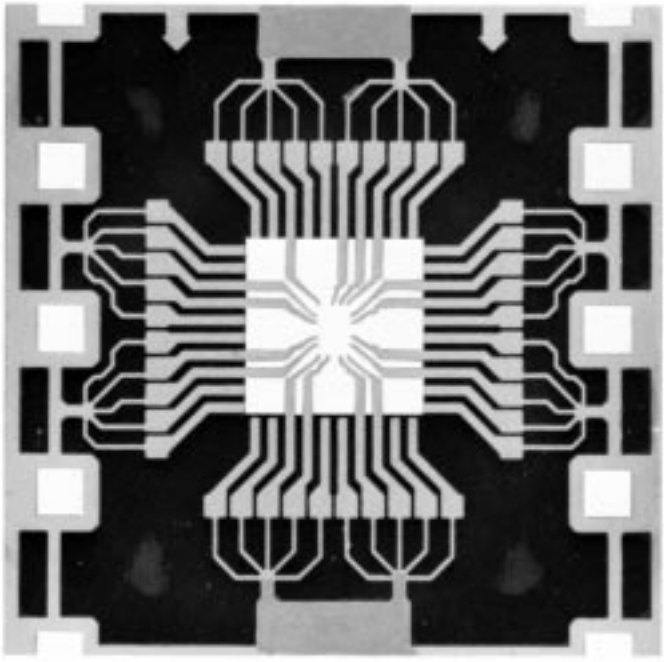


FIG. 3 Leads

dimension must be peeled on each specimen. Averaged value recorded as bond strength in pounds per linear inch (PLI).

7.2.3 *Procedure Bond After Solder Float*—Prepare samples as in 7.2.2. After conditioning, coat each specimen with solder stop and attach to a frame that will hold the sample flat at 288°C. Float each specimen, conductor side down, just beneath the surface of molten solder at 288 ± 3°C for 5 s. Agitate the specimen from side to side during the immersion, then remove the sample and tap the edge to remove excess solder. Repeat the peel test as described in 7.2.2. Record these values as bond strength after solder dip.

7.3 *Dimensional Stability*:

7.3.1 *Apparatus*—Similar to IPC TM-650:

7.3.1.1 *Shear* for cutting specimen,

7.3.1.2 Measurement equipment as described in 7.1.1,

7.3.1.3 *Felt Tip Pen*, non-eraseable,

7.3.1.4 *Mechanical Convection Oven*, capable of maintaining temperature at 150 ± 2°C, and

7.3.1.5 *Etching Tank*, capable of etching metal conductive layer and maintaining 43 ± 5°C. Etchant must not have a detrimental effect on the dielectric or the adhesive, or both.

7.3.2 *Procedure*—Prepare four samples by cutting each to 10.0 ± 0.5-in. (254 ± 12 mm) long by standard use width. Before taking measurements place samples in a controlled environment at 23°C, 50 % RH, for at least 12 h. Remove from dessicator and within 5 min measure from the uppermost portion of one feature window to the uppermost portion of a feature window 5 ± 0.5 in. (127 ± 12 mm) away. Mark the measured edges with an indelible ink felt tipped pen. Record the measurement. Etch off all the conductive foil, dry the sample at 120°C for 15 min, and place sample in a 23°C, 50 % RH dessicator for a minimum of 12 h. Within 5 min of removing a sample from the dessicator, remeasure each sample at the uppermost portion of the previously marked feature windows. Record this measurement. Repeat these measurements for the remainder of the samples. Calculate dimensional stability as follows:

Dimensional Stability, %

$$= \frac{(\text{Measurement before etch} - \text{Measurement after etch})}{\text{Measurement before etch}} \times 100$$

A negative number indicates shrinkage while a positive number indicates growth.

7.4 *Curl*:

7.4.1 *Apparatus*:

7.4.1.1 *Shear* to cut material.

7.4.1.2 *Rule* to measure 3-ft (0.9-m) sample.

7.4.1.3 *Large Protractor*.

7.4.2 *Procedure*—Cut a 3-ft sample piece from a roll of product. Lay product on edge on a flat table. Measure curl as shown with the protractor in Fig. 4. Record the measurement.

7.5 *Twist* (see Fig. 5):

7.5.1 *Apparatus*:

7.5.1.1 *Shear* for cutting a sample.

7.5.1.2 *Mechanical Clamp* to equivalent apparatus to hang

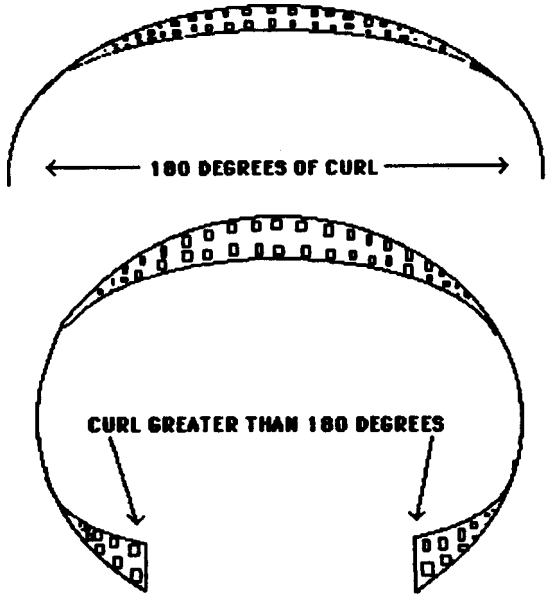


FIG. 4 Curl Measurement

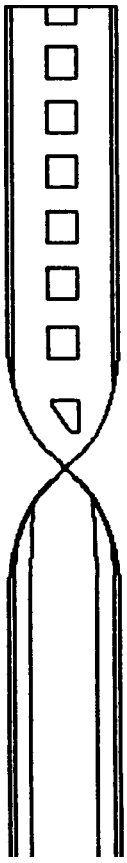


FIG. 5 Twist Measurement

a 3-ft sample vertically with no interference.

7.5.2 *Procedure*—Cut a 3-ft (0.9-m) sample from a roll of product. Hang the sample from a suitable apparatus and measure the number of 180° twists in the material. Record the number.

7.6 *Waviness/Flutter*:

7.6.1 *Apparatus*:

7.6.1.1 *Flat Surface*, measuring 12 by 24 in. (30.5 by 61 cm) with two minimum resistance rollers (see Fig. 6).

7.6.1.2 *Thickness Gage*:

0.070 in. (1.8 mm)

7.6.1.3 *Two Weights* with Jiffy clamps to hang on the ends of tape carrier material.

7.6.1.4 *Shear* to cut product.

7.6.1.5 *Feeler Gage*, needle-type measuring 0.07 in. (1.8 mm)

7.6.2 *Procedure*—Determine correct weight by the following formula:

Weight needed on each end, oz

$$= \frac{8.714\ \text{g}}{(\text{mil})(\text{in.})} * \text{Polyimide thickness (mils)}$$

* Polyimide width (in.)

7.6.2.1 Cut a 3-ft (0.9-m) sample of material. Lay sample on the pull down table and attach appropriate weights as previously discussed. Count the number of peaks in a 1-ft (3⁄10-m) span and using a needle-type feeler gauge determine if the peaks are greater than the allowable height off the flat table per Table 2. Record these measurements.

7.7 *Skew*:

7.7.1 *Apparatus*:

7.7.1.1 Measurement equipment as described in 7.1.1.

7.7.1.2 *Shear* to cut material.

7.7.1.3 *Glass Cover* or equivalent fastening device to prevent material movement after alignment.

7.7.2 *Procedure*—Cut an 18-in. (45.7-cm) sample of material from a roll and place it on the *X,Y* coordinate table. Fasten it in place to prevent any undesired movement. The materials manufacturer shall provide some distinctive mark to allow determination of the primary datum edge. Establish a reference datum along the inside edge of the upper row of sprocket holes. See Fig. 7. In the event that camber prevents establishment of a straight reference line, two sprocket holes 4.0 ± 0.5 in. (102 ± 12 mm) apart shall be used to establish the primary reference line. After establishing the reference line, align the optical measurement unit on the left side of a sprocket hole that falls between the two reference sprocket holes used for setting up the primary reference line. Determine skew by

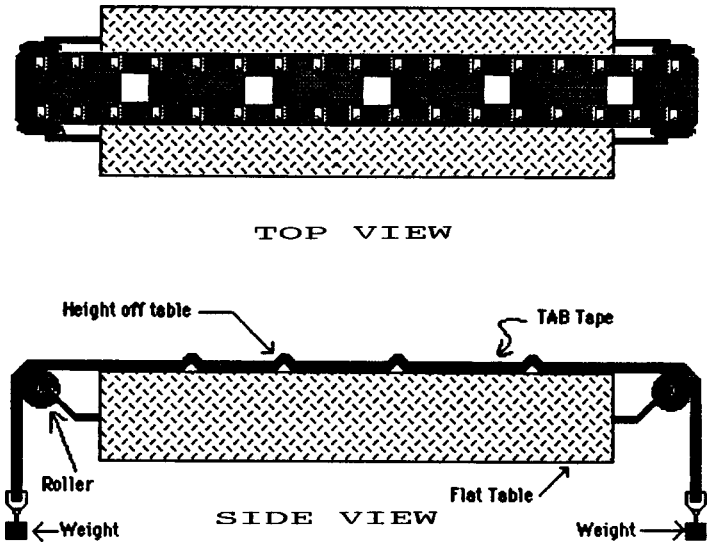


FIG. 6 Waviness/Flutter

TABLE 2 Physical Properties

Property and Test Method	Appropriate Value
Peel Strength (minimum) (see 7.2)	3.0 PLI minimum value
Dimensional Stability (see 7.3)	Less than 0.12 % shrinkage
Curl (see 7.4)	180° max on a 3 ft sample.
Twist (see 7.5)	Material must not twist greater than 180°.
Waviness/Flutter (see 7.6)	No more than three peaks per linear foot. None greater than 0.07 in. off table.
Skew (see 7.7)	≤35 mm: 0.0030 in. max >35 mm: TBD
Camber (see 7.8)	0.0020 in. max
Window Sag (see 7.9)	TBD based on window size and copper thickness.

measuring the misalignment of the paired sprocket hole located across the web. If the reference line falls within this hole this is defined as right skew.

7.8 *Camber*:

7.8.1 *Apparatus*:

7.8.1.1 Measurement equipment as described in 7.1.1,

7.8.1.2 *Shear* to cut material, and

7.8.1.3 *Glass Cover* or equivalent fastening device to prevent material movement after alignment.

7.8.2 *Procedure*—Cut an 18-in. (45.7-cm) sample of material for a roll and place it on the *X,Y* coordinate table. The materials manufacturer shall provide some distinctive mark to permit determination of the primary datum edge. Establish a reference datum using the inside edge of two sprocket holes 4.0 ± 0.5 in. (102 ± 12 mm) apart that are centered between two feature windows on the upper edge of the tape adjacent to the primary datum edge. After defining the reference datum, measure camber as shown in Fig. 8 by measuring the maximum distance between the reference line and the inner edge of a sprocket hole between the two reference holes. Record the amount of camber and the distance between the two reference holes used.

7.9 *Window Sag*:

7.9.1 *Apparatus*:

7.9.1.1 *Z-Axis Measuring Optical Microscope* capable of reading to 0.0001 in. with an *X,Y* coordinate table capable of reading to 0.0001 in., or an equivalent piece of measuring equipment,

7.9.1.2 *Measuring Fixture* with a cut out that is 0.001 in. (25.4 µm) larger than the feature window on all sides, and

7.9.1.3 *Digital Micrometer* capable of reading to 0.0001 in. (2.54 µm) or equivalent piece of measuring equipment.

7.9.2 Determine the thickness of the dielectric film (and adhesive if present) adjacent to the feature window. Record this measurement. Fasten the tape to a test fixture copper side down and establish the top of the dielectric film as a *Z* axis zero reference point. Using the *X,Y* coordinate table, move the measurement point to the center of the window area and measure the *Z* axis height in relation to the previously established zero reference point. Record this measurement. Compute window sag by subtracting the dielectric (and adhesive if present) thickness from the *Z* axis height differential recorded:

$$\text{Window Sag} = Z \text{ axis height differential} - \text{dielectric (and adhesive thickness if present)}$$

A negative number indicates inset window sag.

7.10 *General Visual*:

7.10.1 Unacceptable visual defects include the following:

7.10.1.1 Fingerprints on the copper surface,

7.10.1.2 Spot delamination in excess of five spots per linear foot less than 0.015 in. (0.381 mm) in diameter,

7.10.1.3 Spot delamination in excess of one spot per linear foot greater than 0.015 in. in diameter,

7.10.1.4 Repetitive or regularly spaced pits or dents that scratch or deform the conductive foil, and

7.10.1.5 Pinholes in the polyimide larger than 0.0004 in. (10.16 µm) in diameter.

8. Inspection

8.1 Inspection of the material shall be agreed upon between the purchaser and the supplier as part of the purchase contract.

9. Rejection

9.1 Material that fails to conform to the requirements of this specification may be rejected. Rejection should be reported to the producer or supplier promptly and in writing. In case of dissatisfaction with the results of the test, the producer or supplier may make claim for a rehearing.

10. Certification

10.1 When specified in the purchase order or contract, a producer's or supplier's certification shall be furnished to the purchaser that the material was manufactured, sampled, tested, and inspected in accordance with this specification and has been found to meet the requirements. When specified in the purchase order or contract, a report of the test results shall be furnished.

11. Keywords

11.1 lead carrier tape; 19-mm testable tape carrier; semiconductor devices; tape carrier bonding; 35-mm testable

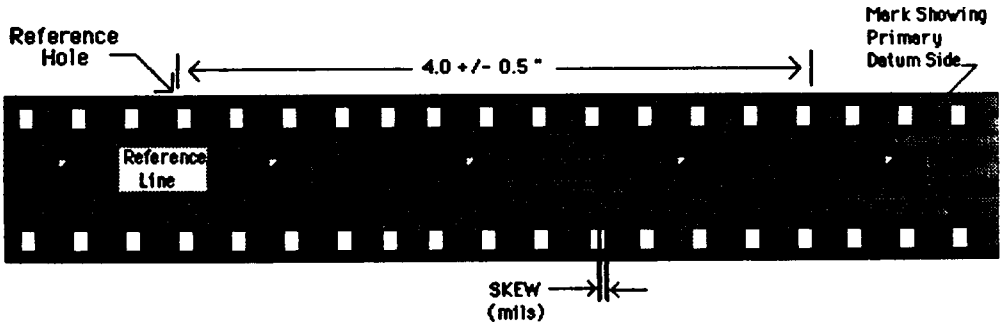


FIG. 7 Skew Measurement

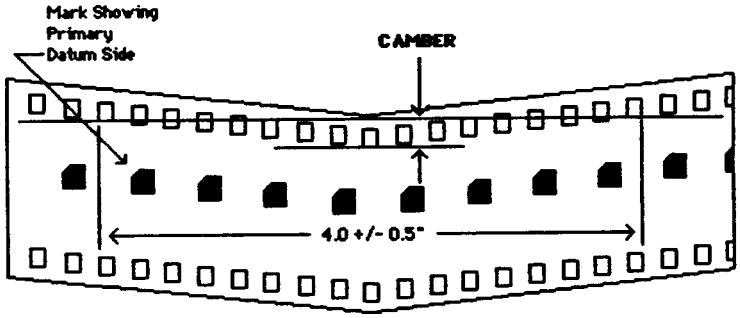


FIG. 8 Camber Measurement

tape carrier

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