8 Procedure

8.1 Fix samples using a clamper or adhesive, so that the sample will not float, without applying excessive stress to the wire.

8.2 Set pull speed to 0.5 mm/sec while measuring.

8.3 Insert the hook under the bonded wire between the top of the first bonding and the center of the loop.

NOTE 2: Select hook position accordingly to package, wiring condition, and wire diameter.

NOTE 3: Place the hook perpendicular to wiring direction if there is no specific instruction.

NOTE 4: Do not measure damaged or deformed wire.

8.4 Pull the hook perpendicular to die/substrate.

8.5 Record the force that breaks the wire as the pull strength.

8.6 Repeat the measurement on another wire.

NOTE 5: Do not change the position while testing the same samples.

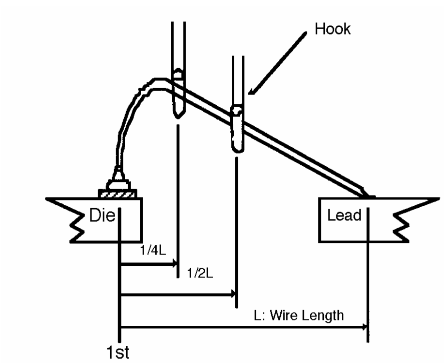

Figure 2
Hook Position

9 Report

9.1 Report of the pull test must contain the following information.

9.2 *Pull Strength*

9.3 *Breaking Mode* — Choose the closest position from Figure 3 below and represent the broken position by number or alphabet in the figure.

9.3.1 Breaking Mode (Report in number or alphabet)

- 1,A: The first bond
- 2,B: The first bond neck
- 3,C: Loop
- 4,D: The second bond neck
- 5,E: The second bond

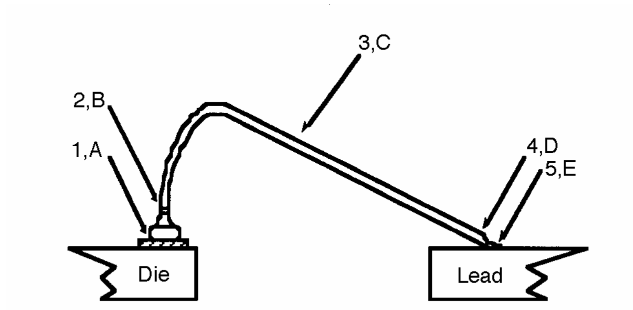

Figure 3
Breaking Mode

9.4 *Hook Position*

9.5 *Rejection* — Criterion of each semiconductor manufacturer to each product. Refer to “Minimum Strength” of the attached MIL-STD-883D.

10 Related Documents

10.1 *SEAJ Document* [2]

SEAJ Technical Term Dictionary, 3rd Edition

10.2 *JEITA Standard* [3]

JEITA ED4703 — In-Line Evaluation Methods and Structural Analysis Methods for Semiconductor Devices

10.3 *IEC Standard* [4]

IEC 749 — Semiconductor Devices: Mechanical and Climatic Test Methods

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2 Semiconductor Equipment Association of Japan, 4F Grand Maison Shinjuku Gyoen., 1-7-10 Shinjuku Shinjuku-ku, Tokyo 160-0022 Japan, 03(3353)7651 Fax 03(3353)7970, http://www.seaj.or.jp/english/index.htm.

3 Electronic Industries Association of Japan, Available through: Japan Electronics and Information Technology Industries Association, 3rd Fl., Mitsui Sumitomo Kaijo Bldg. Annex 11, Kanda Surugadai 3-chome, Chiyoda-ku, Tokyo 101-0062, Japan, http://www.jeita.or.jp/eiaj/english/

4 International Electrotechnical Commission, 3 rue de Varembe, CH-1211, Geneva 20, Switzerland, Phone: 41 22 919 02 11, Fax: 41 22 919 03 00, E-mail: IEC Central Office, http://www.iec.ch/

APPENDIX 1
HOOK POSITION VS. PULL STRENGTH (DEPENDENCE ON PULL SPEED)

NOTICE: The material in this appendix is an official part of SEMI G73 and was approved by full letter ballot procedures.

A1-1

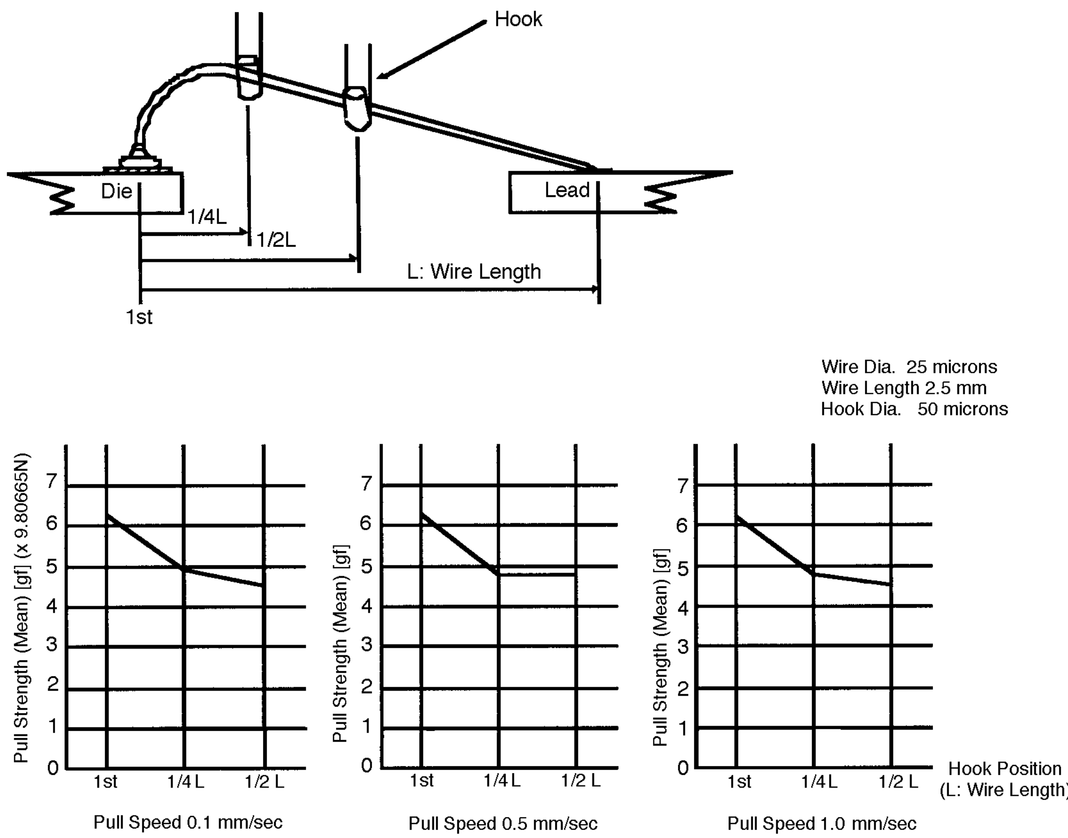

Figure A1-1

APPENDIX 2
HOOK POSITION VS. PULL STRENGTH (DEPENDENCE ON HOOK DIAMETER)

NOTICE: The material in this appendix is an official part of SEMI G73 and was approved by full letter ballot procedures.

A2-1

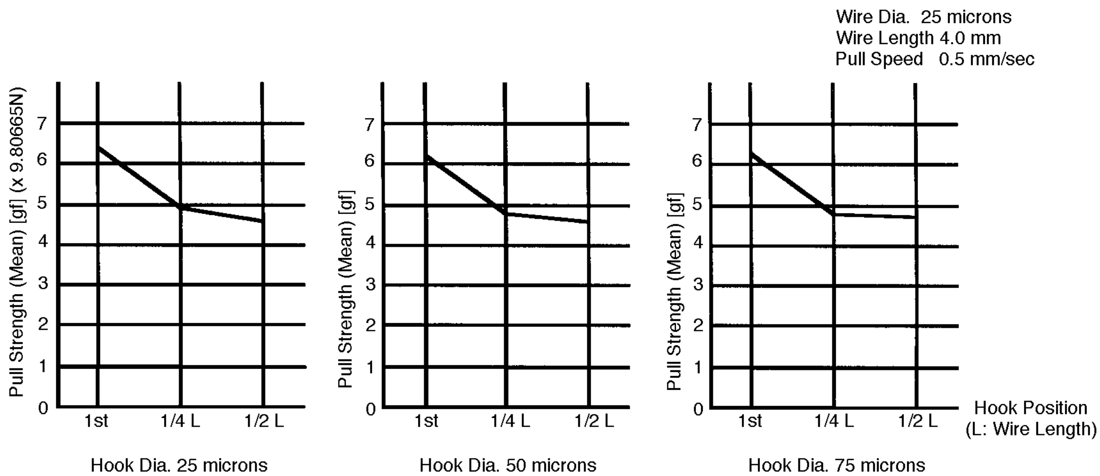

Figure A2-1

NOTICE: SEMI makes no warranties or representations as to the suitability of the standard 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 or equipment mentioned herein. These standards are subject to change without notice.

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SEMI G74-0699
SPECIFICATION FOR TAPE FRAME FOR 300 mm WAFERS

This specification was technically approved by the Global Assembly & Packaging Committee and is the direct responsibility of the Japanese Packaging Committee. Current edition approved by the Japanese Regional Standards Committee on March 17, 1999. Initially available at www.semi.org May 1999; to be published June 1999. Originally published June 1998; previously published September 1998.

1 Purpose

1.1 The purpose of this document is to standardize the specifications for 300 mm wafer tape frames used between the dicing process and the die-bonding process.

2 Scope

2.1 This standard documents the dimensions, characteristics, and measurement methods for 300 mm wafer tape frames.

2.2 This standard can be used as the specification sheet for tape frame upon purchasing.

2.3 This standard uses the SI unit system.

3 Referenced Documents

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

3.1 *ANSI Standard*[1]

ANSI/ASME B46.1 — Surface Texture (Surface Roughness, Waviness, and Lay)

3.2 *ISO Standards*[2]

ISO4287 Part 1 — Surface Roughness Terminology Part 1: Surface and Its Parameters

3.3 *JIS Standards*[3]

JIS B0601 — Surface Roughness - Definitions and Designations

JIS Z2245 — Method of Rockwell and Rockwell Superficial Hardness Test

4 Terminology

4.1 *tape frame* — the frame which applies the wafer tape to the wafer and retains the wafer.

4.2 *wafer tape* — an adhesive plastic tape which retains the wafer or diced chip. It is used between the dicing process and the die-bonding process.

5 Ordering Information

5.1 Purchase orders for tape frames furnished to this specification shall include quantity.

6 Requirements

6.1 *Dimensions* — See Table 1 and Figure 1.

Table 1 300 mm Tape Frame Dimensions

Symbol	*Dimension (mm unless noted))*	*Note*
ϕ A	350 ± 0.5	Inner diameter
ϕ B	400 ± 0.5	Outer diameter
C	380 + 0/-0.5	Width between two cords
D	380 + 0/-0.5	Width between two cords
E	170.4	Outline dimension
F	172	Outline dimension
G	86	Outline dimension
H	90	Outline dimension
I	120°	
J	60°	Partition out with diameter *N* as standard
tK	1.5 or (1.2)	Plate thickness
L	190	
M	190	Frame warpage
ϕ N	3.2	Pin diameter
P	100 ± 0.2	Diameter *N* position
Q	18 ± 0.2	Diameter *N* position
R	276	1 Notch position
S	19.6 ± 0.2	1 Notch position

NOTE 1: Plate thickness of 1.5 mm is recommended.

NOTE 2: No burrings on the edges.

NOTE 3: Surface Roughness: $R_{max} \leq 1$ µm, $R_a \leq 0.1$ µm; (surface indicated as Δ) unindicated Cut Surface Roughness: $R_{max} \leq 100$ µm, $R_a \leq 25$ µm.

[1] *American National Standards Institute, 1430 Broadway, New York, NY 10018*

[2] *International Organization for Standardization, C.P. 56, CH-1211 Geneva 20, Switzerland*

[3] *Japanese Standards Association, 1-24, Akasaka 4 Chome, Minato-ku, Tokyo, Japan*

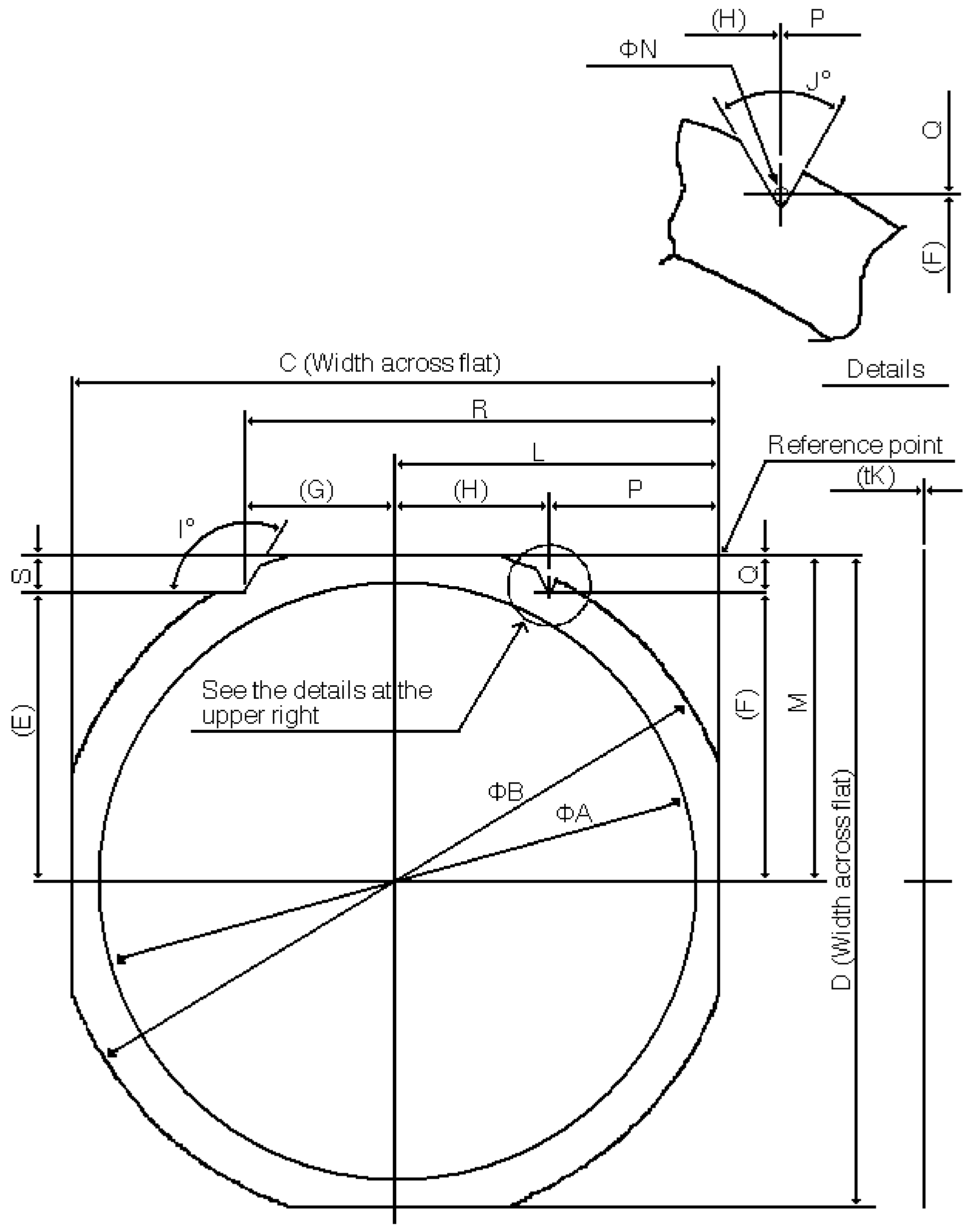

Figure 1

300 mm Tape Frame Dimensions

6.2 *Surface Hardness* — HRc ≥ 47

6.3 *Resiliency* — Must return to original shape, where the linear scale ruler reads 0, after one side is held firm and the other is bent with a force of 30 N for 60 seconds.

6.4 *Surface Roughness* — $R_a \leq 0.1$ µm, R_{max} is within ≤ 1.0 µm

6.5 *Flatness* — Within 0.3 mm

7 Test Methods

7.1 *Dimensions* — To be measured with a measuring device, such as a caliper, with a precision of 0.05 mm.

7.2 *Surface Hardness* — To be measured according to the method in JIS Z2245 with a Rockwell Hardness Tester.

7.3 *Resiliency* — Secure one side of the frame in a vice, and bend with a force of 30 *N* for 60 seconds. After that, release the frame and measure the change from the original shape with a linear scale ruler. The linear scale ruler should have a precision of at least 0.5 mm.

7.4 *Surface Roughness* — Measure with a surface roughness gauge. Surface roughness is measured perpendicular to the undulation and must be shown as roughness average (R_a) and maximum peak-to-valley roughness height (R_{max}). Refer to ISO4287 Part 1, JIS B0601, and ANSI/ASME B46.1.

7.5 *Flatness* — Place the frame on a surface with near-zero flatness. Measure the lowest point and the highest point on the frame with a height gauge, and record the difference in these values. Turn the frame over and repeat the process. The flatness will be the larger of the two values.

8 Certification

8.1 Upon request of the purchaser in the contract or order, a manufacturer's or supplier's certification that the material was manufactured and tested in accordance with this specification, together with a report of the test results, shall be furnished at the time of shipment.

9 Packing and Package Labeling

9.1 The product must be packaged appropriately to prevent deformities, moisture, and contamination, as well as damage during normal shipping.

9.2 The products must be clearly marked with the purchase number, quantity, gross weight, and supplier's name.

9.3 Special packaging and delivery requests will be decided between the supplier and the purchaser at time of purchase.

9.4 *Surface Hardness* — HRc ≥ 47

9.5 *Resiliency* — Must return to original shape, where the linear scale ruler reads 0, after one side is held firm and the other is bent with a force of 30 *N* for 60 seconds.

9.6 *Flatness* — Within 0.3 mm

APPENDIX 1
BARCODE LABEL POSITIONS FOR 300 MM TAPE FRAMES

NOTE: The material in this appendix is an official part of SEMI G74 and was approved by full letter ballot procedures on March 17, 1999.

A-1 Barcode Label Positions

A-1.1 The recommended position for the barcode label is position (A in Figure A1-1).

A-1.2 However, it is acceptable if the barcode labels are within the shaded area (see B in Figure A1-1).

A-2 Reasons to recommend position (A)

A-2.1 It is easier to detect whether there are any barcode labels or not, without pulling out the frames.

A-2.2 It is convenient to have the labels on the opposite side of the notches, as the frames are normally pulled out from the notch side.

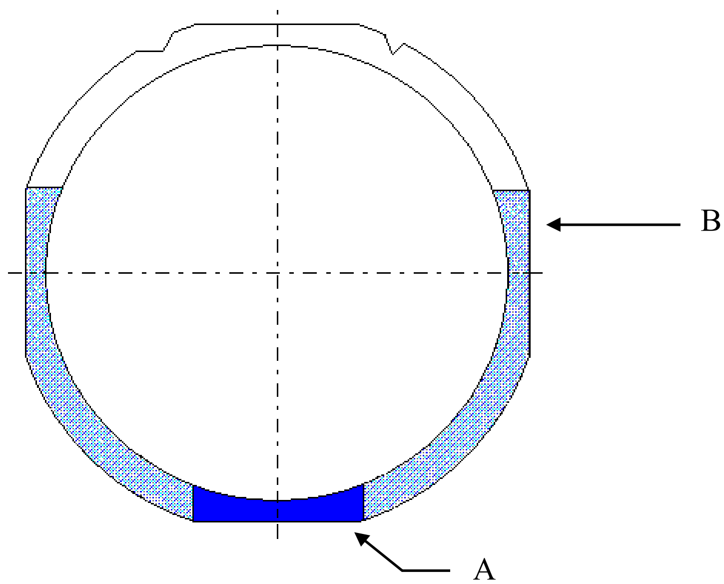

Figure A1-1

Barcode Label Positions

SEMI G75-0698
STANDARD TEST METHOD OF THE PROPERTIES OF LEADFRAME TAPE

1 Purpose

1.1 This standard describes procedures for measuring the mechanical, physical, chemical, thermal, and electrical properties of leadframe tape.

1.2 Equipment, sampling, and procedures are referred to in the individual test methods.

1.3 The test methods for the individual properties have been given in this standard.

1.3.1 Ionic impurities (see SEMI G75.1).

1.3.2 Adhesive strength (see SEMI G75.2).

1.3.3 Peel strength of protective film from leadframe tape (see SEMI G75.3).

1.3.4 Water absorption (see SEMI G75.4).

1.3.5 Weight loss (see SEMI G75.5).

1.3.6 Shrinkage factor (see SEMI G75.6).

1.3.7 Thermal decomposition temperature (see SEMI G75.7).

1.3.8 Coefficient of thermal expansion and glass transition temperature (see SEMI G75.8).

1.3.9 Tensile strength, elongation, and tensile modulus (see SEMI G75.9).

1.3.10 Volume and surface resistivity (see SEMI G75.10).

1.3.11 Dielectric constant and dissipation factor (see SEMI G75.11).

1.3.12 Breakdown strength (see SEMI G75.12).

1.3.13 Leakage current (see SEMI G75.13).

2 Scope

2.1 The methods help tape manufacturers, leadframe manufacturers, and their customers in evaluating leadframe tapes.

2.2 *Units*

2.2.1 This standard test method uses SI (metric) units.

3 Referenced Documents

3.1 Referenced documents are listed in each test method.

4 Terminology

4.1 *breakdown strength* — Under the specified test conditions, the quotient of the minimum r.m.s. voltage at the breakdown of the test piece (breakdown voltage) divided by the distance between the two electrodes (thickness of test piece).

4.2 *dielectric constant* — The amount of electrostatic energy stored in a unit volume of a substance in a unit electric field. It is called dielectric constant (εr) and expressed as the quotient of electrostatic capacity of a parallel condenser employing the test piece as the dielectric (C_x) divided by that of the same condenser when air (under the standard condition, the dielectric constant of air can be taken for that of vacuum) is used as the dielectric (C_o), measured under a specified frequency.

$$\text{i.e., } \varepsilon = C_x/C_o$$

4.3 *dielectric dissipation factor* — Dielectric dissipation factor is the tangent of the complementary angle of dielectric phase angle (tand). The dielectric phase angle is the phase difference angle (q) between sine-wave voltage applied to the test piece and the current component having the same frequency as the applied voltage caused by the voltage application.

4.4 *HAST* — Highly accelerated stress test: For example, 121° C/2 atm/100% RH.

4.5 *leadframe tape* — An adhesive coated tape. After removing protective film, laminated to the inner leads, which stops lead shift and/or lead lift during the assembly process.

4.6 *protective film* —A plastic film to cover the adhesive on leadframe tapes. This film prevents the adhesive from becoming contaminated and is removed from the leadframe tape just prior to taping the lead-frame.

4.7 *strain* — The ratio of elongation of the sample length to the original length at the applied stress level.

4.8 *stress* — The applied force per unit cross-sectional area of the sample.

4.9 *surface resistivity* — The quotient of the voltage gradient parallel to the current along the surface of the test piece divided by the current per unit width of the surface.

4.10 *tensile break strength* — The tensile force per unit of original cross section of the sample at the point of breakage.

4.11 *tensile modulus* — The ratio of stress to strain of the sample below the yield point, in the elastic region of the stress/strain curve.

NOTE: Plastic materials may not have a true elastic region in the stress/strain curve or force/elongation curve. A tangent is drawn to the maximum slope of the curve in order to determine the modulus.

4.12 *thermal decomposition temperature (base film and adhesive)* — The thermal decomposition temperature is determined at 5% of the weight loss when the tape is set to the thermal ramp at 10° C/minute.

4.13 *volume resistivity* — The quotient of the voltage gradient parallel to the current within the test piece divided by the current density.

5 Significance

5.1 *Ionic Impurities*

5.1.1 Ionic contamination can adversely affect the reliability of semiconductor devices by causing leakage currents and aluminum corrosion.

5.2 *Adhesive Strength*

5.2.1 Low adhesive strength may result in inner leads movement of leadframe during the assembly and packaging process which may result in low yield or poor device reliability.

5.3 *Peel Strength of Protective Film from Leadframe Tape*

5.3.1 If the peeling strength of protective film from leadframe tape varies in peeling strength, the taping machines will not operate consistently.

5.4 *Water Absorption*

5.4.1 If the leadframe tapes absorb an excessive amount of water in storage, before or after packaging, then reliability of devices made by these leadframes may be affected. Current leakage and corrosion of device metallization may occur.

5.5 *Weight Loss*

5.5.1 Weight loss may indicate that devices manufactured with the leadframe tape may have reliability problems due to the tape outgassing.

5.6 *Shrinkage Factor*

5.6.1 Excessive shrinkage at thermal processing may cause the lead shift and wire bond problems for automatic bonders.

5.7 *Thermal Decomposition Temperature*

5.7.1 The devices manufactured with leadframe tape that decomposes at too low a temperature may have lower reliability.

5.8 *Coefficient of Thermal Expansion and Glass Transition Temperature*

5.8.1 Excessive expansion of the leadframe tape may cause lead shift and/or lead lift and result in dislocated bonds from automatic bonders.

5.9 *Tensile Strength, Elongation, and Tensile Modulus*

5.9.1 If the tensile strength, elongation, and tensile modulus varies, the taping machines will not operate consistently.

5.10 *Volume and Surface Resistivity*

5.10.1 Low volume and/or surface resistivity is indicative of potential leakage currents between leadframe inner leads which can affect the function of the device.

5.11 *Dielectric Constant and Dissipation Factor*

5.11.1 High dielectric constant materials used in semiconductor packages may cause transmission delays. High dielectric loss causes energy loss, which leads to exothermic problems in semiconductor packages.

5.12 *Breakdown Strength*

5.12.1 Very low breakdown strength may cause devices to fail in use.

5.13 *Leakage Current*

5.13.1 A high leakage current between leadframe inner leads, which may be exacerbated due to high moisture test conditions and impurities in the tape, may result in poor device reliability.

6 Procedure

6.1 Procedures are detailed in the Test Methods following this document.

7 Reporting Results

7.1 The sample size per lot and the reported items shall be determined by agreement between user and supplier.

7.2 The report shall contain the following information:

7.2.1 *Leadframe Tape Material* — Manufacturer, type, and lot number.

7.2.2 Notification of acceptance or rejection.

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 the 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 G75.1-0698
TEST METHOD FOR MEASUREMENT OF IONIC IMPURITIES IN LEADFRAME TAPE

1 Summary of Method

1.1 Ionic impurities are extracted from sample tape by water at 100°C or 121°C and quantitatively analyzed by ion chromatography and flame photometry or atomic absorption spectrometry. The pH and electrical conductivity of the extracted solutions are also measured.

1.2 If sample tape needs the cure before the extraction, vender should inform the customer of the necessity of curing and report the impurity data after cure.

1.3 Ion chromatography is used to determine the presence and concentration of the following ionic species: Na^+, $NH4^+$, K^+, NO_3^-, Cl^-, Br^-, SO_4^{2-}, PO_4^{3-}.

1.4 Flame photometry or atomic absorption spectrometry is used to determine the concentration of Na^+ and K^+ ions.

1.5 pH and conductivity measurements are also described.

2 Referenced Documents

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

2.1 *SEMI Standards*

SEMI G29 — Test Method for Trace Contaminants in Molding Compounds

SEMI G59 — Test Method for Measurement of Ionic Contamination on Leadframe Interleafing and the Contamination Transferred from the Interleafing to the Leadframes

2.2 *ASTM Standards*[1]

ASTM D 1125 — Standard Test Methods for Electrical Conductivity and Resistivity of Water

ASTM D 1193 — Standard Specification for Reagent Water

ASTM D 4327 — Standard Test Method for Anions in Water by Ion Chromatography

ASTM E 70 — Standard Test Method for pH of Aqueous Solutions with the Glass Electrode

2.3 *JIS Specifications*[2]

JIS K 0121 — General Rules for Atomic Absorption Spectrochemical Analyses

JIS Z 8802 — Method for Determination of pH of Aqueous Solutions

3 Interferences

3.1 All the sample preparations and measurements must be carried out in clean containers which have been washed in deionized water in order to reduce any spurious readings.

3.2 Electrodes and syringes must be similarly cleaned before each test.

3.3 Contamination from the sampling process may also affect the results.

4 Equipment

4.1 Ion Extraction Vessels-Parr bomb with Teflon liner.

4.2 Ion chromatograph for anion and cation analysis (see SEMI G59).

4.3 Flame photometer or atomic absorption spectrometer.

4.4 Standard solution preparation vessels, balance and volumetric dispensers (see SEMI G29 and SEMI G59).

4.5 pH meter.

4.6 Microconductivity cell and meter.

5 Reagents and Materials

5.1 Deionized water, conductivity of less than 1.0 μ S/cm at 25°C per ASTM D 1193.

5.2 Eluents and regenerants for specific chromatograph columns prepared per chromatograph equipment manufacturer's recommendations so that the water peak can be separated from the ionic peaks.

5.3 *Compounds for Standard Solutions*

5.3.1 *Cations* — NaCl, NH_4Cl, KCl

5.3.2 *Anions* — NaCl, $Na2HPO_4 \bullet 12H2O$, NaBr, $NaNO_3$, K_2SO_4

NOTE: All compounds to be reagent grade.

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

2 Japanese Standards Association, 1-24, Akasaka 4 Chome, Minato-ku, Tokyo, Japan

5.4 pH standard solutions.

6 Sampling

6.1 Personnel handling the tape must wear double-layered cotton gloves and polyethylene outer gloves in order to avoid additional sample contamination.

6.2 The sampling is one sample per one lot. The vendor must report the definition of lot, if customer requires it.

7 Preparation of Standard Solution and Equipment Calibration

7.1 *Preparation of Standard Solutions and Chromatograph Calibration*

7.1.1 Refer to SEMI G59, Section 9 and ASTM D 4327.

7.2 *Preparation of Standard Solutions and Flame Photometer or Atomic Absorption Spectrometer Calibration*

7.2.1 Refer to SEMI G29 and JIS K 0121.

7.3 *Preparation of Standard Solutions and pH Meter Calibration*

7.3.1 Refer to ASTM E 70 or JIS Z 8802.

7.3.2 Using the standard pH solutions, calibrate the pH meter according to the manufacturer's instructions.

7.4 *Preparation of Standard Solutions and Conductivity Cell Calibration*

7.4.1 Refer to ASTM D 1125.

8 Measurement

8.1 *Procedure for Impurity Extraction*

8.1.1 Remove the protective film from the sample of tape. Cure the tape per tape manufacturer's recommendation, if necessary.

8.1.2 Cut the sample of tape so that it becomes smaller than 2 cm × 2 cm.

8.1.3 Place 5.0 ± 0.1 grams of the tape sample into the Parr bomb, and add 50 ± 0.5 grams of deionized water.

8.1.3.1 In a second bomb, add deionized water only so that a blank solution may be obtained for measurement of the ionic contributed by the bomb.

NOTE: It may be necessary to perform the blank test on both bombs in order to leach out excessive extractable ionic species.

8.1.4 Seal the caps and heat the bombs in an oven set at 100°C ± 2°C, for 20 ± 0.25 hours.

NOTE: The oven temperature may be set at 121°C ± 2°C for 20 hours, if specified.

8.1.5 Allow the bombs to reach room temperature.

8.1.6 Open the bombs just before the measurements are to be made. Measurements must be made within eight (8) hours of the completion of the sample preparation.

8.2 *Quantitative Analysis by Ion Chromatography*

8.2.1 Prepare the chromatograph for operation by regenerating the columns according to the manufacturer's recommendations.

8.2.2 Run the eluent through the chromatograph until a stable baseline calibration is established.

8.2.3 Inject the recommended sample size of test solution into the chromatograph and record the ion chromatogram.

8.2.4 Repeat for all the samples and also run the background sample.

8.2.5 Determine the ionic type and concentration from the calibration curves.

8.2.6 Results

8.2.6.1 The concentration of ionic species in the leadframe tape is given by:

$$A = \frac{(B - C) \times 50}{5}$$

where :

A is the ionic content of the leadframe tape (ppm)
B is the ionic content on the extracted solution, determined from the calibration curves (ppm)
C is the ionic concentration of the back-ground sample (ppm)

8.3 *Quantitative Analysis by Flame Photometer or Atomic Absorption Spectrometer*

8.3.1 Set a specific operational condition for an apparatus.

8.3.2 Introduce the recommended sample size of test solution into a flame.

8.3.3 Repeat for all the samples and also introduce the background sample.

8.3.4 Determine the concentration from calibration curves.

8.3.5 *Results*

8.3.5.1 The concentration of ionic species in the leadframe tape is given by:

$$A = \frac{(B - C) \times 50}{5}$$

where :

A is the ionic content of the leadframe tape (ppm)

B is the ionic content on the extracted solution, determined from the calibration curves (ppm)

C is the ionic concentration of the background sample (ppm)

8.4 *pH Measurements*

8.4.1 Place the pH electrode into the sample solution and record the pH after one (1) minute.

8.5 *Electrical Conductivity Measurements*

8.5.1 Place the conductivity cell into the sample solution and record the conductivity after one (1) minute.

9 Related Documents

NOTE: Additional information relating to test methods for these ionic species may be found in the following specifications:

9.1 *SEMI Standard*

SEMI G12 — Recommended Practice for Aqueous Extraction of Ionic Species from Plastics Used to Package Electronic Devices

9.2 *ASTM Specifications*

ASTM D 512 — Standard Test Methods for Chloride Ion in Water

ASTM D 1293 — Standard Test Methods for pH of Water

9.3 *JIS Specification*

JIS K 0102 — Testing Methods for Industrial Wastewater

SEMI G75.2-0698
TEST METHOD FOR MEASUREMENT OF ADHESIVE STRENGTH OF LEADFRAME TAPE

1 Summary of Method

1.1 Two methods are described:

1.1.1 *Pull-Up Method* — Using a hook attached to a tensile tester, the tape is pulled away from the leadframe inner leads.

1.1.2 *Push-Down Method* — Using a probe attached to a tensile tester, a leadframe inner lead is pushed away from the tape.

1.2 The adhesive strength between the lead and the tape should be measured at 23°C ± 5°C and 250°C.

2 Equipment

2.1 Tensile tester with appropriate load cell, clamping chucks, and a chart recorder. Tensile tester shall keep constant the traveling speed of clamping chucks, of which the traveling distance can be read to the nearest 1 mm, and shall simultaneously record the load imposed on the sample. It shall measure and record the imposed load with ± 1% on a chart recorder.

2.2 *Pull-Up Method*

2.2.1 A clamp should be suitable for each leadframe type. Example of the clamp design, for a typical 40 pins DIP leadframe, is shown in Figure 1.

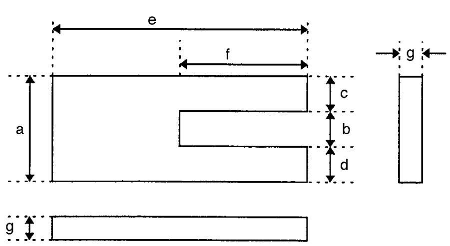

Figure 1
Example of Clamp Design
(40 Pins DIP Leadframe)

Table 1 Dimension and Material of Clamp and Hook in Push-Up Method

Item/Dimension	*Value*	*Material*	*Reference Figure*
Clamp		Aluminum	1
a	60 mm		
b	8 mm		
c	26 mm		
d	26 mm		
e	60 mm		
f	30 mm		
g	3 mm		
Pull-Up Hook		Piano Wire	2
ϕ	0.4 mm		
a	100 mm		
b	5 mm		
r	2.0 mm		

2.2.2 A pull-up hook should be suitable for each leadframe type. Example of the pull-up hook, for a typical 40 pins DIP leadframe, is shown in Figure 2.

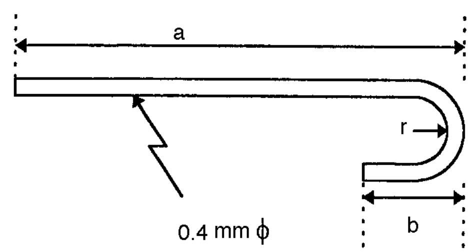

Figure 2
Pull-Up Hook
(40 Pins DIP Leadframe)

2.3 *Push-Down Method*

2.3.1 A table should be suitable for each leadframe type. Example of the table, for a typical 40 pins DIP leadframe, is shown in Figure 3.

2.3.2 A push-down probe should be suitable for each leadframe. Example of the push-down probe, for a typical 40 pins DIP leadframe, is shown in Figure 4.

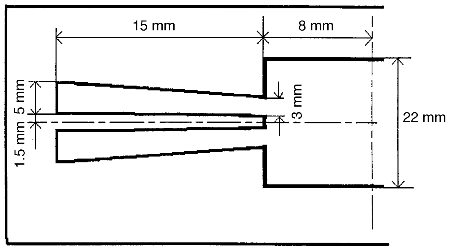

Figure 3
The Dimension of the Table

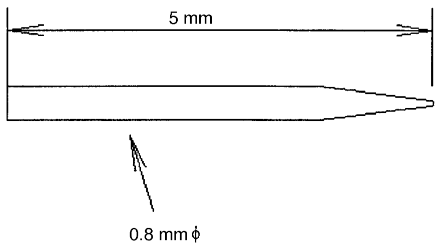

Figure 4
Example of Push-Down Probe
(40 Pin DIP Leadframe)

3 Test Condition

3.1 Adhesion testing shall be carried out at the following ambient conditions:

Temperature — 23°C ± 5°C

Humidity — 50 ± 5% RH

4 Sampling

4.1 The sampling is one sample per one lot. The vendor must report the definition of lot, if the customer requires it.

5 Preparation of Specimens

5.1 *Leadframe Manufacturers*

5.1.1 Leadframes shall be taped using conditions for temperature, pressure, and dwell-time agreed upon between vendor and customer.

NOTE: A typical taped 40 pins DIP leadframe is shown in Figure 5, and relevant information for this frame is shown in Table 2.

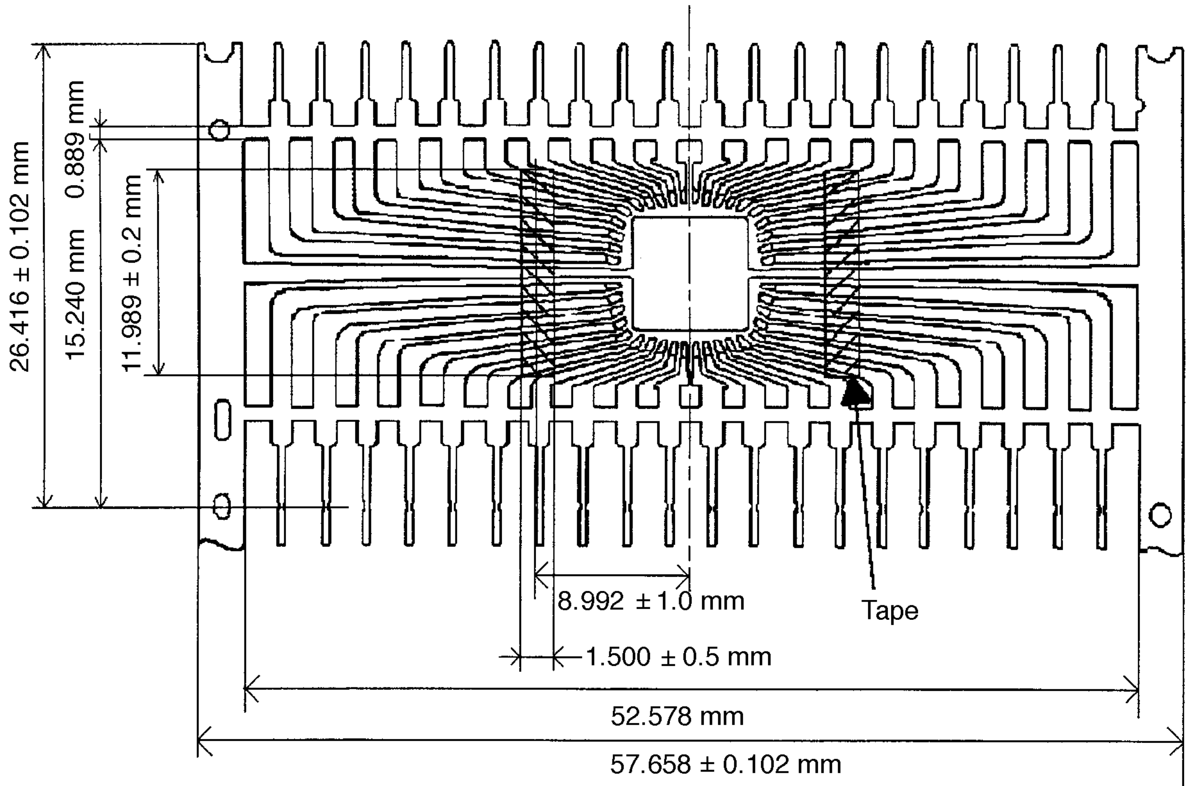

Figure 5
Typical Taped 40 Pin DIP Leadframe

Table 2 Relevant Information for 40 Pin DIP Leadframe

Leadframe Attribute	*Specification*
Leadframe thickness	0.25 mm
Leadframe material	Alloy 42
Leadframe manufacturing process	Stamping
Plating	None/Silver/Others
Surface treatment	To be agreed upon between vendor and customer.

NOTE: The surface state of Alloy 42 is stable compared with Cu alloy which is oxidized easily.

6 Procedure

Hot adhesive strength at 250°C should be measured on the heater block with 60 ± 10 seconds.

6.1 *Pull-Up Procedure*

6.1.1 Set the tensile tester in the up-mode, and adjust the rate to 100 mm/minute.

6.1.2 Place the leadframe under the clamp as shown in Figure 6.

6.1.3 Position the hook under the tape between the tie bar and its neighboring inner lead as shown in Figure 6. Similar leads and hook position shall be selected for other types of leadframes.

6.1.4 Adjust the hook position until it just touches the tape and initiate the tensile tester in the up-mode. Record the strength to break the adhesion between the lead and the tape.

6.1.5 Repeat the test for each leadframe in the samples.

6.1.6 Calculation

6.1.6.1 Discard the maximum and minimum values recorded, and average the remainder.

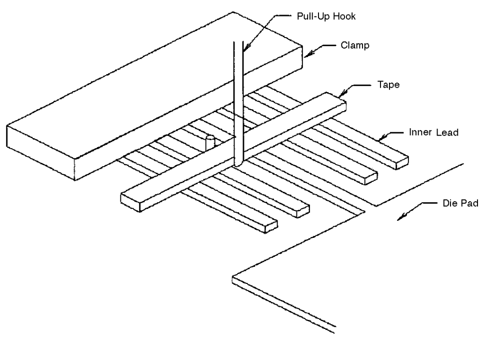

Figure 6
Measurement of Pull-Up Strength

6.2 *Push-Down Procedure*

6.2.1 Set the tensile tester in the down-mode, and adjust the rate to 100 mm/minute.

6.2.2 Place the leadframe on the table as shown in Figures 7 and 8.

6.2.3 Position the probe at Point A over the selected inner lead as shown in Figure 9.

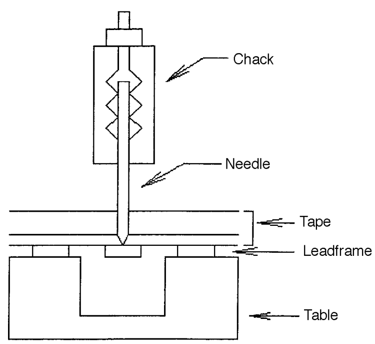

Figure 7
Measurement of Push-Down Strength
(Cross-Section)

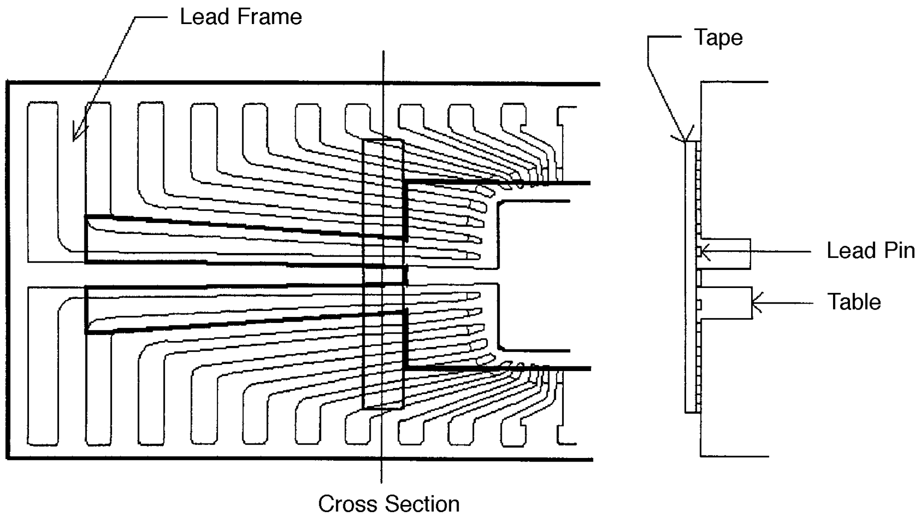

Figure 8
Relation of Leadframe and Table in Push-Down Method

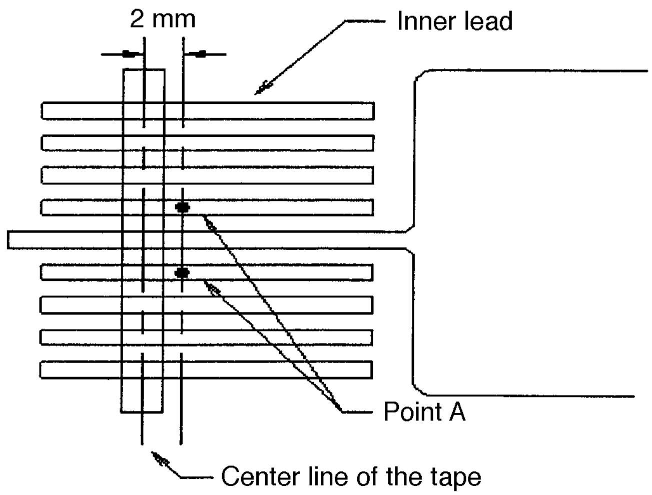

Figure 9
Probe Position over the Selected Inner Lead in Push-Down Method

6.2.4 Adjust the probe position until it just touches the inner lead and initiate the tensile tester in the down-mode. Record the strength to break the adhesion between the inner lead and the tape.

6.2.5 Repeat the test for each of the test positions noted in Section 6.2.4.

6.2.6 Repeat the tests for each leadframe in the sample.

6.3 *Calculation*

6.3.1 Discard the maximum and minimum values recorded and average the remainder.

7 Related Documents

7.1 *JIS Specification*[1]

JIS K 6854 — Testing Methods for Peel Strength of Adhesives

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1 Japanese Standards Association, 1-24, Akasaka 4 Chome, Minato-ku, Tokyo, Japan

SEMI G75.3-0698
TEST METHOD FOR MEASUREMENT OF THE PEEL STRENGTH OF PROTECTIVE FILM ON LEADFRAME TAPE

1 Summary of Method

1.1 A tensile tester is used to peel the film away from the adhesive (see Figure 1) and directly measure the peel strength with a calibrated load cell.

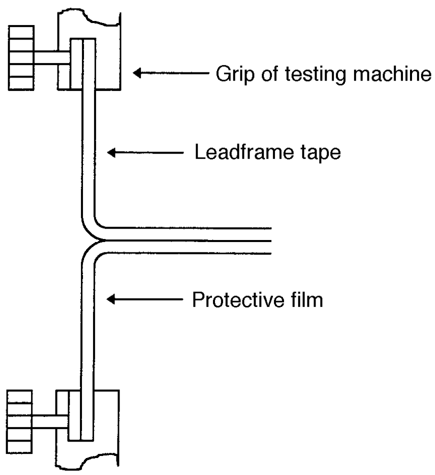

Figure 1
Attaching of Test Piece for T-Type Peel Test

2 Equipment

2.1 Tensile tester with appropriate load cell, clamping chucks, and a chart recorder.

2.1.1 Tensile tester shall keep constant the traveling speed of clamping chucks, of which the traveling distance can be read to the nearest 1 mm, and shall simultaneously record the load imposed on the sample. It shall measure and record the imposed load with ± 1% on a chart recorder.

3 Test Condition

3.1 Peel strength testing shall be carried out at the following ambient conditions:

Temperature — 23 ± 5°C

Humidity — 50 ± 5% RH

4 Sampling

4.1 The sampling is one sample per one lot. The vendor must report the definition of lot, if the customer requires it.

4.2 The width of the tape tested shall be 15 ± 0.2 mm.

5 Equipment Calibration and Setup

5.1 Refer to the tensile tester manufacturer's equipment manual for setup and calibration.

5.2 The sample shall be attached and peeled for T-type peel test shown in Figure 1.

5.3 Both ends of a test piece shall be attached to the grips of the testing machine specified in Section 2.1.

5.4 The pulling rate shall be set to 300 mm/minute.

5.5 The pulling distance shall be 125 mm minimum from the start of peeling.

5.6 The peel strength shall be recorded in grams.

6 Measurements

6.1 As shown in Figure 2, draw the optimum straight line which is parallel to the abscissa for peeling length, that passes through the peeling curve, and find the peeling load after eliminating initial 25 mm of peeling length.

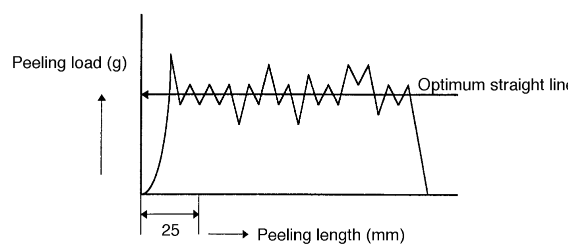

Figure 2
Obtaining Peeling Load by the Optimum Straight Line Method

7 Related Documents

7.1 *JIS Specification*[1]

JIS K 6854 — Testing Methods for Peel Strength of Adhesives

1 Japanese Standards Association, 1-24, Akasaka 4 Chome, Minato-ku, Tokyo, Japan

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SEMI G75.4-0698
TEST METHOD FOR MEASUREMENT OF WATER ABSORPTION OF LEADFRAME TAPE

1 Summary of Method

1.1 Leadframe tape is exposed to an environment at constant humidity and temperature. The water absorption is measured by directly weighing the samples before and after test.

2 Referenced Documents

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

2.1 *ASTM Specification*[1]

ASTM D 1193 — Standard Specification for Reagent Water

3 Equipment

3.1 Direct reading electric balance capable of reading 0.1 mg.

3.2 Thermohygrostat capable of 23 ± 2°C and 50 ± 5% RH.

3.3 Thermohygrostat capable of 85 ± 2°C and 85 ± 5% RH.

4 Materials

4.1 *Deionized Water* — Refer to ASTM D 1193.

5 Test Conditions

5.1 *Specimen Conditioning*

Temperature — 23 ± 2°C

Humidity — 50 ± 5% RH

5.2 *Test Conditions*

Temperature — 85 ± 2°C

Humidity — 85 ± 5% RH

6 Sampling

6.1 The sampling is one sample per one lot. The vendor must report the definition of lot, if customer requires it.

6.2 The sample's weight shall be 1 gram minimum.

6.3 Use plastic tweezers to handle the samples.

1 American Society of Testing and Materials, 100 Barr Harbor Drive, West Conshohoken, PA 19428-2959 (all cited standards may be found in Volume 10.05 of the Annual Book of ASTM Standards)

7 Equipment Setup and Calibration

7.1 Refer to the thermohygrostat manufacturer's manual for setup and calibration procedures.

8 Procedure

8.1 Separate off the protective film from the leadframe tape.

8.2 Set the thermohygrostat at 23°C and 50% RH and condition the samples at these conditions for 16 hours minimum.

8.3 Weigh each sample to 0.1 mg accuracy (W_1, Units-grams).

8.4 Set the thermohygrostat at 85°C and 85% RH and leave the samples at these conditions for 20 ± 0.25 hours.

8.5 Wipe the water from sample surface with lint-free clean wipes.

8.6 Reweigh each sample (W_2, Unit-grams).

8.7 *Calculation*

The water absorption obtained, A (%), is deter-mined from the following equation:

$$A(\%) = \frac{(W_2 - W_1) \times 100}{W_1}$$

9 Related Documents

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

9.1 *ASTM Specification*

ASTM D 570 — Standard Test Method for Water Absorption of Plastics

9.2 *JIS Specifications*[2]

JIS K 6911 — Testing Methods for Thermosetting Plastics

JIS K 7209 — Testing Methods for Water and Boiling Water Absorption of Plastics

2 Japanese Standards Association, 1-24, Akasaka 4 Chome, Minato-ku, Tokyo, Japan

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SEMI G75.5-0698
TEST METHOD FOR MEASUREMENT OF WEIGHT LOSS OF LEADFRAME TAPE

1 Summary of Method

1.1 Specimens are weighed before and after exposure to temperatures comparable to those used in the assembly and packaging of microelectronics devices. The weight loss is calculated as a percentage change in the weight of the sample.

2 Equipment

2.1 Direct reading balance calibrated to 0.1 mg accuracy.

2.2 Recirculating air oven capable of 300°C ± 2°C accuracy.

3 Sampling

3.1 The sampling is one sample per one lot. The vendor must report the definition of lot, if customer requires it.

4 Preparation of Specimens

4.1 Allow the samples to stabilize at 23°C ± 2°C and 50 ± 5% RH for 16 hours minimum. This may be carried out in a climate controlled room or in a thermohygrostat.

4.2 Cut specimens out of the samples such that the minimum weight of each specimen is 1 gram.

5 Test Conditions

5.1 *Test Condition 1* — 100°C for 60 ± 1 minute.

5.2 *Test Condition 2* — 200°C for 60 ± 1 minute.

5.3 *Test Condition 3* — 300°C for 10 ± 0.5 minutes.

NOTE: Alternate temperature may be used by agreement between vendor and customer.

6 Equipment Setup and Calibration

6.1 Refer to the thermohygrostat manufacturer's manual for setup and calibration procedures.

7 Procedure

7.1 In order to ease the handling of the specimens, place each into a weighed cup or tray which has tared their weight (W_1).

7.2 Place the specimens in the oven at the specified test conditions.

7.3 Remove the specimens from the oven and store at 23°C ± 2°C and 50 ± 5% RH for 16 hours minimum.

7.4 Reweigh the specimens (W_2).

7.5 *Calculation*

7.5.1 The Weight Loss, A (%), is determined from the following equation:

$$A(\%) = \frac{(W_1 - W_2) \times 100}{W_1}$$

8 Related Documents

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

8.1 *JIS Specification*[1]

JIS K 0067 — Testing Methods for Loss and Residue of Chemical Products

1 Japanese Standards Association, 1-24, Akasaka 4 Chome, Minato-ku, Tokyo, Japan

SEMI G75.6-0698
TEST METHOD FOR MEASUREMENT OF THE SHRINKAGE FACTOR OF LEADFRAME TAPE

1 Summary of Method

1.1 The length of tape samples is measured before and after exposure to temperatures comparable to those used in the assembly and packaging of IC. The shrinkage is calculated as a percentage in the dimension measured.

2 Equipment

2.1 Magnifying projector with 0.01 mm accuracy

2.2 Circulating air oven capable of 300 ± 2°C accuracy

2.3 Cutting die for sample preparation

2.4 Thermohygrostat

2.5 Straight edge

2.6 Scribing tool

3 Sampling

3.1 The sampling is one sample per one lot. The vendor must report the definition of lot, if the customer requires it.

4 Preparation of Specimens

4.1 Cut specimens out of the samples using the cutting die. The specimen shall be 100 ± 1.0 mm long and 10 ± 1.0 mm wide.

4.2 Allow the specimen to be stabilized at 23° ± 2°C and 50 ± 5% RH for 16 hours minimum. This may be carried out in a climate controlled room or in a thermohygrostat.

4.3 Using the straight edge and scribing tool, scribe marks on the specimens as shown in Figure 1. The marks shall be parallel to each edge of the specimen, and the distance to be measured, L, shall be parallel to the long side of the specimen. The mark shall be located within 5 mm of the ends of the specimen.

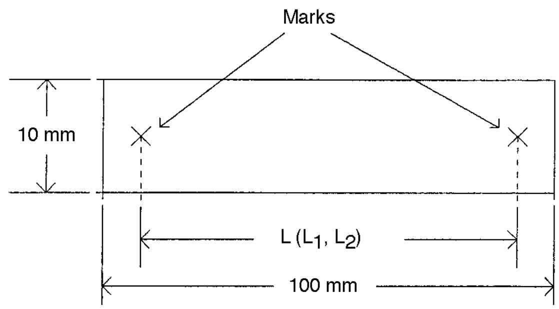

Figure 1
Size of a Marked Specimen

5 Test Conditions

5.1 *Baking Condition 1* — 100°C for 60 ± 1 minute.

5.2 *Baking Condition 2* — 200°C for 60 ± 1 minute.

5.3 *Baking Condition 3* — 300°C for 10 ± 0.5 minutes.

NOTE: Alternate temperatures may be used by agreement between vendor and customer.

6 Procedure

6.1 Place a specimen between the glass plates of the magnifying projector and measure the length, L_1, between two marks (see Figure 1). Repeat this measurement for all specimens.

6.2 Place the specimen in the oven at the appropriate test condition.

6.3 Remove the specimens from the oven and store at 23° ± 2°C and 50 ± 5% RH for 16 hours minimum.

6.4 Place the specimens between the glass plates of the magnifying projector and measure the new length, L_2, between two marks used in Section 6.1.

6.5 *Calculation*

6.5.1 The shrinkage factor, A (%), is determined from the following equation:

$$A(\%) = \frac{(L_1 - L_2) \times 100}{L_1}$$

where :

L_1 is the length (mm) of the specimen before baking

L_2 is the length (mm) of the specimen after baking

7 Related Documents

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

7.1 *JIS Specification*[1]

JIS K 6911 — Testing Methods for Thermosetting Plastics

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SEMI G75.7-0698
TEST METHOD FOR MEASUREMENT OF THERMAL DECOMPOSITION TEMPERATURE OF LEADFRAME TAPE AND ADHESIVE

1 Summary of Method

1.1 A thermogravimetric (TG) analyzer is used to monitor the weight of a tape sample as the temperature increases to 700°C. It should be made to measure the leadframe tape or the base film and the adhesive separately. The results are obtained as a plot of Weight Retention versus Temperature, from which the thermal decomposition temperature for both the base film and the adhesive may be obtained.

2 Equipment

2.1 Thermogravimetric (TG) analyzer capable of 0.01 mg accuracy.

2.2 Thermohygrostat

3 Sampling

3.1 The sampling is one sample per one lot. The vendor must report the definition of lot, if customer requires it.

4 Preparation of Specimens

4.1 Allow the samples to be stabilized at 23 ± 5°C and 50 ± 5% RH for 16 hours minimum. This may be carried out in a climate controlled room or in a thermohygrostat.

4.2 Cut specimens from the sample. The specimen shall weigh 10 to 20 mg.

NOTE 1: The base film before coating with the adhesive can be used for the test. The vendor has to ship the base film before coating with the adhesive, if customer requires it.

NOTE 2: The adhesive sample can be obtained by scraping the adhesive.

5 Equipment Setup and Calibration

5.1 Refer to Thermogravimetric Analyzer manufacturer's manual for setup and calibration procedures.

5.2 The ambient in the measurement shall be air.

6 Procedure

The measurement of TG should be made to measure the leadframe tape or the base film and the adhesive separately.

6.1 Place the specimen in the platinum vessel.

6.2 Set the thermal ramp to 10 ± 1°C/minute and maximum temperature to 700°C.

6.3 Repeat for all specimens.

7 Method of Reading TG Curve

7.1 In Figure 1, the thermal decomposition is determined by the temperature at 5% of the weight loss.

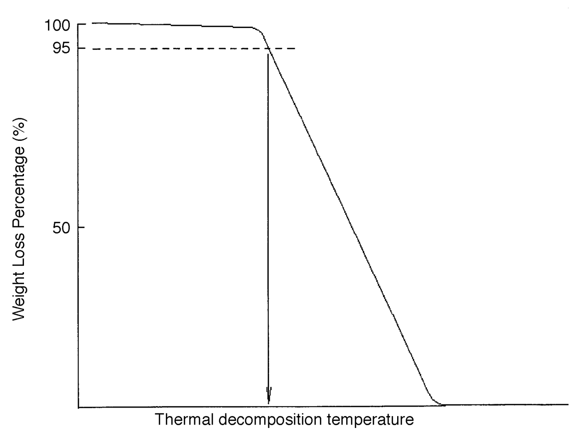

Figure 1
TG Curve of the Leadframe Tape

8 Related Documents

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

8.1 *ASTM Specification*[1]

ASTM D 3850 — Standard Test Method for Rapid Thermal Degradation of Solid Electrical Insulating Materials by Thermogravimetric Method

8.2 *JIS Specification*[2]

JIS K 7120 — Testing Methods of Plastics by Thermogravimetry

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SEMI G75.8-0698
TEST METHOD FOR MEASUREMENT OF THE COEFFICIENT OF THERMAL EXPANSION AND GLASS TRANSITION TEMPERATURE OF LEADFRAME TAPE

1 Summary of Method

1.1 A thermal mechanical analyzer is used to monitor the dimension of a tape sample with temperature increases to 400°C. It can be made to measure the base film, adhesive, and the leadframe tape. The results are obtained as a plot of expansion versus temperature, from which Coefficient of Thermal Expansion (CTE) and Glass Transition Temperature (Tg) may be obtained. CTE above the Tg cannot be measured because of softening and elongation of the sample.

2 Equipment

2.1 Thermal mechanical analyzer (TMA) with chart recorder.

2.2 Thermohygrostat

2.3 Cutting die for sample preparation

2.4 *Calipers* — 0.1 mm accuracy

3 Sampling

3.1 The sampling is one sample per one lot. The vendor must report the definition of lot, if customer requires it.

4 Preparation of Specimens

4.1 Cut specimens out of the samples using the cutting die. The specimens shall be 20 ± 0.1 mm long and 5.0 ± 0.1 mm wide.

4.2 Allow the samples to be stabilized at 23 ± 5°C and 50 ± 5% RH for 16 hours minimum. This may be carried out in a climate controlled room or in a thermohygrostat.

5 Equipment Setup and Calibration

5.1 Refer to the thermal mechanical analyzer manufacturer's manual for setup and calibration procedures.

Procedure

6.1 Set the specimen to the chuck so that the length of the specimen under test is 10 ± 0.1 mm. Measure the specimen length using calipers.

6.2 Attach the chuck to the TMA.

6.3 Zero the recorder.

6.4 Set the Thermal Ramp to 10°C/minute, the maximum temperature to 400°C, and the load to 2.0 ± 0.2 grams.

6.5 Initiate the test sequence and obtain a chart record of Elongation of the specimen versus Temperature (see Figure 1).

6.6 Repeat for all specimens.

6.7 Calculation of Results

6.7.1 Coefficient of Thermal Expansion (k) — Calculate the CTE using the following equation:

$$k = \frac{\Delta L}{L \times \Delta T}$$

where :

L is the length (mm) of the specimen at room temperature.
ΔL is the elongation of the specimen (mm) for a given temperature difference, Δ T (°C).
These values are taken from the chart as shown in Figure 1.

6.7.2 Glass Transition Temperature (Tg)

6.7.2.1 On the chart, draw a best-fit tangent line to the curve between Point (A) and (B) and a second tangent between Point (C) and (D) (see Figure 1).

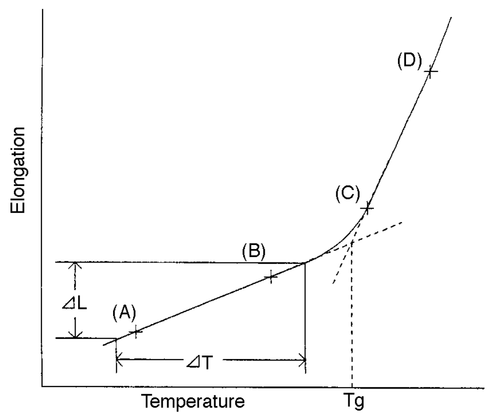

Figure 1
Coefficient of Thermal Expansion (CTE)

6.7.2.2 Extend the lower tangent line above its highest temperature and the higher tangent line below its lowest temperature until they intersect. The temperature at the intersection point is the Glass Transition Temperature.

6 Related Documents

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

6.1 *SEMI Standard*

SEMI G13 — Standard Test Method for Expansion Characteristics of Molding Compounds

6.2 *ASTM Specification*[1]

ASTM D 669 — Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics

6.3 *JIS Specification*[2]

JIS K 6911 — Testing Methods for Thermosetting of Plastics

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2 Japanese Standards Association, 1-24, Akasaka 4 Chome, Minato-ku, Tokyo, Japan

SEMI G75.9-0698
TEST METHOD FOR MEASUREMENT OF TENSILE STRENGTH, ELONGATION, AND TENSILE MODULUS OF LEADFRAME TAPE

1 Purpose

1.1 Tensile strength, elongation, and tensile modulus of leadframe tape are measured by a tensile pull tester, which is used to stretch the tape samples to the point of breakage with a calibrated load cell.

2 Equipment

2.1 Tensile pull tester with 100 kg MAX load cell, sample clamping chucks, and a chart recorder.

2.2 Micrometer with 0.001 mm accuracy.

2.3 Calipers with 0.02 mm accuracy.

3 Test Condition

3.1 Tensile test measurements shall be carried out at the following ambient conditions:

Temperature — 23 ± 5°C

Humidity — 50 ± 5% RH

4 Sampling

4.1 The sampling is one sample per one lot. The vendor has to report the definition of lot, if the customer requires it.

4.2 The sample width shall be 15.0 ± 0.2 mm, and the length must be 100 mm minimum.

5 Equipment Setup and Calibration

5.1 Refer to the tensile tester manufacturer's equipment manual for setup and calibration.

5.2 The pulling rate shall be set to 5 ± 0.5 mm/minute.

5.3 The load shall be recorded in kilograms.

6 Procedure

6.1 Measure the thickness (T) of the sample with the micrometer and the width (W) with calipers (mm).

6.2 Clamp the tape in the chucks so that the distance (L_0) between the chucks is 50 ± 5 mm.

NOTE: Some equipment may measure this length automatically or plot Stress versus Strain, (L/L_0), directly, where L is the elongation.

6.3 Start the pulling and record until the sample breaks.

6.4 Repeat the testing procedures for all the samples.

7 Results

7.1 Read the Break Force A (kg) and Elongation L_1 (mm) at sample breakage from the chart.

7.2 Draw a tangent line from the origin of the Load-Elongation curve to the maximum slope of the curve. (See Figure 1.)

NOTE: B (kg) is the incremental force change required to produce an elongation, L_2, in the elastic region and may be determined from the tangent line.

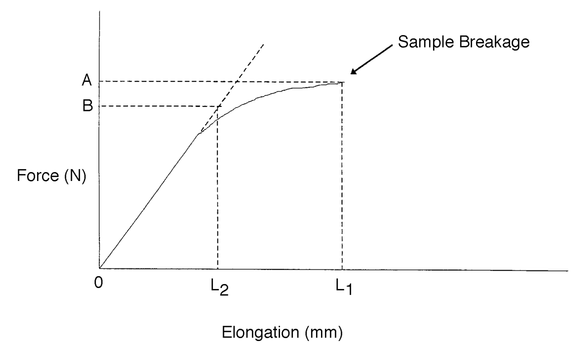

Figure 1
Breakage Point Calculation Diagram

7.3 *Calculations* — Tensile Strength at Break (s) is determined from the following equation:

$$S(N/mm^2) = \frac{9.8\,A}{WT}$$

7.3.1 Percentage Elongation at Break (e) is determined from the following equation:

$$\varepsilon(\%) = \frac{100\,L_1}{L_0}$$

7.3.2 Tensile Modulus (E) is determined from the following equation:

$$E(N/mm^2) = \frac{\Delta Stress}{\Delta Strain} = \frac{9.8B/WT}{L_2/L_0}$$

8 Related Documents

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

8.1 *ASTM Specification*[1]

ASTM D 638 — Standard Test Method for Tensile Properties of Plastics

8.2 *JIS Specification*[2]

JIS K 6911 — Testing Methods for Thermosetting of Plastics

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1 American Society of Testing and Materials, 100 Barr Harbor Drive, West Conshohoken, PA 19428-2959 (all cited standards may be found in Volume 10.05 of the Annual Book of ASTM Standards)

2 Japanese Standards Association, 1-24, Akasaka 4 Chome, Minato-ku, Tokyo, Japan

SEMI G75.10-0698
TEST METHOD FOR MEASUREMENT OF VOLUME AND SURFACE RESISTIVITY OF THE LEADFRAME TAPE

1 Summary of Method

1.1 A resistance is measured across the thickness and along the surface of the adhesive of tape between electrodes deposited on the tape. Volume and surface resistivity are calculated from these resistances and the dimensions electrodes.

2 Equipment

2.1 *Power Source* — 500 volts DC battery or 500 volts rectified voltage supply.

2.2 Amplified galvanometer should be used for measuring insulating resistance no less than $10^6\Omega$.

2.3 Electrostatically and electromagnetically shielded box

2.4 Humidity-controlled storage box

2.5 *Micrometer* — 0.001 mm accuracy

3 Sampling

3.1 The sampling is one sample per one lot. The vendor must report the definition of lot, if the customer requires it.

4 Preparation of Specimens

4.1 The specimen shall be punched out from tape, the diameter of which has to be no less than that of the opposite electrode.

4.2 Place the specimens in the constant humidity box 23° ± 2°C and 50 ± 5% RH for 90 ± 2 hours. This may also be done after the electrodes are formed.

5 Test Conditions

5.1 *Temperature* — 23° ± 2°C

5.2 *Relative Humidity* — 50 ± 5% RH

5.3 *Applied Voltage* — 500 volts

6 Procedure

6.1 Measure the thickness of specimen with the micrometer. Attach the electrodes to the specimen. Electrodes are formed by conductive epoxy printing or aluminum evaporation shown in Figure 1.

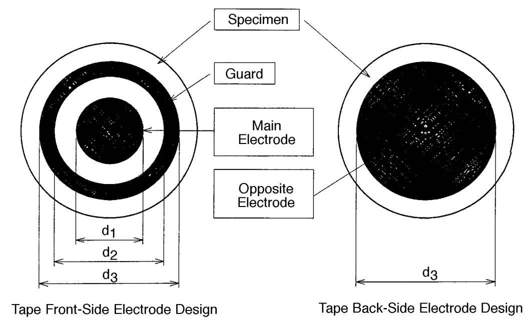

Figure 1
Electrodes Formed on the Leadframe Tape

NOTE 1: The electrodes shall be formed on both sides of the tape.

NOTE 2: Suggested dimensions for the electrodes as shown in Table 1 (d_1–d_2) should be at least 10 times the tape thickness.

Table 1 Suggested Dimension of the Electrodes

Suggested Dimension(for tape thickness 0.063–0.077 mm)	*Value*
d1	18 mm
d2	20 mm
d3	30 mm

NOTE 3: At surface resistivity measurement, main electrode and guard electrode is attached to the adhesive surface.

6.2 Place the specimens in the electrode system as shown in Figure 2A.

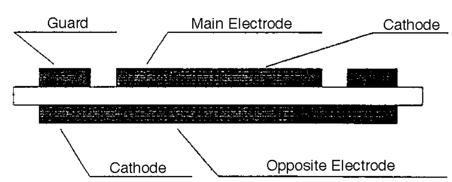

Figure 2A
Volume Resistivity Electrode Connection

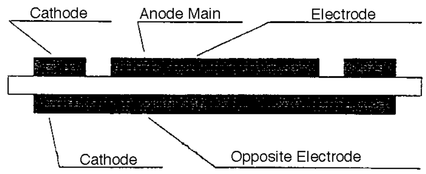

Figure 2B
Surface Resistivity Electrode Connection

6.3 Apply the specified voltage for one (1) minute and then read the resistance on the galvanometer.

6.4 Repeat the measurements for all the specimens.

6.5 Measure the thickness of the specimens using the micrometer.

6.6 *Calculations*

6.6.1 Volume resistivity should be calculated from the following equation:

$$\sigma v = \pi d_e^2 \times R_v / 4t$$

where :

σv	:	volume resistivity	Ωcm
d_e	:	effective diameter (41 +42)/2	cm
R_v	:	measured resistance cross tape thickness	Ωv/t
t	:	tape thickness	cm
d_1	:	inside diameter of the guard electrode	cm
d_2	:	outside diameter of the main electrode	cm

6.6.2 Surface resistivity should be determined from the following equation:

$$\sigma s = \pi(d_1 + d_2) \times R_s /(d_1 - d_2)$$

where :

σs	:	surface resistivity	Ω
d_1	:	inside diameter of the guard electrode	cm
d_2	:	outside diameter of the main electrode	cm
R_s	:	measured resistance along the adhesive surface side of tape thickness	Ω

7 Related Documents

7.1 *ASTM Specification*[1]

ASTM D 257 — Standard Test Methods for D-C Resistance or Conductance of Insulating Materials

7.2 *JIS Specification*[2]

JIS K 6911 — Testing Methods for Thermosetting of Plastics

1 American Society of Testing and Materials, 100 Barr Harbor Drive, West Conshohoken, PA 19428-2959 (all cited standards may be found in Volume 10.05 of the Annual Book of ASTM Standards)

2 Japanese Standards Association, 1-24, Akasaka 4 Chome, Minato-ku, Tokyo, Japan

SEMI G75.11-0698
TEST METHOD FOR MEASUREMENT OF THE DIELECTRIC CONSTANT AND DISSIPATION FACTOR OF THE LEADFRAME TAPE

1 Purpose

1.1 Capacitance is measured for tape specimens and air with similar electrode setups. Dielectric constant and dissipation factor of the tapes are calculated from the results.

2 Referenced Documents

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

2.1 *JIS Specification*[1]

JIS K 6911 — Testing Methods for Thermosetting Plastics

3 Equipment

3.1 *Measurement Circuit* — See JIS K 6911 5.14.2 (1) (b)-(d) and Figure 1.

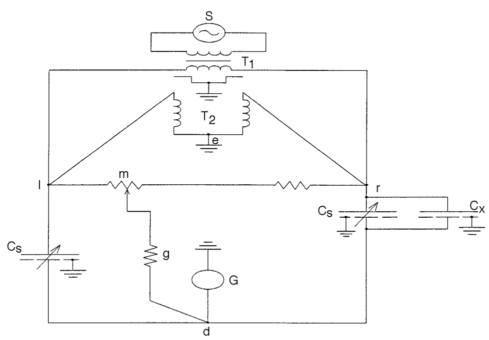

Figure 1
Mutual Inductance Bridge Method

Following is the Mutual Inductance Bridge Method (Transformer Bridge Method):

G:	Galvanometer
S:	Power source
T:	Shielded transformer
C_s:	Variable condenser
g:	Constant conductance
m, d:	Variable resistance
C_x:	Capacitance of sample

3.2 Electrostatically and electromagnetically shielded box

3.3 Micrometer with an accuracy of 0.001 mm

3.4 Humidity-controlled storage box

4 Sampling

4.1 The sampling is one sample per one lot. The vendor must report the definition of lot if the customer requires it.

5 Preparation of Specimens

5.1 The specimen shall be punched out from tape, the diameter of which must be no less than that of the opposite electrode.

5.2 Place the specimens in the constant humidity cabinet at 23 ± 2°C and 50 ± 5% RH for 90 ± 2 hours. This may also be done after the electrodes are formed.

6 Procedure

6.1 Measure the thickness of specimen with the micrometer. Attach the electrodes to the specimen. Electrodes are formed by conductive epoxy printing or aluminum evaporation shown in Figures 2 and 3.

NOTE 1: The electrodes shall be formed on both sides of tape.

NOTE 2: Suggested dimensions for the electrodes are shown in Table 1 (d_1– d_2). They should be at least 10 times the tape thickness.

Table 1 Suggested Dimension of Electrodes

Suggested Dimension (for Tape Thickness of 0.063–0.077 mm)	*Value*
d_1	18 mm
d_2	20 mm
d_3	30 mm

6.2 Connect the specimen in the position of C_x as shown in Figure 1, and balance the bridge by adjusting the measuring condenser C_s and conductance shifter. In this state, measure the C_s value, the conductance value between “m” and “d”, resistance between “I” and “m”, and “r” and “m” of the conductance shifter in Figure 1.

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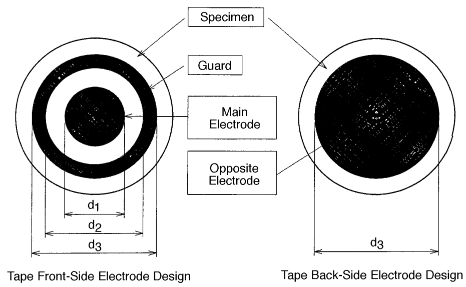

Figure 2
Electrodes Formed on the Leadframe Tape

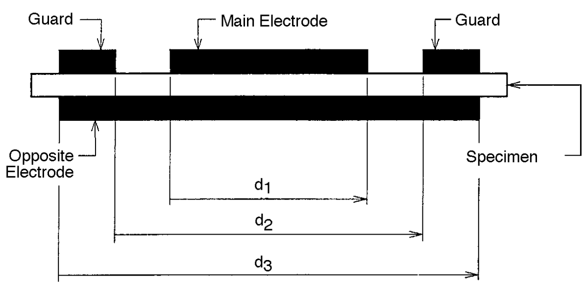

Figure 3
Electrode Connection

6.3 Dielectric constant and dielectric dissipation factor should be calculated by the following equation:

$$\varepsilon = C_x / C_o$$

$$\tan\delta = G_x / 2\pi f C_x$$

where :

ε : dielectric constant

tan : dielectric dissipation factor

C_x : capacity of measuring condenser C_c balances

C_o : electrostatic capacity for $\varepsilon = 1$ calculated by the following equation using the area of the main electrode and thickness of specimen

$$C_o = r^2 / 3.6\, t$$

where :

r : radius of main electrode

t : thickness of specimen

G_x : conductance of specimen calculated by the following equation

$$G_x = g \times Sv/100$$

where :

g : conductance between "m" and "d" of conductance shifter in Figure 1

Sv/100 : resistance ration of conductance shifter at balance

f : the frequency of measurement

: the ratio of the circle's circumference to its diameter

7 Related Documents

7.1 *ASTM Specification*[2]

ASTM D 150-64T — Standard Test Methods for Dielectric Constant and Dissipation Factor of Insulating Materials

2 American Society of Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 (all cited standards may be found in Volume 10.05 of the Annual Book of ASTM Standards)

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SEMI G75.12-0698
TEST METHOD FOR MEASUREMENT OF BREAKDOWN STRENGTH OF LEADFRAME TAPE

1 Summary of Method

1.1 An increasing voltage is applied between electrodes placed on both sides of the leadframe tape until breakdown, a large increase in current and voltage collapse, is observed.

2 Equipment

2.1 *Power Source* — DC High Voltage Generator (50 kv capability)

2.2 *Electrodes* — A brass spherical electrode with a diameter of 12.5 mm and a brass electrode with a diameter of 25 mm, which peripheral edges being rounded off to a radius of 2.5 mm. (See Figure 1.)

2.3 *Micrometer* — Accuracy 0.001 mm

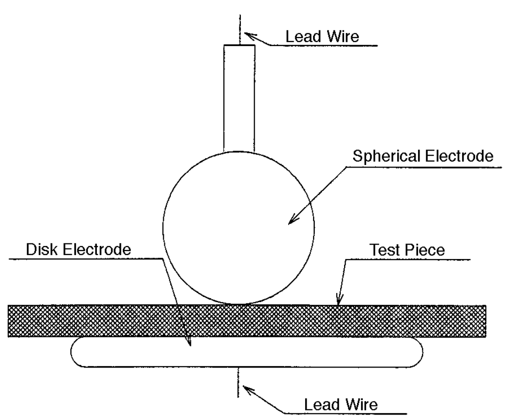

Figure 1
Electrodes for Measurement of Breakdown Strength

3 Sampling

3.1 The sampling is one sample per one lot. The vendor must report the definition of lot, if customer requires it.

4 Preparation of Specimens

4.1 Cut the specimens from the tape samples so that the size of the specimens is larger than the diameter of the disk electrode.

4.2 The specimens shall be stabilized in 23° ± 5°C and 50 ± 5% RH for 90 ± 2 hrs.

5 Test Conditions

5.1 *Temperature* — 23° ± 5°C

5.2 *Relative Humidity* — 50 ± 5% RH

6 Procedure

6.1 Place the specimens on the disk electrode and place the spherical electrode on the top of the tape. Ensure good contact between electrodes and tape.

6.2 *Setup Specimen*

6.2.1 Turn on the voltage supply and increase the voltage with constant ramp, until breakdown occurs.

NOTE 1: Note the voltage at breakdown. In subsequent specimens, arrange the voltage ramp so that the breakdown occurs approximately within 10–20 seconds after the beginning of voltage application.

6.3 Repeat the measurements for all the specimens.

6.4 Measure the thickness of the specimens using the micrometer.

6.5 *Calculations*

6.5.1 Breakdown strength should be calculated by the following equation:

$$\text{Dielectric Strength} \quad \frac{\text{kv}}{\text{mm}} = \frac{V_{BD}}{t}$$

where :

V_{Bd} = Breakdown voltage (kv)

t = tape thickness (mm)

7 Related Documents

7.1 *ASTM Specification*[1]

ASTM D 257 — Standard Test Methods for D-C Resistance or Conductance of Insulating Materials

1 American Society of Testing and Materials, 100 Barr Harbor Drive, West Conshohoken, PA 19428-2959 (all cited standards may be found in Volume 10.05 of the Annual Book of ASTM Standards)

7.2 *JIS Specification*[2]

JIS K 6911 — Testing Methods for Thermosetting of Plastics

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SEMI G75.13-0698
TEST METHOD FOR MEASUREMENT OF THE LEAKAGE CURRENT IN LEADFRAME TAPE

1 Summary of Method

1.1 Taped leadframes are molded under normal conditions, and the leakage current between designated leads is measured before and after submitting the samples to HAST (121°C/2 atm/100% RH) moisture testing.

2 Equipment

2.1 HAST Chamber

2.2 Amperemeter with 10^{-15} ampere measuring capability

2.3 Power supply capable of 500 volts DC maximum

2.4 Electrostatically and electromagnetically shielded box

3 Sampling

3.1 The sampling is one sample per one lot. The vendor must report the definition of lot if the customer requires it.

4 Preparation of Specimens

4.1 Leadframes shall be cleaned up previous to taping, using a procedure agreed on between vendor and customer.

4.2 *Taping Conditions* — Temperature, pressure, and dwell time shall be agreed on between vendor and customer.

NOTE 1: A typical taped 40 pin DIP leadframe is shown in Figure 1, and relevant information for this frame is tabulated in Table 1.

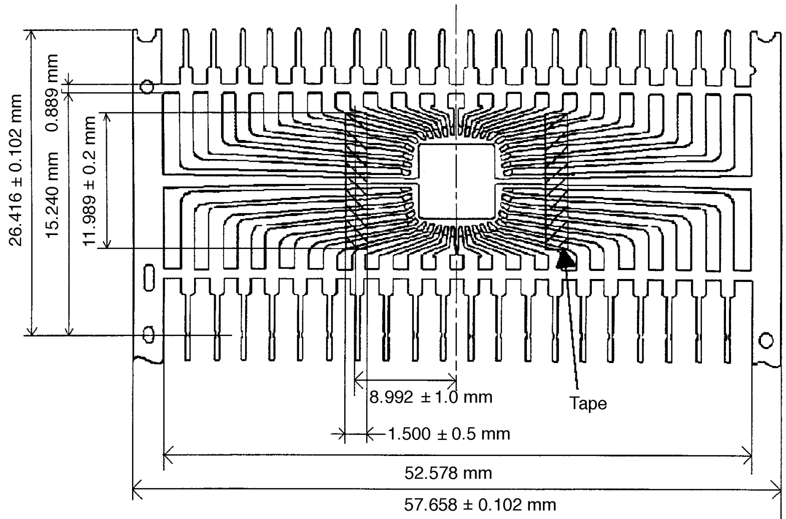

Figure 1
Typical Taped 40 Pin DIP Leadframe

Table 1 Relevant Information for 40 Pin DIP Leadframe

Leadframe Attribute	*Specification*
Leadframe thickness	0.25 mm
Leadframe material	Alloy 42
Leadframe manufacturing process	Stamping
Plating	None/Silver/Others
Surface treatment	To be agreed between tape user and supplier.

NOTE 2: The surface state of Alloy 42 is stable compared with Cu alloy, which is oxidized easily.

4.3 The leadframes shall be molded using molding compounds and cured with post mold curing conditions agreed on between vendor and customer. The untaped leadframe shall be prepared with the same procedure as a control.

4.4 Trim the leads according to a procedure agreed on between vendor and customer.

5 Procedure

5.1 Setup the test circuit as shown in Figure 2.

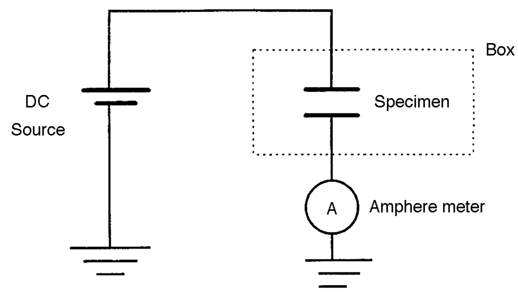

Figure 2
Test Circuit for Measurement of Leakage Current

5.2 Place the first molded sample in the shielded box and attach clips to the leads A_1 and A_2 (see Figure 1). Measure the initial leakage current at 500 volts maximum.

NOTE 3: The leakage current shall be measured after 5 minutes voltage application.

5.3 Repeat the measurement for all the lead pairs, A_2 with A_3, B_1 with B_2, and B_2 with B_3.

5.4 Place the samples in the HAST chamber and run the test.

5.5 After the tester has been automatically cooled to room temperature, remove the samples.

5.6 Measure the leakage current between the same lead pairs mentioned in Sections 5.2 and 5.3.

5.7 Repeat the HAST exposure and measure the cur-rent leakage.

5.8 *Calculation*

5.8.1 Maximum and minimum leakage current shall represent the test results.

5.8.2 Calculate the average result for all of the test points at each test stage.

5.8.3 Obtained data should be converted to 100 volts basis or as agreed on between vendor and customer.

6 Related Documents

6.1 *ASTM Specification*[1]

ASTM D 257 — Test Methods for D-C Resistance or Conductance of Insulating Materials

6.2 *JIS Specification*[2]

JIS K 6911 — Testing Methods for Thermosetting Plastics

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SEMI G76-0299
SPECIFICATION FOR POLYIMIDE-BASED ADHESIVE TAPE USED IN TAPE CARRIER PACKAGES (TCP)

1. Purpose

1.1 This standard addresses the adhesive demands of tape carrier packages (TCPs) and how reliability, versatility and cost may be optimized. The standardization of polyimide adhesive tape used in TCP is being promoted in order to meet these demands.

2. Scope

2.1 This standard defines the standard for polyimide-based adhesive tapes (hereinafter " tape").

3. Referenced Documents

NOTE: Standards cited below refer to the latest adopted revision of the standard. *(Draft documents may not be referenced.)*

3.1 *JIS Standards*[1]

C-1303 — High Insulation Resistance Meters

C-2110 — Testing Methods for Electric Strength of Solid Insulating Materials

C-2318 — Polyester Films for Electrical Purposes

P-8101 — Testing Method for Dissolving Pulp

Z-3282 — Soft Solder

4. Terminology

4.1 *camber* — Curvature of the tape strip edge.

4.2 *machine direction (MD) curl* — Curvature along the length of the tape.

4.3 *tranverse direction (TD) curl* — Transverse bowing of the tape.

4.4 *twist* — Angular rotation of one end of the tape with reference to the other end.

4.5 *wakame* — Waviness along the edge of the tape.

5. Ordering Information

5.1 The following items shall be included in purchase orders for tape which conforms to this standard:

5.1.1 Type of adhesive material

5.1.2 Type of base film

5.1.3 Width of adhesive material

5.1.4 Width of base film

5.1.5 Length of product

6. Requirements

6.1 *Structure of Polyimide Adhesive Tape Used in TCP* — Adhesive material is applied to polyimide film defined in Section 6.2. When necessary, a protective film may be used to stop adhesion of the adhesive material to the back of the tape to prevent contamination of the adhesive material, improve puncture characteristics, etc.

6.2 *Base Film Thickness and Width*

6.2.1 *Base Film Thickness (see Table 1)*

Table 1. Base Film Thickness

Thickness (μm)	*Tolerance (μm)*
50.0	± 4.0
75.0	± 5.0
125.0	± 8.0

For thicknesses other than those above, use nominal value thickness denoted in μm.

6.2.2 *Base Film Width (see Table 2)*

Table 2. Base Film Width

Width (mm)	*Tolerance (mm)*
34.975	± 0.10
48.175	± 0.10
69.95	± 0.10

For widths other than those above, use nominal value width denoted in mm.

6.3 *Adhesive Material Thickness and Width*

6.3.1 *Adhesive Material Thickness (see Table 3)*

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Table 3. Adhesive Material Thickness

Center Thickness t/µm	*Tolerance/µm*
10.0 ≤ t < 14.0	± 2.0
14.0 ≤ t < 20.0	± 3.0

For thicknesses other than those above, use nominal value thickness denoted in µm.

6.3.2 *Adhesive Material Width (see Table 4)*

Table 4. Adhesive Material Width

Width/mm	*Tolerance/mm*
29.7	± 0.1
42.7	± 0.1
60.6	± 0.1
64.4	± 0.1

For widths other than those above, use nominal value width denoted in mm.

6.4 *Distance from Edge of Base Film to Edge of Adhesive Material (see Table 5)*

Table 5. Distance from Edge of Base Film to Edge of Adhesive Material

Base Film Width/mm	*Adhesive Material Width/mm*	*Distance/mm*
34.975	29.7	≥ 2.40
48.175	42.7	≥ 2.40
69.95	60.6	≥ 4.40
69.95	64.4	≥ 2.40

6.5 *Cover Film Type, Thickness and Width*

6.5.1 *Cover Film Thickness (see Table 6)*

Table 6. Cover Film Thickness

Thickness at Center/µm	*Tolerance/µm*
10.0–50.0	± 2.0

For thicknesses other than those above, use nominal value thickness denoted in µm.

6.5.2 *Cover Film Width* — Use the same measurements as found in Section 6.3.2.

6.6 *Adhesive Tape Thickness and Tolerance*

6.6.1 *Adhesive Tape Thickness* — Use the sum of the nominal thicknesses of the base film, adhesive material and cover film.

6.6.2 *Tolerance* — Use the sum of the nominal tolerances of the base film, adhesive material and cover film.

6.7 *Characteristics (see Table 7)*

Table 7. Characteristics of Adhesive Tape

Item	*Condition*	*Unit*	*Test Method*	*Value*
Copper Foil Adhesive Strength	Normal	N/cm	8.5.1 (a)	> 5
	Heated	N/cm	8.5.1 (b)	> 1
	Soaked in solvent	N/cm (see NOTE 3)	8.5.1 (c)	> 3
Cover Film Release Strength	Normal	N/cm	8.5.2	< 0.2
Insulation Resistance	Normal	Ω	8.6.3 (3)(a)	Not Specified
	In High Temp. High Humidity	Ω (see NOTE 4)	8.6.3 (3)(b)	Not Specified
	In High Temp. High Humidity, Under Bias	Ω (see NOTE 5)	8.6.3 (3)(c)	Not Specified
Volume Resistivity	Normal	Ω-cm	8.6.1	$> 10^{13}$
Surface Resistivity	Normal	Ω	8.6.2	$> 10^{10}$
Voltage Resistance	Normal	Ω	8.6.4	No Flash-over
Relative Permittivity	Normal	-	8.6.5	< 4.0
Dielectric Dissipation Factor	Normal	-	8.6.5	< 0.07
Solder Heat Resistance	Normal	-	8.7.1	No Delamination No Swelling
Heat Shrinkage	Normal	%	8.7.3	< 0.5
Coefficient of Thermal Expansion	-	cm/cm/°C	8.7.4	$< 3.0 \times 10^{-5}$
Tensile Strength	-	Mpa	8.7.5	> 100
Elongation	Normal	%	8.7.5	> 20
Water Absorption	Normal	%	8.7.2	< 4.0
Flammability	Normal	-	8.7.6	Not Specified

NOTE 1: *Normal Condition* — Normal condition refers to a temperature of 23 ± 5°C, and relative humidity of 55 ± 15%.

NOTE 2: *Heated Condition* — See Section 8.5.1, (3)(b).

NOTE 3: *Soaked in Solvent* — See Section 8.5.1, (3)(c).

NOTE 4: *High Temperature, High Humidity* — See Section 8.6.3, (3)(b).

NOTE 5: *High Temperature, High Humidity, Under Bias* — See Section 8.6.3, (3)(c).

6.8 *Appearance and Defects* — See Table 8. Width and thickness for the base film, adhesive material and cover film are not particularly specified.

Table 8. Appearance and Defects

Item	*Test Method*	*Unit*	*Value*
MD Curl	8.8.1	mm	< 15
TD Curl	8.8.2	mm	< 6
Wakame	8.8.3	Number/m	< 20 of < 2 mm, 0 of > 2 mm
Camber	8.8.4	mm/m	< 1
Twist	8.8.5	Degrees	< 135
Defect	8.8.6	#/m or #/100m	< 5/m between 0.1 mm^2 and 1mm^2 or, < 10/100 m of > 1 mm^2

7. Sampling

A sampling plan shall be defined between the user and supplier.

8. Test Methods

8.1 *Test Conditions*

8.1.1 *Normal* — Normal condition refers to a temperature of 23 ± 5°C, and relative humidity of 55 ± 15%.

8.2 *Materials*

8.2.1 *Material Preparation* — Unless otherwise specified, take the needed length of material from the inner part of the roll after peeling off the first three layers.

8.2.2 *Lamination* — Use the following steps to prepare materials which require lamination:

(1) *Material* — Unless otherwise specified, use a copper foil which has previously been decided upon by the user and supplier.

(2) *Lamination Method* — Unless otherwise specified, a method used shall be agreed between user and supplier.

(3) *Curing* — Unless otherwise specified, a method used shall be agreed between user and supplier.

8.2.3 *Etching* — For material which requires etching, unless otherwise specified, a method used shall be agreed between user and supplier.

8.2.4 *Plating* — For material which requires plating, unless otherwise specified, a method used shall be agreed between user and supplier.

8.2.5 *Test Pattern* — The pattern used in Figure 1 is recommended for the shape and dimensions of the test pattern. Where this is not applicable, a pattern used shall be agreed between user and supplier.

8.3 *Pre-Conditioning* — Unless otherwise specified, leave the sample materials in normal condition for 24 ± 4 hours.

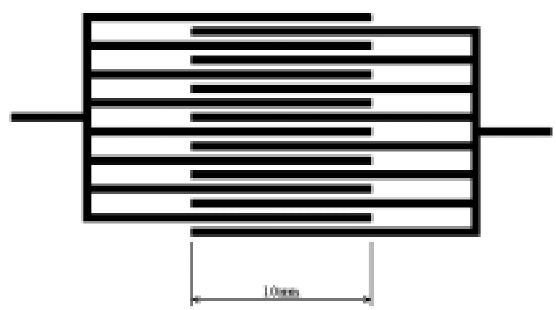

Figure 1
Test Pattern

Table 9. Test Pattern

Line Pitchs (µm)	*Line Widths (µm)*	*Line Spacings (µm)*
90	45	45
70	35	35
60	30	30
50	25	25
40	20	20

8.4 *Dimension Test Procedure*

8.4.1 *Thickness*

(1) *Equipment* — Use a micrometer standardized to JIS C-2318 or equivalent.

(2) *Material* — Use the TCP polyimide adhesive tape as received from the supplier.

(3) *Measurement* — Measure the center, and 3 points at least 1m apart in the MD direction, and calculate the average.

8.4.2 *Width*

(1) *Equipment* — Use a projector capable of reading a minimum of 0.001 mm integrals.

(2) *Material* — Use the TCP polyimide adhesive tape as received from the supplier.

(3) *Measurement* — Measure the TD direction length in 3 points at least 1m apart in the MD direction, and calculate the average.

8.5 *Mechanical Efficiency Tests*

8.5.1 *Copper Foil Adhesive Strength*

(1) Equipment

(a) A pull tester with an appropriate measurement range, having a tolerance of ± 5% of the indicated value, and capable of maintaining a cross-head speed of 10–50 mm/min.

(b) A pull tester with a sample retention heating device or sample chamber for retaining surface temperature for measuring conditions.

(2) Material

(a) *Normal* — Use a sample with copper etching and conductor width of 50 ± 10 μm and conductor length of more than 30 mm. The measurement direction and number of samples should be previously determined by the user and supplier. Unless otherwise specified, use 2 samples and measure in the MD direction.

(b) *Heated* — Use the same as (a), except with a conductor width of 2 ± 0.5 mm.

(3) Measurement

(a) *Normal* — After measuring the sample conductor width, fix the sample in the pull tester. In order to keep peeling angle at 90°, affix a reinforcement panel with double-sided adhesive tape. Pull and peel off more than 20 mm of copper foil at a speed of 10 mm/min^{-1} and an angle of 90 ± 5°. Measure the load during this interval.

(b) *Heated* — Fix the sample in retention heating device of the pull tester and raise the temperature, or, fix the sample in a previously retention heating device in the pull tester. It is also feasible to use a sample chamber which can heat the whole sample. Measure the sample surface temperature with a contact surface thermometer, and when a temperature of 150 ± 5°C is confirmed, quickly pull and peel off more than 20 mm of copper foil at a speed of 10 mm/min^{-1} and an angle of 90 ± 5°. Measure the load during this interval.

(c) *Soaked in Solvent* — After soaking the sample in a specified solvent at 23 ± 5°C for 5 minutes, remove the sample and rinse and dry off solvent thoroughly. Place in normal conditions, as described in Section 8.1.1, for 24 ± 4 hours and perform the same test as above " normal" (3)(a). However, if the solvent is inorganic, wash sample well with water after taking it out of the solvent and dry at 80 ± 5°C for 30 minutes. Then place in normal conditions, as described in Section 8.1.1, for 24 ± 4 hours and perform the same test as above " normal" (3)(a). The type and condition of the solvent used shall be agreed between the user and supplier.

(4) Calculation

(a) Compile the measurements, leaving out the overshoot at the beginning and end, and calculate the average of samples with a stable section of 10 mm. The method of calculating the average should be predetermined by the user and supplier. Unless otherwise speci-fied, place a ruler over the chart and determine visually.

(b) Calculate the load on pulling and peeling off of each sample, excluding the samples conductor width, and the average will be the copper foil adhesive strength.

8.5.2 *Cover Film Release Strength*

(1) *Equipment* — Use the same equipment as in Section 8.5.1 (1).

(2) *Material* — Use a 250 mm section cut from the TCP polyimide adhesive tape as received from the vendor.

(3) *Measurement* — After measuring the sample cover film width, fix the sample in the pull tester. In order to keep the sample at 90°, affix a reinforcement panel with double-sided adhesive tape. Pull and peel off more than 50 mm of cover film at a speed of 50 mm/min^{-1} and an angle of 90 ± 5°. Measure the load during this interval.

(4) *Calculation* — Use the same method as Section 8.5.1, (4).

8.6 *Electrical Efficiency Test*

8.6.1 *Volume Resistivity*

(1) *Equipment* — Use high insulation-resistance meter which conforms to JIS C-1303, or similar resistance measuring device (see Figure 2).

(2) *Material* — Prepare a section of TCP polyimide adhesive tape with adhesive material width of more than 50 mm, laminate with copper foil and cure according to the method described in Section 8.2. In addition, etch the main electrode and guard electrode into the shapes found in Figure 3. For the counter electrode, melt on a conductive material to the opposing polyimide film surface, or form it out of conductive paste. Dry these at 80 ± 5°C for 30 minutes. Cut these into 50 mm squares for the material.

(3) *Measurement* — Use the following steps to measure under normal conditions: Measure the thickness of the samples in units of 0.1 µm, and measure the inner diameter of the gap in the circular upper electrode in units of 0.05 mm. Apply direct voltage of 500V ± 5V, and measure the resistance value after 1 minute.

(4) *Calculation* — Use the equation below.

$$\rho v = Rv \times \frac{\pi D_1}{4t} (\Omega / cm)$$

Where ρv is volume resistivity, Rv is resistance value, t is sample thickness, π is pi, and D_1 is main electrode outer diameter.

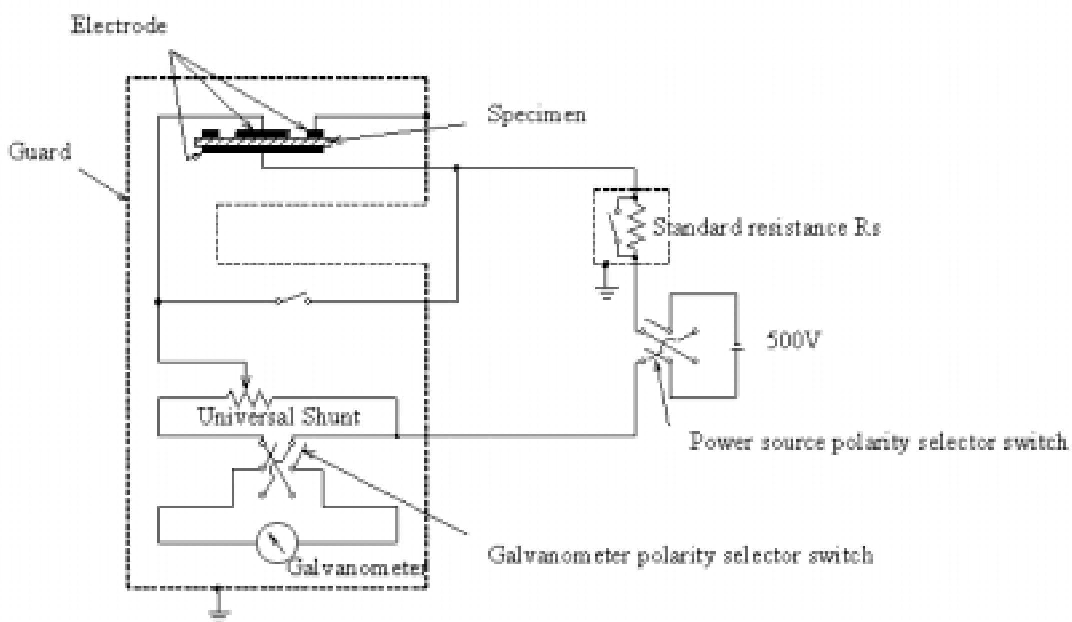

Figure 2
Resistance Measurement Device for Volume Resistivity