



IPC-TM-650 TEST METHODS MANUAL

1.0 Scope

1.1 This test method establishes a procedure for determining the low frequency out of plane dielectric constant and loss tangent of organic free films using a two-fluid method. (Low frequency is defined as less than or equal to 1 MHz in this method.)

1.2 The two-fluid method uses a three-terminal guarded electrode cell and allows for capacitance measurements which are independent of sample dimensions, electrode size, and electrode spacing. The two fluids to be used in this procedure are air and 1.0 centistoke silicone fluid.

1.3 The change in dielectric constant is the key indicator of moisture uptake and can be used to estimate the mass uptake of water by an organic film. For this reason, the dielectric constant is to be measured on films conditioned at two relative humidity levels and the difference used to estimate a value defined as "electrical water" for the sample.

2.0 Applicable Documents

ASTM D 150 Standard Test Methods for A-C Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulating Materials

ASTM D 1531 Standard Test Method for Relative Permittivity (Dielectric Constant) and Dissipation Factor by Fluid Displacement Procedure

ASTM E 104 Standard Practice for Maintaining Constant Relative Humidity by Means of Aqueous Solutions

3.0 Test Specimen

3.1 Free films should have a minimum thickness of approximately 25 μm for ease of handling. Films may be stacked to achieve a total test specimen thickness of approximately 50 μm (minimum) or greater for the test.

3.2 Note that sample handling becomes more difficult as the number of film layers used in a test specimen increases, especially when trying to keep air bubbles from between the layers

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when immersed in the silicone fluid. However, greater accuracy is achieved with thicker test specimens.

3.3 Process the organic coating according to the manufacturer's recommended procedures. Specify the film preparation method, including coating method, substrate type, and release method as follows.

3.3.1 Particulate Control Many test methods for determining the physical properties of polymers are sensitive to defects or particulates in the test specimens (e.g., measurement of tensile properties). The preparation of organic coatings should be conducted in a particulate free environment (e.g., laminar flow hood or clean room) to minimize particulate defects in the films.

3.3.2 Preparation of Uniform Coatings

3.3.2.1 Apply the test material using one of the coating methods listed in Column A of Table I to one of the substrates listed in Column B of Table I following the manufacturer's recommended procedure.

3.3.2.2 Process the coating according to the manufacturer's recommended procedures.

Table I

A: Coating Methods:	B: Substrates
Spin Coater	125 mm Polished Silicon Wafer
Automatic Extrusion Coater	100 x 100 mm Ceramic Substrate
Automatic Spray Coater	Polished Aluminum Disk
Motor Driven Blade Applicator	Glass or Quartz Disk
Hand Held Spray Gun	Tin Coated Disk
Hand Held Blade Applicator	Aluminum (or other metal) Panel
Vacuum Deposition	Glass Plate
Sputter	PTFE Panel
Evaporation	PTFE Panel

3.3.3 Patterning Techniques

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3.3.3.1 The organic or metal coating can be patterned using one of the following techniques.

Wet Etch
Plasma Etch
RIE Etch
Laser Ablation
Photosensitive Material

3.3.3.2 Patterning may involve the use of organic photoresists or metal hard masks. Descriptions of how these materials were processed must be provided.

3.3.4 Release Methods

3.3.4.1 Buffered HF Solution

3.3.4.1.1 This release method can be used to remove films that have been coated on silicon wafers containing an oxide layer.

3.3.4.1.2 Score completely around the outside of the coated substrates approximately 3 mm (1/8 inch) in from the edge. A template (e.g., inverted funnel) can be used as a cutting aid.

3.3.4.1.3 Place several rubber bands around the coated substrate to prevent the film from floating away.

3.3.4.1.4 Place the coated substrates in a *Teflon® boat, leaving a space between each coated substrate. Be sure to write down the order of the coated substrates since the HF will remove any ink labeling on the backs of the coated substrates.

3.3.4.1.5 Place the boat of coated substrates into a plastic container filled with a buffered (6:1) HF solution.

3.3.4.1.6 Remove the boat of coated substrates from the bath once the films have lifted from the coated substrates (15 min to 2 hrs.). Place the boat in a clean empty container and rinse with water for 1 hour or until all traces of HF have been removed (the water will turn from cloudy to clear).

3.3.4.1.7 Carefully remove the films from the substrates while still wet and place between two absorbent sheets to dry. Label the absorbent sheets, put in a safe place, and allow the films to dry overnight.

3.3.4.2 Buffered HCL Solution

3.3.4.2.1 This release method can be used to remove films coated on aluminum disks or panels.

3.3.4.2.2 Secure the test specimen to a glass plate with several rubber bands to prevent the film from floating away.

3.3.4.2.3 Place the coated substrate in a bath of buffered HCl solution. Stir the bath to keep a fresh supply of HCl flowing past the substrate and to remove any oxide that has formed.

3.3.4.2.4 After the substrate has been completely removed, carefully pick up an end of the free film with tweezers, and place the film in a clean empty container and rinse with water for 1 hour or until all traces of HCl have been removed.

3.3.4.2.5 Remove the films while still wet and place between two absorbent sheets to dry. Label the absorbent sheets, put in a safe place, and allow the films to dry overnight.

3.3.4.3 Mercury Amalgam

3.3.4.3.1 This release method can be used to remove films that are coated onto substrates coated with a layer of tin.

3.3.4.3.2 Place the tin coated substrate film side up in a pool of mercury to remove the tin by amalgamation.

3.3.4.3.3 After amalgamation is completed, carefully pick up an end of the free film with tweezers, and carefully brush the film free of mercury and amalgam with a soft camel hair brush.

3.3.4.4 Boiling Water

3.3.4.4.1 This release method can be used to remove films coated on any of the recommended substrates. This release method generally can not be used if the material contains an adhesion promoter (coupling agent) or if the manufacturer recommends that the material be tested along with the use of an adhesion promoter.

3.3.4.4.2 Place the coated substrate in a bath of boiling water.

3.3.4.4.3 Once the film has lifted from the substrate (or can be easily peeled from the substrate without tearing) carefully remove the films while still wet and place between two absorbent sheets to dry. Label the absorbent sheets, put in a safe place, and allow the films to dry overnight.