



# IPC-TM-650 TEST METHODS MANUAL

Number <b>2.5.17</b>	
Subject <b>Volume Resistivity and Surface Resistance of Printed Wiring Materials</b>	
Date <b>5/98</b>	Revision <b>E</b>
Originating Task Group <b>Flex Peel Strength Test Methods Task Group (D-13A)</b>	

**1 Scope** This test method is designed to determine both the volume (cross-sectional) and surface electrical resistance of the dielectric material under humid conditions.

## 2 Applicable Documents

**ASTM-D-257** DC Resistance or Conductance of Insulating Materials

**3 Test Specimens** At least two specimens 10 cm x 10 cm x thickness.

## 4 Apparatus

**4.1 Chamber** A test chamber capable of maintaining a combination of 35°C ± 2°C and 90% -0, +5% relative humidity (RH).

**4.2 Drying Chamber** A chamber capable of maintaining 80°C.

**4.3 Meter** A Keithly model L-7 megohmmeter, or equivalent.

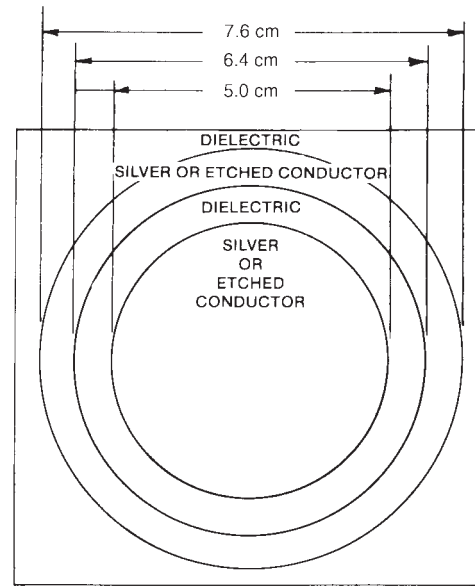
**4.4 Miscellaneous** Desiccator, silver paint, conductor composition 4817 by DuPont Co. or equivalent, distilled water source, calcium chloride desiccant, analytical balance. Fabrication of a special test fixture (such as a Balsbaugh Fixture) may be desirable if frequent testing is required.

## 5 Procedure

### 5.1 Sample Preparation for Volume Resistivity

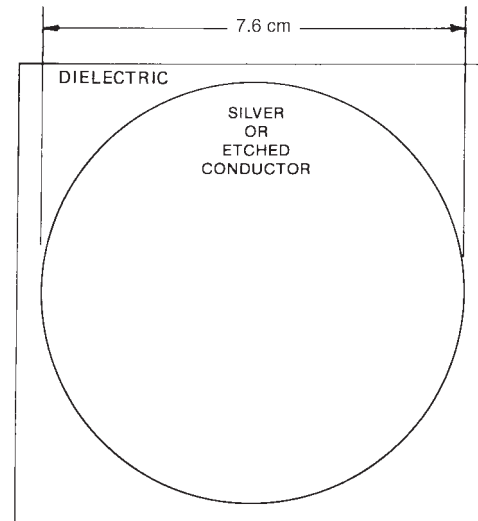
**5.1.1 Double Clad Laminate** Prepare etched conductor test specimens in accordance with Figure 1 for one side and Figure 2 for other side using standard commercial practices. Immerse each specimen in distilled water for 24 hours at 23°C ± 2°C, then dry in oven for two hours at a temperature between 49°C and 60°C.

**5.1.2 Single Clad Laminate** Prepare test specimens by etching the foil, single clad laminate per Figure 1, then clean (if etched) by immersion in distilled water for 24 hours at 23°C ± 2°C, then dry in oven for two hours at a temperature between



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**Figure 1** Volume and Surface Resistivity Test Pattern. (Side 1)



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**Figure 2** Volume and Surface Resistivity Test Pattern. (Side 2)

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49°C and 60°C. Coat unclad side with silver conductive paint (per Figure 2). Sand all edges to remove any silver paint to prevent a conductive path.

**5.1.3 Bare Dielectric** Prepare test specimens by immersing in distilled water for 24 hours at 23°C ± 2°C, then dry in an oven for two hours at a temperature between 49°C and 60°C. Coat the unclad material with silver conductive paint (one side per Figure 1 and the other per Figure 2). Sand all edges to remove any silver paint.

**5.2 Conditioning**

**5.2.1** Condition specimens together with the test fixture at 35°C ± 2°C and 90% -0, +5% RH for 96 hours.

**5.2.2** Specimens (and test fixture) must remain in the chamber for all phases of both the volume resistivity and surface resistance tests.

**5.2.3** These conditions may vary depending on the request of the material user.

**5.3 Test**

**5.3.1** After conditioning, and without removing specimens from the chamber, connect specimen to electrodes as follows:

<i>Megohmmeter Leads</i>	<i>Specimen Location</i>
High .....	Guarded (5.0 cm circle)
Ground .....	Guarded (6.35 cm ring)
Test .....	Unguarded (7.6 cm circle)

**5.3.2** Turn on the megohm meter and allow to warm up for a minimum of 15 minutes.

**5.3.3** After warm up, calibrate meter and adjust internal voltage to 500 volts DC.

**5.3.4** Read the meter (in megohms) after the test switch is held depressed for 60 seconds.

**5.4 Evaluation**

**5.4.1** Calculate the volume resistivity (r) in megohm centimeters as derived from the following formula:

$$r = \frac{RA}{L}$$

- r = volume resistivity in megohm cm
- L = thickness of specimen in cm
- A = area of guarded electrodes is 25.6 cm<sup>2</sup>
- R = volume resistance in megohms (meter reading)

**5.5 Preparation for Surface Resistance** Leave the same specimens in the test chamber and prepare to test surface resistance by connecting the specimens to electrodes as follows:

<i>Megohmmeter Leads</i>	<i>Specimen Location</i>
High.....	Guarded
Ground .....	Unguarded
Test .....	Guard

**5.6 Test** Perform the same testing procedures per 5.3.

**5.7 Evaluation** The surface resistance is the direct reading of the megohmmeter scale and should be recorded in megohms.

**6 Notes** This method may also be used for rigid dielectric materials.

**6.1** For additional information see ASTM-D-257, DC Resistance or Conductance of Insulating Materials.