The Institute for Interconnecting and Packaging Electronic Circuits
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IPC-TM-650
TEST METHODS MANUAL

Number	
2.4.22.1	
Subject	
Bow and Twist—Laminate	
Date	Revision
5/93	**C**
Originating Task Group	

1.0 Scope This method covers the measurement of bow and twist by maximum vertical displacement of an unrestrained panel of either cut to size panels or finished rigid printed boards including single- and double-sided, multilayer, and the rigid segments of rigid flex printed circuits. This test method is only applicable to laminates greater than or equal to 0.5 mm [0.020 in] in thickness. This test method can also be used after etching or after thermal stress with requirements as agreed between user and vendor.

2.0 Applicable Documents

None

3.0 Test Specimen The test specimen for incoming inspection shall be 300 x 300 mm ± 2 mm [12 x 12 in ± 0.08 in] in size. For smaller panel sizes and finished printed wiring boards, use actual size. A minimum of three specimens is required per sample, when evaluating pressed laminate sheets.

4.0 Apparatus

4.1 Sample Shear

4.2 Granite Surface Plate or Equivalent

4.3 Feeler Gauges or Equivalent

4.4 Micrometer

5.0 Test Procedure

5.1 Preparation of the Test Specimen

5.1.1 For laminate sheet, the test specimens are to be cut in such a fashion as to minimize mechanical flexing.

5.1.2 For cut to size panels or printed wiring boards, use actual size.

5.1.3 Mark the specimen for traceability. No mechanical or chemical pre-cleaning is permitted on the specimens.

5.2 Measurement of Bow and Twist

5.2.1 Place the test panels on the surface plate such that the maximum vertical displacement is observed. The panel should be turned over in establishing the maximum vertical displacement. The maximum vertical displacement may be a corner or a side of the test specimen as illustrated in Figures 1 and 2.

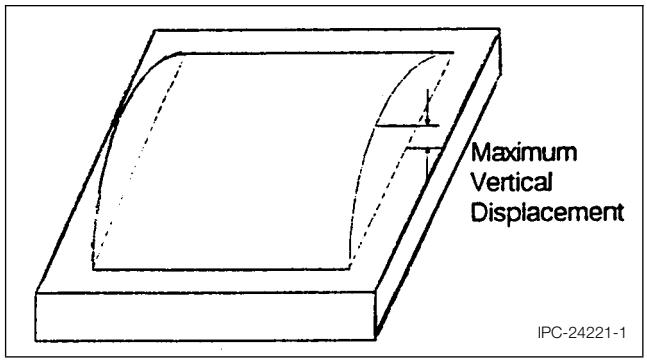

Figure 1

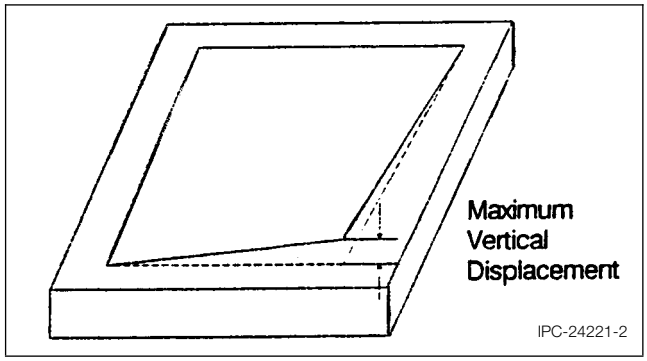

Figure 2

5.2.2 Measure the maximum vertical displacement by inserting the feeler gauges between the surface plate and the bottom surface of the laminate.

5.2.3 Verify the thickness measurement by measuring the total thickness of the feeler gauges with the micrometer.

5.2.4 Record the maximum vertical displacement in 0.25 mm [0.01 in]. One value is recorded per test specimen. This is the bow and twist of the test specimen.

5.3 Calculation of Results

5.3.1 Average Bow and Twist Results

Bow and Twist =

$$\frac{\text{Sum of the Measured Maximum Vertical Displacements in mm [in]}}{\text{Number of Test Specimens}}$$

5.3.2 Maximum Bow and Twist Results The maximum vertical displacement in mm [in] obtained for each lot of material.

6.0 *Notes*

6.1 This is the referee method; other methods of measurement are allowable, if agreed upon between user and vendor.