



# IPC-TM-650 TEST METHODS MANUAL

**1 Scope** This test method is to determine the land bond strength of unsupported holes, after repeated soldering and unsoldering, by mechanical pull in the perpendicular plane.

## 2 Applicable Documents

**IPC-2221** Generic Standard on Printed Board Design

**3 Test Specimen** Any unsupported component hole sample or test coupon “A” or “A/B” described in IPC-2221. Three holes per sample or test coupon shall be tested.

## 4 Apparatus or Material

**4.1 Soldering Iron** 60-watt soldering iron capable of producing a tip temperature of 232 °C to 260 °C [450 °F to 500 °F].

**4.2 Force Tester** Vertical pull force tester capable of operating at a speed of 50.0 mm [2.0 in] per minute and measuring up to 9 kg [20 pounds] load.

**4.3** Tinned or solder coated copper wire.

## 5 Procedure

### 5.1 Preparation

**5.1.1** If conductors are connected to the land area, the following procedure is to be followed:

Take a sharp model knife and cut conductor at least 6.0 mm [0.2 in] away from the land. Place blade of knife on edge of land area where conductor enters. While holding the blade down, pull conductor to the land and use knife blade as fulcrum to break conductor from land without disturbing bond of the land.

**5.1.2** Insert wire so that the portion extending from the soldered side of the circuit may be fitted into the gripping mechanism of a tensile tester. The wires shall have a diameter between 150 µm and 500 µm [5,906 µin and 19,685 µin] less than the diameter of the hole. The wires shall not be clinched. Select suitable wire of sufficient length to connect to gripping mechanism of bond strength tester.

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| Subject<br><b>Land Bond Strength, Unsupported Component Hole</b>                    |                      |
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| Originating Task Group<br><b>Rigid Printed Board Performance Task Group (D-33a)</b> |                      |

**5.1.3** Insert wire in holes in selected lands and solder to lands by machine or hand, as applicable. The wire shall not be clinched.

### 5.2 Soldering Cycles

**5.2.1** The hand soldering and desoldering operation of the wire shall be performed as follows:

- Step 1: Solder wire into lands
- Step 2: Remove (desolder) wire from lands
- Step 3: Resolder wire into lands
- Step 4: Remove (desolder) wire from lands
- Step 5: Resolder wire into lands

During the desolder and solder steps, solder every other land in the row and allow the specimen to cool to room temperature. Then solder the remaining lands.

**5.2.2** During the solder and desoldering steps, the soldering and/or desoldering iron shall have a tip temperature as follows (see 6.1):

- Method A: 260 °C [500 °F] - Default method
- Method B: 315 °C [599 °F]
- Method C: 371 °C [700 °F]

### 5.3 Pull Test

**5.3.1** Following the fifth cycle, clamp the test specimen sufficiently in the jaws of the bond tester to assure that the test specimen is perpendicular to the direction of pull.

**5.3.2** Apply a pull at the rate of 50.0 mm per minute [2.0 in per minute] to the wire on the pattern side of the test specimen.

**5.3.3** The load must be applied perpendicular to the major surface of the land. The load shall be applied until failure occurs or the minimum force as specified by the procurement documentation is reached. The formula to calculate force for circular lands is as follows:

$$\frac{4L}{\pi (D2^2 - D1^2)}$$

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Where:

D1 = Hole diameter

D2 = Land diameter

L = Load (force)

**Note:** The formula given utilizes the diameter of both the land and the hole in the determination of the area of the land, rather than the radius of each. Thus, a factor of four is applied to the numerator as the area of a circle as defined by using the diameter is  $(\pi * (\text{diameter})^2) / 4$ .

**5.4 Evaluation** Examine test specimen for loosening of bond and for loosening of the land from the base material. It shall be considered a failure when a land around an unsupported hole is loosened.

## 6 Notes

**6.1** Breaking of a wire, or wire pull-out, shall not be considered a failure, but the wire shall be resoldered and pulled again.

**6.2** The following details are to be specified in the applicable performance specification:

- a. Test specimen, if other than specified in 3.
- b. Force, if other than specified in 5.3.3.