



IPC-TM-650 TEST METHODS MANUAL

1.0 Scope The purpose of this test is to determine the peel strength of metal cladding to the base laminate while at elevated temperature; and to evaluate the base laminate material after the peel strength test is completed for degradation due to the conditioning.

2.0 Applicable Documents

IPC-TM-650 Test Methods Manual

Method 2.4.8.1, Peel Strength, Metal Foil (Keyhole Method for Thin Laminates)

Method 5.8.3, Peel Strength Test Pattern

3.0 Test Specimens

3.1 Size and Configuration Specimens shall be 50.8 mm x 50.8 mm [2.0 x 2.0 in] by the thickness of the laminate. Cladding test strips shall be as specified (see 5.1.2).

3.2 Quantity and Sampling Unless otherwise specified, specimens shall be one lengthwise for each clad side and one crosswise for each clad side. The outside 25.4 mm [1 in] border of the parent sheet or panel shall be excluded.

4.0 Apparatus or Material

4.1 Tensile Tester A tensile strength tester equipped with a load cell, capable of measuring to the nearest 0.0045 kg [0.01 lbs.] and a light load wire or chain and clamp at least 457 mm [18 in] long (its weight is included in the load cell calculation). The clamp jaws must cover the entire width of each peel strip tab. Any equipment or apparatus having the described accuracy, precision, and reproducibility may be used.

4.2 Hot Fluid Bath A fluid bath or pot capable of maintaining the specified fluid at the specified temperature when measured 2.54 mm [1.0 in] below the surface.

4.2.1 Dow Silicone Fluid No. 704, or equivalent.

4.3 Specimen Hold-down A suitable hold-down clamping system equivalent in performance as that defined in IPC-TM-650, Method 2.4.8.1.

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4.4 Data Collection For qualification testing, a recording system capable of permanent data retention incorporated into the test apparatus.

4.5 Measuring device capable of measuring from 0.000 to 12.7 mm [0.500 in] to within ± 0.0025 mm [0.0001 in].

4.6 Etch Resist Materials or Systems

4.6.1 Plater's tape, or equivalent, to act as etch resist for strip formation of the specified widths (see 3.3 and 3.4).

4.6.2 Photoresist system (printing, developing, and stripping).

4.7 Etching system capable of complete removal of metallic cladding.

4.8 Circulating air oven capable of maintaining $125 \pm 2^\circ\text{C}$ [$257 \pm 3.6^\circ\text{F}$].

5.0 Procedure

5.1 Specimen Preparation

5.1.1 Cut the specimens from the laminate sample. Specimens shall be taken no closer than 2.54 mm [1.0 in] from the edge of the laminate sheet as manufactured.

5.1.2 Specimens shall be prepared with at least four resist strips of 3.18 mm [0.125 in] width and then etched, cleaned and processed using standard industry practices and equipment. For qualification and referee testing the specimen shall be photoimaged in accordance with the artwork shown in Method 5.8.3 of IPC-TM-650 and reproduced here as Figure 1, except that tab ends are optional. Specimens shall be etched so that the conductor strips on one specimen are in one direction per Figure 1. Double clad laminate shall have each side tested using separate specimens. The opposite side cladding shall be either fully removed or left fully clad. Separate specimens for both the warp and fill directions are required for each side. For referee testing the cladding on the opposite side shall remain.

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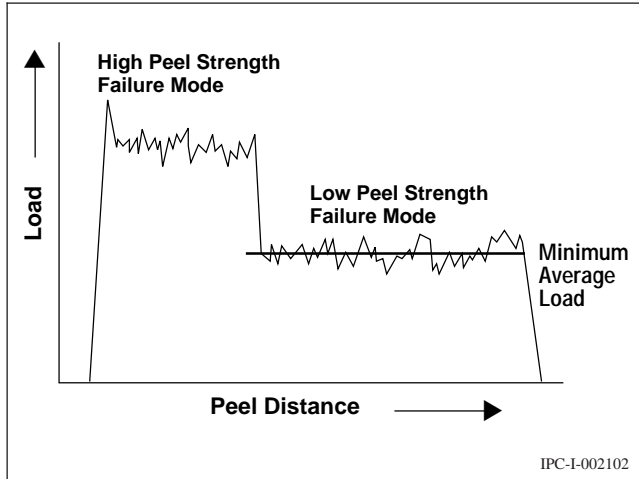


Figure 1 Multiple Failure Modes

5.1.3 Thin specimens may be provided with support by bonding them to a rigid substrate base, or may be tested with the aid of the keyhole fixture (see Figure 2). For referee testing of laminates less than 0.51 mm [0.020 in], the specimens shall be bonded to a rigid substrate or laminate.

Note: Peel values can be affected by the adhesive used to bond the specimen to the rigid substrate. It is imperative that the best adhesive be found for the type of materials being bonded to least influence the true peel strength value.

5.1.4 Peel the test strip back no more than 12.7 mm [0.5 in] at the tab end.

5.1.5 For qualification or referee testing purposes, specimens shall be preconditioned by baking at $125 \pm 2^\circ\text{C}$ [$257 \pm 3.6^\circ\text{F}$] for a minimum of two hours. This preconditioning is in addition to elevated test temperature requirements on the appropriate material specification.

5.1.6 Heat fluid bath to specified temperature and stabilize at least 5 minutes. Measure temperature approximately 25.4 mm [1.0 in] below surface.

5.2 Measurement

5.2.1 Peel Strength Determination

5.2.1.1 Clamp the tab end (if present) of each individual test strip and place specimen and clamp into fluid bath immersing specimen horizontally approximately 25.4 mm [1.0 in] below the surface.

5.2.1.2 Fasten specimen with hold down fixture so that an unencumbered vertical pull can be exerted. The end of the test strip and the wire connecting the clamp to the tensile tester must be free to pull vertically within 5° .

5.2.1.3 Prior to starting test, allow immersed specimen to stabilize at the specified temperature for laminates to 0.51 mm [0.020 in] or for laminates greater than 0.51 mm [0.20 in].

5.2.1.4 Start test and apply force in the vertical direction at the rate of 50.8 mm [2.0 in] per minute, until at least 25.4 mm [1.0 in] of the test strip has been pulled, or the strip breaks or tears. (See 6.1).

5.2.1.5 Observe and record the minimum load as defined by Figure 1. Measure the actual width of the test strip and record with the minimum load.

5.2.1.6 If the full width of the test strip does not peel, the results shall be discarded and another strip tested.

5.2.1.7 Perform the procedure as per 5.2.1.1 through 5.2.1.4 on a minimum of 2 strips per side per specimen. Any unusual event or irregularity in the data shall be cause to void the strip's results and repeat the sequence on a different strip.

5.2.2 Determination of Degradation Examine the specimens using normal or corrected 20/20 vision. Record the presence of any base laminate degradation, including loss of surface resin, discoloration, resin softening, delamination, blistering, propagation of imperfections, measling, crazing, or voids.

5.3 Calculation and Report

5.3.1 Calculate the peel strength load as shown:

$$\text{Lbs/in} = \frac{L_M}{W_S}$$

where:

L_M = Minimum load

W_S = Measured width of peel strip

5.3.2 Record and report such individual peel strength value as determined in 5.3.1. Average the individual peel strength values for each side and each grain direction of the laminate sampling. For example, if the sampling plan calls for one specimen per side and per grain direction, there will be at least two values to be averaged from four different specimens.

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5.3.3 Report any presence of laminate degradation as observed in 5.2.1.2.

6.0 Notes

6.1 Test strip breakage may be caused by either a bond greater than the tensile strength of the foil, or foil brittleness. Where superior bond is shown (value at break above specification) value at break may be used instead of minimum peel. The average reported shall indicate that the value is greater than average.

6.2 For metallic cladding less than one ounce thickness, copper plating or solder coating may be used to build up to 0.035 ± 0.0035 mm [0.0014 ± 0.00014 in] to previous strip strength.