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IPC-TM-650
TEST METHODS MANUAL

Number	
2.4.4	
Subject	
Flexural Strength of Laminates (at Ambient Temperature)	
Date	Revision
12/94	**B**
Originating Task Group	
MIL-P-13949 Test Methods Task Group (7-11b)	

1.0 Scope This test is designed to determine the flexural strength of laminates of thicknesses greater than, or equal to, 0.51 mm [0.020 in] by applying a specific load to a specific size and shaped specimen.

2.0 Applicable Documents

ASTM-D-790 Flexural Properties for Unreinforced and Reinforced Plastics and Insulating Material.

IPC-TM-650

Methods 2.3.6, Etching Ammonium Persulfate
Method 2.3.7, Etching Ferric Chloride
Method 2.3.7.1, Cupric Chloride Etching

3.0 Test Specimens

3.1 Size and Configuration Dimensions of the specimens shall be as shown in Table 1. Edges of the specimens shall be free of fractures, delamination, or roughness by means of sanding or equivalent means (do not radius the edges.)

3.2 Quantity and Sampling Unless otherwise specified, four specimens shall be tested, two in the lengthwise and two in the crosswise direction of the sample sheet or panel.

4.0 Apparatus or Material

4.1 Tester A standard tension and compression test apparatus which can be operated at a constant rate of crosshead movement shown in Table 1. The error in the load measuring system shall not exceed ± 1%. The loading nose and supports shall have cylindrical surfaces. The radius of nose and supports shall be in accordance with ASTM-D-790 (in order to avoid excessive indentation).

4.2 Etching system capable of complete removal of the metallic cladding.

4.3 Measuring devices capable of determining specimen widths to the nearest 0.025 mm [0.001 in] and specimen thickness to the nearest 0.0025 mm [0.0001 in].

5.0 Procedure

5.1 Specimen Preparation

5.1.1 When applicable, chemically etch off all metallic cladding in accordance with standard industry etching practices. For referee purposes, etching shall be in accordance with 2.3.6, 2.3.7, or 2.3.7.1.

5.1.2 Cut specimens to the size as shown in Table 1 and smooth the edges of specimens. Measure and record specimen width to the nearest 0.025 mm [0.001 in] and thickness to the nearest 0.0025 mm [0.0001 in].

5.2 Measurement

5.2.1 Set tester for the required span and crosshead vertical speed as specified in Table 1.

5.2.2 Align the loading nose and supports so that the axis of the cylindrical surfaces are parallel and the loading nose is midway between the supports.

Table 1

	Specimen Dimensions		Test Parameters	
Nominal thickness[1] mm [inches]	**Width[2] mm [inches]**	**Length[3] mm [inches]**	**Span mm [inches]**	**Speed of testing mm [inches] per min.**
0.79 [0.031]	25.4 [1.0]	63.5 [2.5]	15.9 [0.625]	0.51 [0.020]
1.57 [0.062]	25.4 [1.0]	76.2 [3.0]	25.4 [1.0]	0.76 [0.030]
2.36 [0.093]	25.4 [1.0]	88.9 [3.5]	38.1 [1.5]	1.02 [0.040]
3.18 [0.125]	25.4 [1.0]	101.6 [4.0]	50.8 [2.0]	1.27 [0.050]
6.35 [0.250]	12.7 [0.5]	152.4 [6.0]	101.6 [4.0]	2.03 [0.080]

1.) Nominal thicknesses other than those listed shall be prepared and tested in accordance with the next greater nominal thickness.
2.) Width as cut and smoothed to within 5% of nominal shown.
3.) Length as cut (not necessary to smooth) to within 10% of nominal shown.

5.2.3 Specimens shall be at room temperature. Center the specimen on the supports with the long axis of the specimen perpendicular to the loading nose and supports.

5.2.4 Apply the load at the speed of testing from Table 1 until the specimen breaks. The load at breakage shall be recorded in pounds. (P).

5.3 Calculation and Report

5.3.1 Calculate the flexural strength for each specimen using the formula below:

$$S = \frac{3PL}{2bd^2}$$

S = Flexural strength in psi

P = Load at breaking (pounds)

L = Span, inch

b = Width of specimen

d = Thickness, inch

5.3.2 Average the flexural strengths and record in psi.

5.3.3 Report the specimen thicknesses, individual psi values, and average psi for each direction; note the orientation of the sample panel or sheet associated with the direction of the specimen.

6.0 ***Notes*** None

6.1 Additional information and background useful to the performance of the test may be found in ASTM-D-790.