BUILD ELECTRONICS BETTER
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Number	
2.4.17.1	
Subject	
Propagation Tear Strength, Flexible Insulating Material	
Date	Revision
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Originating Task Group	
Flexible Circuits Test Methods Subcommittee (D-15)	

IPC-TM-650
TEST METHODS MANUAL

1 Scope This method covers the determination of the force necessary to propagate a tear in flexible insulating materials that range between the thicknesses of approx.12 µm to 100 µm [approx. 0.0005 in to 0.004 in]. This test method is based on ASTM D 1938.

2 Applicable Documents ASTM D 1938 Standard Test method for Tear propagation Resistance (Trouser Tear) of Plastic Film and Thin Sheeting by a Single Tear Method

3 Test Specimen Preparations

3.1 If the specimens to be tested are clad flexible dielectric materials, the copper foil **shall** be fully etched (removed) using standard commercial practices. If the dielectric material to be tested is unclad, use the material as it exists for this test method. If the specimens are flexible insulating bonding material that inherently has an adhesive that is not fully cured, full curing of this adhesive **shall** be accomplished before the material is tested.

3.2 The specimens **shall** be of the single-tear type and **shall** consist (see Figure 1) of strips 75 mm [approx. 3 in] long by 25 mm [approx. 1 in] wide and **shall** have a clean longitudinal slit 50 mm [approx. 2 in] long cut with a sharp razor blade or the equivalent (Note: All dimensions **shall** be measured to within a 0.5% tolerance.)

3.3 If the specimen is composed of a base dielectric plus adhesive coated on one or both sides, the thickness of the base dielectric needs to be measured, either via cross-sectional analysis or if feasible, removal of the adhesive layer(s). The thickness of the specimen below the slit (see Figure 1) **shall** be measured in three places and recorded in millimeters or microns [in]. This provides the user of this test method with knowledge of only the base dielectric film thickness.

3.4 Sufficient specimens **shall** be cut to provide a minimum of five specimens in both transverse and longitudinal axes and identified. Specimens **shall** be free of nicks or other defects that might cause premature test failure. Verification of lack of defects in the slit **shall** be done using a minimum magnification of 3X.

4 Test Equipment

4.1 Constant Strain Rate Tensile Test Machine This test machine **shall** have a weighing head that can measure the load applied to tear the specimen. It should be equipped with a device for recording the load carried by the specimen and amount of separation of the grips during the test. The testing machine **shall** be essentially free from inertia lag at the specified rate of testing and **shall** indicate the load with an accuracy of ± 2% of the indicated value, or better. A device **shall** be included to control the grip separation rate at 250 mm [approx.10 in] ± 5% per minute.

4.2 Thickness Measuring Devices Suitable micrometers, or thickness gages, reading to 2.5 µm [approx. 0.10 in] or less **shall** be used for measuring the thickness of the specimens.

4.3 Cutter The cutter **shall** be a sharp razor blade or the equivalent.

5 Conditioning

5.1 Conditioning Condition the specimens at 23°C ± 2°C [73.4°F ± 3.6°F] and 50% ± 5% relative humidity for not less than 24 hours prior to test.

5.2 Test Conditions Conduct tests in the Standard Laboratory Conditions of 23°C ± 2°C [73.4°F ± 3.6°F] and 50% ± 5% relative humidity.

6 Procedure

6.1 Secure tongue A (Figure 1) in one grip and tongue B in the other grip of the tensile testing machine using an initial grip separation of 50 mm [approx. 2 in]. Align the specimen so that its major axis coincides with an imaginary line joining the centers of the grips.

6.2 Using a grip separation speed of 250 mm [approx. 10 in] / minute, start the tensile test machine and record the load necessary to propagate the tear through the entire unslit 25 mm [approx. 1 in] portion.

6.3 Test not less than five (5) specimens in each of the transverse and longitudinal directions.

7 Calculations

7.1 Low Extensible Films For base dielectric films that have load-time charts characterized by Figure 2, the average tear propagation force in grams [ounces] is obtained by averaging the load indicated on the chart over the time period, disregarding the initial and final portions of the curve. Record the average load value reading from the tensile testing machine. The average resistance to tearing **shall** be calculated from all specimens tested in each of the transverse and longitudinal directions.

7.2 High Extensible Films For base dielectric films that have load-time charts characterized by Figure 3, the initial force to continue the propagation of the slit and the maximum force attained are obtained from the chart and reported in grams [ounces]. The initial force may be more readily detected by placing a dot approximately 3 mm [1/8 in] in diameter at the base of the razor blade slit with a wax pencil. As the load is applied to the sample, the dot area is observed. When the load is just sufficient to begin the extension of the slit, a ''blip'' is introduced on the chart (see Figure 3) by pushing the appropriate button on the recorder or the equivalent to mark this point. The maximum load is the highest reading on the chart as indicated. Calculate the average of the five initial tear propagation forces and the average of the five maximum tear propagation forces in grams [ounces] for the transverse and longitudinal directions of the material test specimens.

8 Report

8.1 Report the average base dielectric film thickness only of the specimens tested. This provides the user of this test method with the base dielectric film thickness only, if required, by the flexible circuitry material specifications.

8.2 For low extensible base dielectric films described in 7.1, report the average of the five average tear propagation determinations in grams [ounces] for the transverse and longitudinal specimens.

8.3 For high extensible base dielectric films described in 7.2, report the average of the five initial tear-propagation forces and the average of the five maximum tear-propagation forces in grams [ounces] for the transverse and longitudinal specimens.

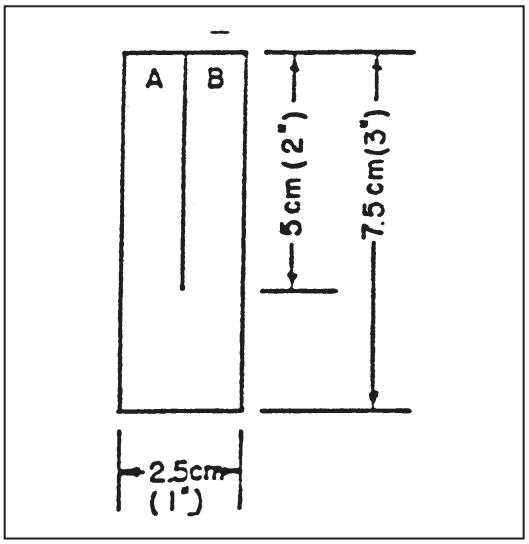

Figure 1 Single-tear specimens

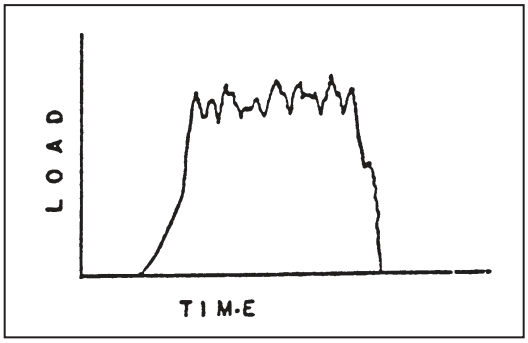

Figure 2 Load-time chart for low-extensible base dielectric films

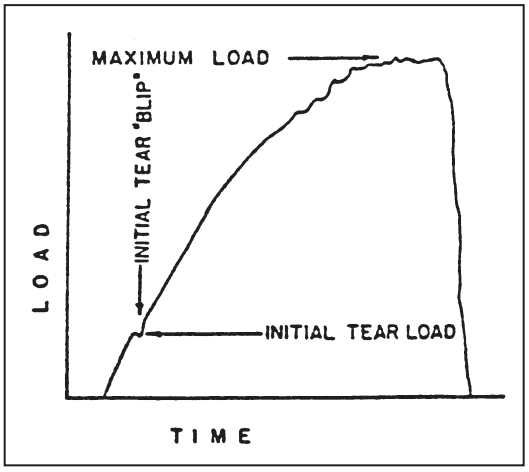

Figure 3 Load-time chart for high extensible base dielectric films