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# IPC-TM-650 TEST METHODS MANUAL

**1 Scope** This method covers the determination of the force required to initiate tearing in flexible insulating materials. It is based on ASTM D1004.

## 2 Applicable Documents

**ASTM D374** Standard Test Methods for Thickness of Solid Electrical Insulation

**ASTM D1004** Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting

## 3 Test Specimens

**3.1** The specimens **shall** be prepared using flexible dielectric material. If the flexible dielectric is clad, the copper foil **shall** be etched using standard commercial practices.

**3.2** Ten specimens, five in the transverse and five in the longitudinal (machine) directions, **shall** be cut from the sample material.

**3.3** The test specimens **shall** conform to the dimensions shown in Figure 1.

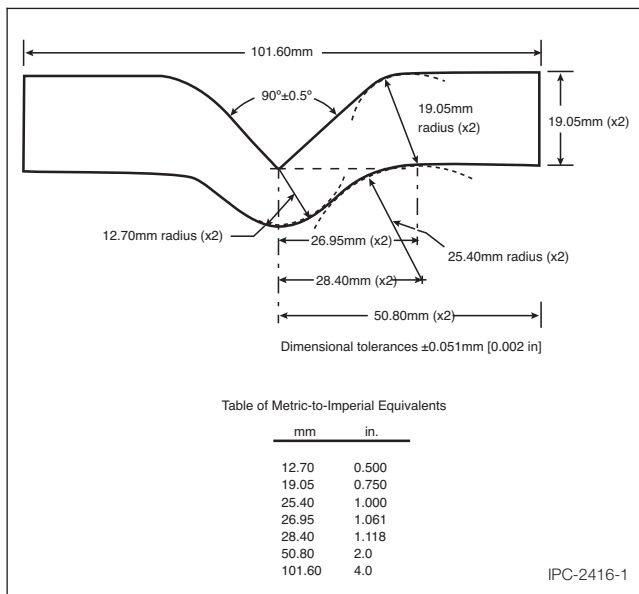


Figure 1 Die for Tear Test Specimen

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## 4 Test Equipment

**4.1 Testing Machines** A power driven machine of either of the two following types **shall** be used.

**4.1.1 Static Weighing** Constant rate of grip separation type, negligible movement of the upper jaw.

**4.1.2 Pendulum Weighing** Constant rate of grip motion type, constant rate of lower jaw movement, variable upper jaw movement. Either maximum load indicating devices or recorders are permissible in the testing machine. The applied load, as indicated by a recorder, dial or scale, **shall** be accurate to within 12 percent. If an indicating device is used, the indicator **shall** remain at the point of maximum load after rupture of the test specimen.

**4.2 Grips** A gripping system that minimizes both slippage and uneven stress distribution on the specimen **shall** be used.

**4.3 Thickness Measuring Devices** Suitable calibrated ratchet/friction thimble machinist's micrometer reading to 0.0025 mm [0.0001 in] or less **shall** be used for measuring the thickness of the specimens. The micrometer **shall** conform to ASTM D374.

**4.4 Die** A die having the dimensions shown in Figure 1 **shall** be used to cut all specimens. The 90° angle **shall** be honed sharp with no radius or have a minimum practical radius, as per ASTM D1004. The cutting edge of the die **shall** have a 5° negative rake, and **shall** be kept sharp and free from nicks to avoid leaving ragged edges on the specimen. Cutting may be facilitated by wetting the surface of the sample and cutting edges of the die with water. The sample **shall** rest on a smooth, slightly yielding surface that will not injure the die blade. Lightweight cardboard or a piece of leather belting is suitable. Care should be taken that the cut edges of the specimens are perpendicular to its other surfaces and that the edges have a minimum of concavity. NOTE: The test specimen results depend on the quality of the die used.

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## 5 Conditioning

**5.1 Conditioning** The test specimens **shall** be conditioned at  $23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$  ( $73.4\text{ }^{\circ}\text{F} \pm 3.6\text{ }^{\circ}\text{F}$ ) and  $50\% \pm 5\%$  relative humidity for not less than 24 hours prior to test.

**5.2 Test Conditions** Conduct tests in the Standard Laboratory Atmosphere of  $23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$  ( $73.4\text{ }^{\circ}\text{F} \pm 3.6\text{ }^{\circ}\text{F}$ ) and  $50 \pm 10$  percent relative humidity.

**6 Speed of Testing** A jaw separation of 25.4 mm [1 in] **shall** be used. The rate of travel of the power activated grip **shall** be 51 mm [2 in]/minute and **shall** be uniform at all times.

## 7 Procedure

**7.1** Measure the thickness of the specimen at several points to the accuracy limits of the measuring devices specified in 4.3. Record the average thickness in millimeters or microns [in].

**7.2** Place the specimen in the grips of the testing machine so that the long axes of the enlarged ends of the specimen

are in line with the points of attachment of the grips to the machine.

**7.3** Apply the load at 51 mm [2 in]/minute rate of grip separation. After complete rupture of the specimen, the maximum tearing load in grams [ounces] **shall** be noted from the dial scale or recorder chart and recorded. Data from specimens which break at some obvious flaw or which break in or at the edges of the grips **shall** be discarded and retests made.

**8 Calculation** The average resistance to tearing **shall** be calculated from five specimens tested in each principal direction of orientation. Data **shall** be recorded as grams [ounces] of tearing resistance.

## 9 Report

**9.1** Report the average thickness of all specimens.

**9.2** Report the average transverse and the average longitudinal initiation tear strength values.