Designation: F2750 – 16

Standard Test Method for Determining the Effects of Bending a Membrane Switch or Printed Electronic Device[1]

This standard is issued under the fixed designation F2750; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method establishes a method for the bending of any part of a membrane switch or printed electronic device with conductive circuits.

1.1.1 The values given in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.2 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Terminology

2.1 *Definitions:*

2.1.1 *bend*—to force from a straight form into a different and especially a curved one.

2.1.1.1 *Discussion*—In this case, no "hard" or angled crease or fold is to occur. The substrate will only be formed into a radius.

2.1.2 *bend cycle*—a bend of a sample around a specified mandrel which is "rolled" in one direction, followed by rolling in the opposite direction, returning the sample to its original position (see Fig. 1).

2.1.3 *mandrel*—a cylindrically shaped metal rod, such as a brazing or drill rod.

2.1.4 *membrane switch*—a momentary switching device in which at least one contact is on, or made of, a flexible substrate.

2.1.5 *membrane switch tail*—a flexible portion of a membrane switch used for input/output connection.

3. Significance and Use

3.1 Bending of membrane switches, printed electronic device or their components can affect their visual appearance, mechanical integrity or electrical functionality. This test method simulates conditions that may be seen during manufacture, installation or use.

3.2 Bend testing may be destructive, therefore any samples tested should be considered unfit for future use.

3.3 Specific areas of testing include, but are not limited to:

3.3.1 Membrane switch flex tails or printed electronic device, and

3.3.2 Any component of a membrane switch or printed electronic device that may be subjected to bending.

4. Interferences

4.1 The following parameters may affect the results of this test:

4.1.1 temperature,

4.1.2 humidity, and

4.1.3 orientation of the conductor (either extension or compression) could have significant impact on the results.

NOTE 1—Experience has shown that some conductors recover their conductive properties if allowed to stabilize after the dynamic portion of the test. Therefore, continuous monitoring is recommended.

5. Apparatus

5.1 *Mandrel,* allowed to rotate smoothly around its longitudinal axis, rigid, low friction smooth surface. Diameter to be specified.

5.2 Fixture to hold test sample securely in place in a vertical manner (refer to Fig. 1).

5.3 Mechanism capable of providing a consistent force and rate of pull to the sample.

5.4 Equipment for the monitoring and recording of resistance.

NOTE 2—Experience has shown that some conductors recover their conductive properties if allowed to stabilize after the dynamic portion of the test. Therefore, continuous monitoring is recommended.

6. Test Samples

6.1 The test samples may be components, tail assembles or finished switches. If the sample length is too short for the test fixture, a sample coupon of the same construction (layer to layer) must be provided (minimum; 250 mm length by 25 mm width).

[1] This test method is under the jurisdiction of ASTM Committee F01 on Electronics and is the direct responsibility of Subcommittee F01.18 on Printed Electronics.

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One complete bend cycle is depicted below. The test sample is clamped in a vertical position. The sample is wrapped around the test mandrel, with appropriate test weights applied. The sample is drawn up to a specified distance and returned to the home position.

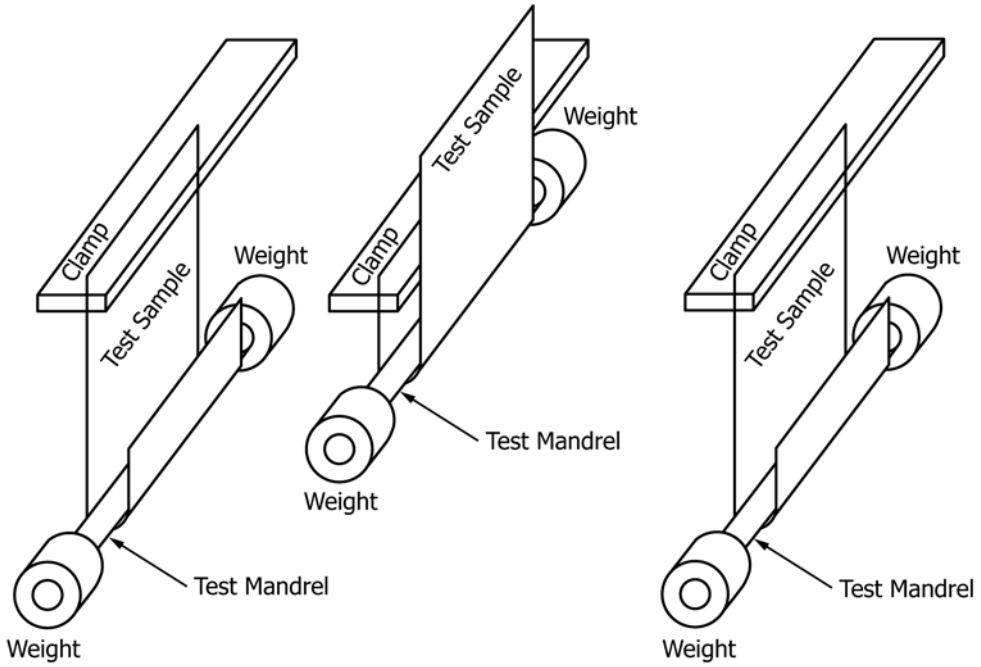

FIG. 1 Test Fixture Setup

6.2 The width of the test sample must not exceed the length of the mandrel.

7. Procedure

7.1 Clamp one end of the test sample to the test fixture – this is the static end of the test sample.

7.1.1 *Compression Conductor Testing* —conductor side of the test sample faces the mandrel.

7.1.2 *Extension Conductor Testing* —conductor side of the test sample faces away from the mandrel.

7.2 Loop the unsecured end of the test sample around the mandrel – this later becomes the dynamic end of the test sample.

7.3 Clamp the unsecured end of the test sample to the lifting mechanism (no tension).

7.3.1 Ensure that both ends of the test sample remain parallel during motion of test.

7.4 Connect to the test sample so that circuit resistance can be monitored.

NOTE 3—Experience has shown that some conductors recover their conductive properties if allowed to stabilize after the dynamic portion of the test. Therefore continuous monitoring is recommended.

7.4.1 Verify test sample is functional and being monitored.

7.5 Apply the minimum tension load of sufficient magnitude such that the test sample contacts 50 % of the circumference surface of the mandrel. (Typically, this is a kg mass providing the tension load.)

7.6 Adjust the test fixture to achieve maximum travel of the mandrel by pulling the unsecured end (dynamic end) of the test sample while maintaining 50 % contact with the mandrel.

7.7 Start test.

7.7.1 Record the closed loop resistance (Ri) - measurement made on the first test cycle. At the end of the test, the "R maximum" value, which is the largest value using a time constant chosen appropriately for the measurement, is recorded.

7.7.2 A cycle is defined as travel from maximum extension to minimum extension and back to maximum extension.

7.7.3 The linear speed of the dynamic end of the test sample should not exceed 25.4 mm/s.

7.8 Repeat cycles until resistance increases by 30 % or more of Ri for 10 consecutive cycles or the specified number of cycles are completed. Resistance is to be continuously monitored or measured within 3 s of cycling. Time between cycles shall not exceed 3 s.

7.9 Remove test sample from test fixture.

8. Report

8.1 *Report the following information:*

8.1.1 Temperature,

8.1.2 Humidity,

8.1.3 Resistance measurements, Ri, R maximum,

8.1.4 Number of cycles per specimen,

8.1.5 Part number or description of specimen,

8.1.6 Date of test,

8.1.7 Orientation of test sample (compression, extension, or both),

8.1.8 Diameter of mandrel, and

8.1.9 Load weight.

9. Precision and Bias

9.1 *Precision*—It is not possible to specify the precision in Test Method F2750 for measuring bend because inter-laboratory studies have proven inconclusive due to insufficient participating laboratories with the appropriate equipment.

9.2 *Bias*—No information can be presented on the bias of the procedure in Test Method F2750 for measuring bend because no standard sample is available for this industry.

10. Keywords

10.1 bend; mandrel; membrane switch; printed electronic device; tail assembly