



Standard Test Method for Evaluating the Reliability of Surface Mounted Device (SMD) Joints on a Flexible Circuit by a Rolling Mandrel Bend¹

This standard is issued under the fixed designation F3147; 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 covers a means to test a completed Surface Mounted Device (SMD) joint for bond strength and inter-layer stress compatibility

1.2 A completed SMD joint includes; SMD (LED, resistor, etc), PTF ink land (typically silver), conductive adhesive (typically silver), staking compound (non-conductive), and encapsulant (non-conductive).

2. Referenced Documents

2.1 *ASTM Standards:*

F1996 Test Method for Silver Migration for Membrane Switch Circuitry

F2750 Test Method for Determining the Effects of Bending a Membrane Switch or Assembly

3. Terminology

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

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

3.2 *bend cycle, n*—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**).

3.3 *conductive adhesive, n*—a material used for electrical or mechanical bonding, or both, of the SMD to the substrate and land-pad.

3.4 *encapsulant, n*—a non-conductive adhesive that is applied over or around, or both, the SMD for added bond strength and prevention of silver migration (**F1996**).

3.5 *land-pad, n*—the printed circuit pattern at the location that interfaces with conductive adhesive, in this case conduc-

tive link circuitry (commonly silver) that will make electrical contact to the SMD via conductive adhesive.

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

3.7 *SMD, n*—abbreviation for surface mount device (that is, light emitting diode (LED), resistor, capacitor, etc.).

3.8 *SMD joint, n*—the combined interface of silver land-pad, conductive adhesive, staking compound (if included), and encapsulant that holds the SMD in place.

3.9 *SMD-populated flexible printed circuit, n*—flexible substrate with conductive circuitry and electronic components only—not to include other laminates.

3.10 *staking compound, n*—a non-conductive adhesive that is applied at a location directly under the SMD and between conductive adhesive deposits (commonly two or more dispensed dots of conductive adhesive) to provide added bond strength and prevent shorting or silver migration.

4. Significance and Use

4.1 The existing Test Method **F1995**, while very useful, is difficult to conduct if an encapsulating dome is applied, and does not reveal the possible failures caused by mechanical stress incompatibility in the overall SMT joint. This mandrel bend test will reveal possible mechanical stress incompatibility between the various adhesives which can result in latent field failures during production handling or with thermal cycling in normal use.

4.2 The existing Test Method **F2750** does not include specifics for SMD attachments and only addresses the conductivity change of the conductive trace.

4.3 The different combinations of SMD types, attachment medias, circuit substrates and process variation can account for significant variation in test outcome.

4.4 Bending of printed flexible circuit 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.

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

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.

Current edition approved June 1, 2015. Published July 2015. DOI: 10.1520/F3147-15