



Standard Test Method for Measuring Adhesion Strength of Solderable Films to Substrates¹

This standard is issued under the fixed designation F 692; 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 the determination of the adhesion strength of films to substrates by pulling wires soldered to the films.

1.2 This test method is intended to measure the adhesion of metallization to substrates, and not the strength of the solder.

1.3 This test method applies to all films that can be soldered.

1.4 The maximum melting point of solder used with this test method is determined by the characteristics of the solder flux.

1.5 This test method is destructive.

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

2. Terminology

2.1 *Definitions of Terms Specific to This Standard:*

2.1.1 *solder interface failure*—in microelectronics, a failure mode in which most of the solder is removed from the film and no detectable amount of film is removed from the substrate.

2.1.2 *solder failure*—in microelectronics, a failure mode in which the wire tears through the solder.

3. Summary of Test Method

3.1 Test specimens, each consisting of a substrate upon which a pattern of square test films, are prepared using equipment, materials, and procedures typical of the process to be evaluated. Specimens are pre-tinned; wires are centered over test pads and held in place with a fixture of low thermal mass. Specimens and wires are then soldered using controlled amounts of solder and flux and controlled heating followed by a 24-h period for stress relaxation. A soldered wire is bent at a right angle from each substrate. The substrate is then restrained and supported in an appropriate fixture, and the wire is attached to a lifting mechanism by a grip. The grip and substrate holder are moved apart until the wire is pulled off the substrate. The force applied in order to cause separation is recorded. The mode of failure is observed and recorded.

3.2 The solder alloy used is not specified by the test method,

and shall be agreed upon by the parties to the test.

3.3 The flux used is not specified by the test method, and shall be agreed upon by the parties to the test.

4. Significance and Use

4.1 Failure of hybrid microcircuits is often due to failure of a solder bond. The limiting strength that can be obtained for a solder bond is often the adhesion of the soldered film to the substrate.

4.2 This test method can be used for material selection, process development, research in support of improved yield or reliability, and specification for material procurement.

4.3 It is not recommended that this test method be used in deciding questions between buyers and sellers until the precision of the method has been determined by interlaboratory comparison.

5. Interferences

5.1 If the angle between the direction of the lifting force and the top surface of the substrate differs from a right angle by more than 5°, the force measured may differ significantly from that required to achieve operation with a perpendicular configuration.

5.2 Visible irregularities in the motion of the lifting mechanism may introduce extraneous forces and thus invalidate the test.

5.3 The presence of vibration or mechanical shock may cause the application of an extraneous force and thus invalidate the test.

5.4 Each specimen presents a thermal mass to the heating apparatus. Changes in substrate thickness will require a re-determination of the time temperature profile.

5.5 Changes in melting points when using different solder alloys also require a redetermination of the time temperature profile.

6. Apparatus

6.1 *Bond-Pulling Machine*—Apparatus for measuring the adhesion pull strength, incorporating the following components:

6.1.1 *Gripping Means* to attach the wire to the lifting mechanism.

6.1.2 *Lifting and Gaging Mechanism* for applying a measured vertical force to the gripping means with respect to the substrate holder. The mechanism shall incorporate a means for recording the maximum force applied within 0.5 N and shall be capable of moving at a rate of at least 13 mm/min.

¹ This test method is under the jurisdiction of ASTM Committee F-1 on Electronics and is the direct responsibility of Subcommittee F01.03 on Metallic Materials.

Current edition approved Dec. 10, 1997. Published March 1998. Originally published as F 692–80. Last previous edition F 692–80 (1991).