



Standard Test Methods for Measuring Pull Strength of Microelectronic Wire Bonds ¹

This standard is issued under the fixed designation F 459; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 These test methods cover tests to determine the pull strength of a series of wire bonds. Instructions are provided to modify the methods for use as a referee method. The methods can be used for wire bonds made with wire having a diameter of from 0.0007 to 0.003 in. (18 to 76 μm).

NOTE 1—Common usage at the present time considers the term “wire bond” to include the entire interconnection: both welds and the intervening wire span.

1.2 These test methods can be used only when the loop height of the wire bond is large enough to allow a suitable hook for pulling (see Fig. 1) to be placed under the wire.

1.3 The precision of these methods has been evaluated for aluminum ultra-sonic wedge bonds; however, these methods can be used for aluminum ball bonds and gold wedge or ball bonds, as aluminum wedge bonds are the most sensitive to manufacturing variations (such as bond deformation) of any wire-bond type. ²

1.4 These methods are destructive. They are appropriate for use in process development or, with a proper sampling plan, for process control or quality assurance.

1.5 A nondestructive procedure is described in Practice F 458.

1.6 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

1.7 *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. Referenced Documents

2.1 *ASTM Standards:*

F 458 Practice for Nondestructive Pull Testing of Wire Bonds ³

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 For the purposes of these test methods the following failure points are defined:

3.1.2 *bond-wire junction failure*—a rupture in the wire within two wire diameters of the bond and in which more than 25 % of the bonded area is left on the pad after the pull test has been applied.

3.1.3 *weld interface failure*—a rupture in which less than 25 % of the bonded area is left on the pad after the pull test has been applied.

3.1.4 *wire span failure*—a rupture in the wire other than (1) at a point within two wire diameters of either bond, or (2) at the point at which the hook contacted the wire.

4. Summary of Test Methods

4.1 The microelectronic device with the wire bond to be tested is held firmly in an appropriate fixture. A hook is positioned under the wire midway between the two bonds. The hook is then raised until the wire bond breaks. The force applied to the hook in order to cause failure of the wire bond is recorded. The point of failure is observed and recorded. In the referee method, the force in the wire on breaking is calculated.

5. Significance and Use

5.1 Failure of microelectronic devices is often due to failure of an interconnection bond. A common type of interconnection bond is a wire bond. These methods can assist in maintaining control of the process of making wire bonds. They can be used to distinguish between weak, nonadherent wire bonds and acceptably strong wire bonds. The methods are destructive.

5.2 These test methods are appropriate for on-line use for process control, for purchase specifications, and for research in

¹ These test methods are under the jurisdiction of ASTM Committee F-1 on Electronics and are the direct responsibility of Subcommittee F01.07 on Wire Bonding.

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² Harman, G. G., “Microelectronic Ultrasonic Bonding,” *NBS Special Publication* 400-2, pp. 94-95.

³ *Annual Book of ASTM Standards*, Vol 10.04.