



Standard Test Methods for Destructive Shear Testing of Ball Bonds¹

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1. Scope

1.1 These test methods cover tests to determine the shear strength of a series of ball bonds made by either thermosonic or thermal compression techniques using either gold or copper wires.

NOTE 1—Common usage at the present time considers the term “ball bond” to include the enlarged spheroidal or nailhead portion of the wire, (produced by the flameoff/spark [EFO] and first bonding operation in the thermosonic [or thermal compression] process), and the ball bond-bonding pad interfacial-attachment area or weld interface.

1.2 These test methods cover ball bonds made with small diameter (from 18 to 76- μm (0.0007 to 0.003-in.)) gold or copper wire of the type used in integrated circuits and hybrid microelectronic assemblies, system on a chip, and so forth.

1.3 These test methods can be used only when the ball height and diameter are large enough and adjacent interfering structures are far enough away to allow suitable placement and clearance (above the bonding pad and between adjacent bonds) of the shear test ram.

1.4 These test 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 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.6 *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:²

F458 Practice for Nondestructive Pull Testing of Wire Bonds

¹ These test methods are under the jurisdiction of ASTM Committee F01 on Electronics and is the direct responsibility of Subcommittee F01.03 on Metallic Materials, Wire Bonding, and Flip Chip.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

F459 Test Methods for Measuring Pull Strength of Micro-electronic Wire Bonds

2.2 *NIST Documents*:³

NBS Handbook 105-1 Specification and Tolerances for Reference Standards and Field Standards, Weights and Measures

IOLM Class M2-Circular 547-1 Precision Laboratory Standards of Mass and Laboratory Weights

2.3 *Military Standard*:⁴

MIL-STD 883, Method 2010

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *ball lift*—a separation of the ball bond at the bonding pad interface with little or no residual (less than 25 % of the bond deformation area) ball metallization remaining on the bonding pad (that remains essentially intact). In the case of gold ball bonds on aluminum pad metallization, a ball lift is defined as a separation of the ball bond at the bonding pad interface with little or no intermetallic formation either present or remaining (area of intermetallic less than 25 % of the bond deformation area).

3.1.1.1 *Discussion*—Intermetallic refers to the aluminum gold alloy formed at the ball bond pad metallization interfacial area where a gold ball bond is attached to an aluminum pad metallization. If the wire/ball is of copper, then the aluminum intermetallic is normally much thinner and may not be optically observable.

3.1.2 *ball shear (weld interface separation)*—an appreciable intermetallic (in the case of the aluminum-gold system) and ball metallization, or both, (in the case of the gold-to-gold system) remains on the bonding pad (area of remaining metal or intermetallic greater than 25 % of the bond deformation area).

3.1.3 *bonding pad lift (substrate metallization removal)*—a separation between the bonding pad and the underlying substrate. The interface between the ball bond and the residual pad metallization attached to the ball remains intact.

³ Available from the National Technical Information Service, 5285 Port Royal Rd., Springfield, VA 22161.

⁴ Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.