



Designation: F458 – 13

Standard Practice for Nondestructive Pull Testing of Wire Bonds^{1,2}

This standard is issued under the fixed designation F458; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

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

1. Scope

1.1 This practice covers nondestructive testing of individual wire bonds made by either ultrasonic, thermal compression or thermosonic techniques. The test is intended to reveal (by breaking) nonacceptable wire bonds but is designed to avoid damage to acceptable wire bonds.

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 The practice covers wire bonds made with small-diameter (from 0.0007 to 0.003-in. (18 to 76- μ m)) wire such as the type used in integrated circuits and hybrid microcircuits, system in package, and so forth.

1.3 This practice can be used only when the loop height of the wire bond is large enough to allow a suitable hook for pulling to be placed under the wire.

1.4 While the procedure is applicable to wire of any composition and metallurgical state, criteria are given only for gold and aluminum wire.

1.5 A destructive pull test is used on wire bonds of the same type and geometry to provide the basis for the determination of the nondestructive pulling force to be used in this practice. This may only be used if the sample standard deviation, s , of the pulling forces required to destroy at least 25 of the same wire bonds tested by the destructive pull-test method is less than or equal to 0.25 of the sample average, \bar{x} . If $s > 0.25 \bar{x}$, this practice may not be used.

NOTE 2—If $s > 0.25 \bar{x}$, some aspect of the bonding process is out of control. Following corrective action, the destructive pull-test measurements should be repeated to determine if the $s \leq 0.25 \bar{x}$ criterion is met.

1.6 The nondestructive wire-bond pull test is to be performed before any other treatment or screening following

bonding and at the same point in processing as the accompanying destructive test. Preferably, this is done immediately after bonding.

1.7 The procedure does not ensure against wire-bond failure modes induced after the test has been performed.

1.8 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.9 *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*:³

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

2.2 *Military Standard*:⁴

MIL-STD-883 Method 2023

3. Summary of Practice

3.1 The use of nondestructive wire-bond pull tests is predicated on data obtained from destructive pull tests on typical samples selected from a lot. The maximum safe nondestructive pull-force levels are determined as a function of the metallurgical properties of the wire and from the calculated mean (\bar{x}) and standard deviation (s) of the destructive pull-test data determined in accordance with Test Methods F459.

3.2 In some cases, rather than use a calculated nondestructive pull force, a fixed pull force may be agreed upon by test participants. This value may be based upon industry practice, or some other accepted value, such as that in MIL STD 883, Method 2023. All other parts of the present ASTM standard will apply.

¹ This practice is 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 This procedure, with current status and limitations, was published in: Harman, G. G., *Wire Bonding in Microelectronics*, 3rd Edition, McGraw Hill, 2010, Appendix 4B.2.

³ 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.

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