



## Designation: ~~F487–88 (Reapproved 2006)~~ F487 – 13

# Standard Specification for Fine Aluminum–1 % Silicon Wire for Semiconductor Lead- Bonding<sup>1</sup>

This standard is issued under the fixed designation F487; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This specification covers aluminum–1 % silicon alloy wire for internal connections in semiconductor devices and is limited to wire of diameter up to and including ~~0.0020 in. (0.051 mm); 76  $\mu$ m (0.003 in.)~~. For diameters larger than ~~0.0020 in. (0.051 mm); 76  $\mu$ m (0.003 in.)~~, the specifications are to be agreed upon between the purchaser and the supplier.

1.2 The values stated in ~~inch-pound~~ SI units are to be regarded as the standard. The values standard, regardless of whether they appear first or second in a table. Values given in parentheses are for information only.

## 2. Referenced Documents

2.1 *ASTM Standards*:<sup>2</sup>

~~F16 Test Methods for Measuring Diameter or Thickness of Wire and Ribbon for Electronic Devices and Lamps~~

~~F72 Specification for Gold Wire for Semiconductor Lead Bonding~~

~~F205 Test Method for Measuring Diameter of Fine Wire by Weighing~~

~~F219 Test Methods of Testing Fine Round and Flat Wire for Electron Devices and Lamps~~

~~F584 Practice for Visual Inspection of Semiconductor Lead-Bonding Wire~~

2.2 *Military Standard*:<sup>3</sup>

~~MIL-STD-105 Sampling Procedures and Tables for Inspection by Attributes~~

## 3. Ordering Information

3.1 Orders for material under this specification shall include the following information:

3.1.1 Quantity,

3.1.2 Size (see Section 5),

3.1.3 Breaking load and elongation (see Section 4),

3.1.4 Packaging and marking (see Section 11), and

3.1.5 Special requirements, such as for certificate of compliance (see Section 10).

## 4. Physical Requirements

4.1 Elongation and breaking-load ranges for the wire shall be specified by the purchaser. The maximum ranges of these mechanical properties are listed in **Table 1**.

4.2 Mechanical property requirements in ranges smaller than those listed in **Table 1** may be specified upon agreement between the purchaser and the supplier.

NOTE 1—The nature of aluminum–1 % silicon alloy is such that the mechanical properties of both as-drawn and annealed wires overlap considerably. It is also possible to alter the properties of hard wire by varying the manufacturing parameters and procedures. For these reasons, no distinction is made between the two types of wire in this specification.

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee F01 on Electronics and is the direct responsibility of Subcommittee F01.07 on Wire Bonding, Flip Chip, and Tape Automated Bonding.

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<sup>2</sup> 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.

<sup>3</sup> Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

**TABLE 1 Typical Elongation and Breaking Load of Aluminum-1 % Silicon Alloy Wire**

NOTE 1—Select the desired nominal breaking load and elongation for the wire by specifying a range of mechanical properties that includes the desired values.<sup>A</sup>

Nominal Diameter, in. (mm)	Breaking Load, g			Elongation, %		
	Min	Max	Max Range <sup>B</sup>	Min	Max	Max Range <sup>C</sup>
0.0005 (0.013)	4	5	2	0.5	2.0	4.5
0.0007 (0.018)	3	12	2	0.5	3.0	2.0
0.0010 (0.025)	12	22	3	0.5	4.0	2.5
0.0012 (0.030)	14	30	3	0.5	4.0	2.5
0.00125 (0.032)	15	32	3	0.5	4.0	3.0
0.0015 (0.038)	20	50	4	0.5	4.0	3.0
0.0020 (0.051)	32	90	6	1.0	4.0	3.0

<sup>A</sup>Example: Wire of 0.0010 in. (0.025 mm) 25- $\mu$ m (0.001-in.) diameter with a breaking load of 16 g and an elongation of 2.0 % is desired. Specify a breaking-load range of 14 to 18 g (16  $\pm$  2 g) and an elongation range of 1.0 to 3.5 % (2.0 + 1.5 %, 2.0 – 1.0 %). (Note—Smaller ranges are acceptable; for this example, ranges of 15 to 17 g and 1.0 to 3.0 % could be specified. For diameters larger than 0.0020 in. (0.051 mm), the specifications are to be agreed upon between the purchaser and the supplier.)

<sup>B</sup>A range of permissible breaking strength of no more than the number of grams shown shall be selected from within the overall range designated by the minimum and maximum values for the given diameter.

<sup>C</sup>A range of permissible elongation of no more than the number of percentage points shown shall be selected from within the overall range designated by the minimum and maximum values for the given diameter.

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## 5. Dimensions, Weights, and Permissible Variations

5.1 Wire size shall be expressed in terms of wire diameter in decimal fractions of an inch (or millimetre) or in weight per unit length—millimetres (inches). Tolerances for various size ranges are specified in Table 2.

5.2 When wire size is expressed in terms of weight, the following values shall be used:

5.2.1 Density of Aluminum-1 % Silicon—2.7 g/cm<sup>3</sup>.

5.2.2 Weight of a 200-mm Length of Wire 0.0254 mm 25.4  $\mu$ m in Diameter—0.274 mg.

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## 6. Surface Finish

6.1 The wire surface shall be clean and free of finger oils, lubricant residues, stains, and particulate matter.

6.2 Mechanical damage to the wire surface, such as nicks, scratches, and kinks, shall be held to a minimum.

6.3 The inspection shall be carried out under conditions prescribed in Practice by electronic, optical, or F584 unless some other inspection method is agreed upon between the purchaser and the supplier. The nature and extent of defects permitted to be present on the surface of the wire shall be agreed upon between the purchaser and the supplier.

## 7. Chemical Requirements

7.1 The alloy composition shall be 1.00  $\pm$  0.15 % silicon, and between 98.84 and 99.15 % aluminum. All other elements are considered impurities.

7.2 No single impurity shall exceed 0.0050 % and the total of all detectable impurities shall not exceed 0.01 %.

7.3 Any lower or higher impurity content shall be as agreed upon between the purchaser and the supplier as part of the purchase contract.

7.4 Larger aluminum wire diameters often include nickel or other impurities or both to minimize corrosion in plastic packages. Such wire is not covered by this specification.

**TABLE 2 Dimensional Tolerances**

Nominal Diameter, in. (mm)	Diameter Tolerance, % of nominal	Weight Tolerance, % of nominal
0.0005 to 0.0020 (0.013 to 0.051), incl	$\pm$ 3	$\pm$ 6