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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Specification for Fine Aluminum—1 % Magnesium Wire for Semiconductor Lead-Bonding¹

This standard is issued under the fixed designation F 638; 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.

^{ε1} NOTE—Keywords were added editorially in June 1995.

1. Scope

1.1 This specification covers aluminum-1% magnesium alloy wire for internal connections in semiconductor devices and is limited to wires of diameter up to and including 0.002 in. (0.051 mm). For diameters larger than 0.0020 in. (0.051 mm), the specifications are to be agreed upon between the purchaser and the supplier.

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

2. Referenced Documents

2.1 ASTM Standards:

F 16 Test Methods for Measuring Diameter or Thickness of Wire and Ribbon for Electronic Devices and Lamps²

F 72 Specification for Gold Wire for Semiconductor Lead Bonding²

F 205 Test Method for Measuring Diameter of Fine Wire by Weighing²

F 219 Test Methods of Testing Fine Round and Flat Wire for Electron Devices and Lamps

F 584 Practice for Visual Inspection of Semiconductor Lead Bonding Wire²

2.2 Military Standard:

MIL-STD-105 Sampling Procedures and Tables for Inspection by Attributes³

3. Ordering Information

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

3.1.1 Quantity,

3.1.2 Composition (see Section 7),

3.1.3 Size (diameter) (see Section 5),

3.1.4 Breaking load and elongation (see Section 4),

3.1.5 Spooling, packaging, and marking (see Section 11),

3.1.6 Buyer part number, and

3.1.7 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 the 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 % magnesium alloy is such that the mechanical properties of both as-drawn and annealed wires overlap considerably. It is also possible to vary the properties of the hard wire by changing manufacturing parameters and procedures. For these reasons, no distinction is made in this specification between the two types.

5. Dimensions, Weights, and Permissible Variations

5.1 Wire size shall be expressed as wire diameter in decimal fractions of an inch (or millimetres) or as weight per unit length.

5.2 Tolerances for various size ranges are specified in Table 2.

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

5.3.1 *Density of Aluminum-1 % Magnesium—2.7 g/cm³*

5.3.2 *Weight of a 200-mm Length of Wire 0.0254 mm in Diameter—0.274 mg.*

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 nature and the extent of defects permitted to be present on the surface of the wire shall be agreed between the supplier and the purchaser.

7. Chemical Requirements

7.1 The alloy composition shall be 1.00 ± 0.15 % magnesium and between 98.84 and 99.15 % aluminum. All other elements are considered impurities.

¹ This specification is under the jurisdiction of ASTM Committee F-1 on Electronics and is the direct responsibility of Subcommittee F 01.07 on Interconnection Bonding Carrier Bonding.

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² *Annual Book of ASTM Standards*, Vol 10.04.

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

TABLE 1 Elongation and Breaking Load, Aluminum-1 % Magnesium Alloy

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.^A

Nominal Diameter, in. (mm)	Breaking Load, g			Elongation, %		
	min	max	Maximum Range ^B	min	max	Maximum Range ^C
0.0005 (0.013)	1	5	2	0.5	2.0	1.5
0.0007 (0.018)	4	12	2	0.5	2.5	2.0
0.0010 (0.025)	12	24	3	0.5	4.0	2.5
0.0012 (0.030)	14	30	3	0.5	4.0	2.5
0.00125 (0.0318)	18	36	3	0.5	4.0	3.0
0.0015 (0.038)	25	60	4	0.5	5.0	3.0
0.0020 (0.051)	45	100	6	1.0	5.0	3.0

^AExample: Wire of 0.0010-in. (0.025-mm) diameter with a nominal breaking load of 16 g and a nominal elongation of 2.0 % is desired. Specify a breaking-load range of 14 to 18 g (16 ± 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 0.002 in. (0.051 mm), the specifications are to be agreed upon between the purchaser and the supplier.)

^BA 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.

^CA 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.

TABLE 2 Dimensional Tolerances

Nominal Diameter, in. (mm)	Diameter Tolerance, % of Nominal Diameter	Weight Tolerance, % of Nominal Weight
0.0005 to 0.0020 (0.013 to 0.051)	±3	±6

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.

8. Sampling

8.1 Unless otherwise agreed upon between the purchaser and the supplier, conformance with Section 4 shall be determined by MIL-STD-105.

9. Test Methods

9.1 *Elongation and Breaking Load*—Test Methods F 219.

9.2 *Dimensional Measurement*—Determine the wire diameter by one of the following methods:

9.2.1 Measure the diameter indirectly by weighing in accordance with Test Method F 205.

9.2.2 Measure the diameter by the direct-contact method (for example, compressing wire between preloaded anvils whose separation is indicated on a micrometer scale) agreed upon between the purchaser and the supplier.

NOTE 2—The procedures of Test Methods F 16 may be applicable in some instances. Use of Test Methods F 16 for measuring bonding wire diameter is under study by Committee F-1.

9.3 *Chemical Analysis*—Verify that the chemical requirements are satisfied by means of spectrographic analysis or other means agreed upon between the purchaser and the supplier.

9.4 *Surface Finish*—Examine surface finish in accordance with Practice F 584.

10. Certification

10.1 When agreed upon in writing by the purchaser and the supplier, a certification shall be made the basis of acceptance of the material. This shall consist of a statement by the supplier, accompanied by a copy of the test results, that the material has been sampled, tested, and inspected in accordance with the provisions of this specification. Each certification so furnished shall be signed by an authorized agent of the supplier or manufacturer.

11. Packaging (Spooling) and Package Marking

11.1 The type of spool shall be specified as agreed upon between the purchaser and the supplier. (For aging properties see shelf life aging test, in Appendix X1.)

NOTE 3—Types of spools recommended for fine lead-bonding wire are described in Specification F 72.

11.2 The maximum and minimum length of wire on a spool shall be as specified by the purchaser.

11.3 Wire shall be wound so that it despools freely and will be free of kinks and nicks. Spools shall be free of nicks, burrs, and dents. Beginning and end of the wind shall be clearly identified. The method of termination shall be as agreed upon between the purchaser and the supplier.

11.4 Wire shall be protected against damage in normal handling and shipping, and the outer container shall bear markings indicating “fragile” contents and designating the proper end to be “up” in order to maintain spool axes horizontal during shipping. The outer container shall also be marked “Extremes of Temperature Must Be Avoided.”

NOTE 4—Special package marking should be as specified by the purchaser if required.

11.5 The basic packing unit shall be legibly marked with the following information:

- 11.5.1 Material description,
- 11.5.2 Diameter, inches (or millimetres),
- 11.5.3 Length, feet (or metres),
- 11.5.4 Elongation and breaking-load specifications,
- 11.5.5 Melt or bar number,
- 11.5.6 Date of packaging,
- 11.5.7 User’s part number, and
- 11.5.8 Manufacturer’s name and product designation if any.

12. Keywords

12.1 magnesium aluminum wire; wire bonding

APPENDIX

(Nonmandatory Information)

X1. SHELF LIFE AGING TEST 1983-1985

X1.1 Purpose

X1.1.1 To determine the effect of room temperature aging on the stress-strain characteristics of bonding wires of several compositions and tempers.

X1.2 Test parameters

X1.2.1 *Environment*—Typical stock room, 73°F, ± 3°.

X1.2.2 *Spooling*—2-in. diameter, aluminum, 100 ft/spool.

X1.2.3 *Instrument*—Instron type, 1 in./min., 10 in. length.

X1.2.4 *Sampling*—Average of five readings per notation.

X1.2.5 *Time*—Intervals shown on charts, see Fig. X1.1.

X1.2.6 *Wire Size*—All specimens, 0.001 in. diameter.

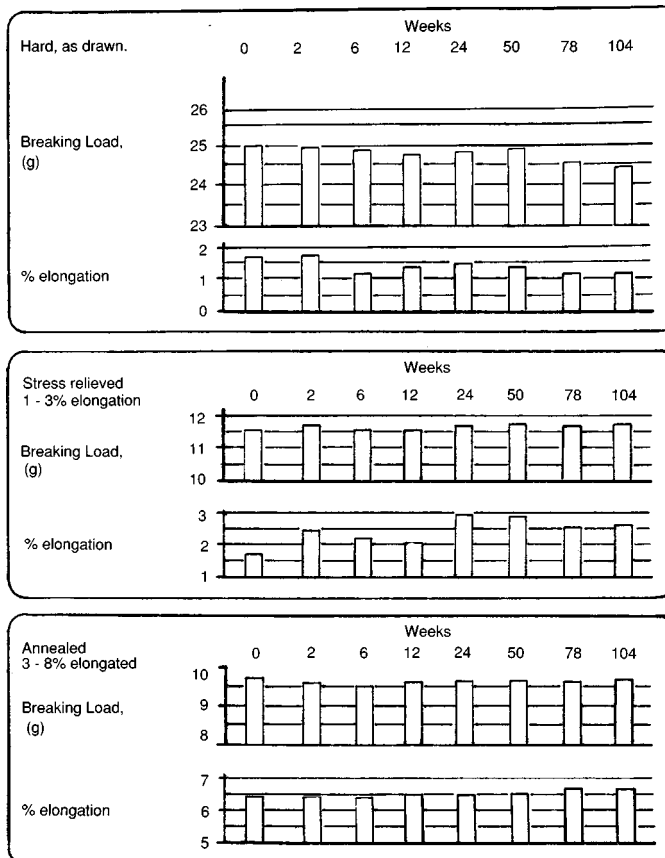


FIG. X1.1 Chart 4 1 % Magnesium Aluminum Alloy

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