Designation: ~~B941 – 16~~ B941 – 22

Standard Specification for Heat Resistant Aluminum-Zirconium Alloy Wire for Electrical Purposes[1]

This standard is issued under the fixed designation B941; 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.

1. Scope

1.1 This specification covers heat resistant aluminum-zirconium alloy round wire for electrical purposes. There is a family of aluminum-zirconium alloys that are used for heat-resistance (that is, resist annealing), which differ by zirconium content, tensile strength, electrical conductivity, and maximum use temperature. This standard covers one currently commercially applicable alloy from this family.

1.2 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.

1.3 *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~~ safety, health, and ~~health~~environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 The following documents of the issue in effect on the date of material purchase form a part of this specification to the extent referenced herein.

2.2 *ASTM Standards:*[2]

B193 Test Method for Resistivity of Electrical Conductor Materials
B557 Test Methods for Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products
B830 Specification for Uniform Test Methods and Frequency

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *lot*—a group of production units, up to 30 000 ~~lb [15 000 kg]~~ lb (15 000 kg) of mass, of one type and size of wire, which was produced during the same time period, under similar production conditions, and. is presented for acceptance at the same time (Explanatory Notes 1 and 2).

[1] This specification is under the jurisdiction of ASTM Committee B01 on Electrical Conductors and is the direct responsibility of Subcommittee B01.07 on Conductors of Light Metals.

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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.

3.1.2 *production unit*—a coil, reel, spool, or other package of wire that represents a single usable length.

3.1.3 *sample*—the production unit(s) from which a test specimen(s) has been removed, and which is considered to have properties representative of the lot.

3.1.4 *specimen*—a length of wire removed for test purposes.

4. Ordering Information

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

4.1.1 Quantity of each size,

4.1.2 Wire size (see 11.1 and 11.2),

4.1.3 Special tension test, if required (see 6.1, 6.2 and 7.1),

4.1.4 Frequency of bending test (see 8.1 and 14.7),

4.1.5 Special jointing procedures, if permitted (see 12.1),

4.1.6 Place of inspection (see 16.2),

4.1.7 Package size and type (see 17.1),

4.1.8 Special package marking, if required (see 17.4).

5. Materials and Manufacture

5.1 The aluminum wire shall be made from drawing stock. The rod shall have properties such that once drawn into wire, the wire properties set forth in Table 1 are met.

5.2 The wire shall be aluminum-zirconium alloy of such quality and purity that the finished product shall have the properties and characteristics prescribed in this specification, including tensile, elongation, heat resistance properties, bending properties, and electrical resistivity. Chemical analysis of a specific alloy is not a requirement of this specification unless definite agreement is reached between the manufacturer and the purchaser on individual orders.

6. Tensile Properties

6.1 *Tensile Strength and Elongation*—The wire shall conform to the tensile strength and elongation requirements set forth in Table 1 (Explanatory Note 3).

6.2 When requested by the purchaser, tension tests shall be made of specimens of wire containing joints made in the drawing stock or in the wire prior to final drawing. Such tests shall indicate tensile strengths not less than 90 % of the values for individual tests shown in Section 6.1.

TABLE 1 Tensile Strength and Elongation Requirements

Diameter		Tensile Strength		Heat Resistance	Elongation in 10 in. (250 mm)
in.	(mm)	min ksi	min (MPa)	(%)	min (%)
0.050-0.128	(1.25-3.25)	24.0	(165)	90 % of Minimum	2 %
0.128-0.154	(3.25-3.91)	23.5	(162)	90 %	2 %
0.154-0.185	(3.91-4.70)	23.0	(159)	90 %	2 %
> 0.185	(> 4.70)	22.5	(155)	90 %	2 %

7. Heat Resistance

7.1 Heat resistance tests (see section 14.4) shall indicate strengths not less than 90 % of the values for individual tests shown in Table 1. For the smallest size group, heat resistance values shall not be less than 90 % of the minimum strength specification. (Explanatory Note 5).

8. Wrap Test

8.1 The wire shall be free of brittleness as evidenced by its ability to be coiled or looped at least six times around its own diameter in a close helix, with or without a mandrel (see section 14.7). No fracture shall occur. Slight surface checks shall not constitute cause for rejection.

9. Resistivity

9.1 Electrical resistivity, determined on samples of drawn wire selected and tested in accordance with Test Method B193, shall not exceed 17.28 Ω.cmil/ft (0.02873 Ω.mm^2/m) at ~~20°C (68°F)~~68 °F (20 °C) (Explanatory Note 4).

9.2 Equivalent conductivity; the wire shall meet or exceed 60.0 % IACS at ~~20°C (68°F).~~68 °F (20 °C).

9.3 When resistance measurements are made at temperatures other than ~~20°C (68°F),~~68 °F (20 °C), corrections shall be based on a temperature coefficient of resistance of ~~0.0040/°C (0.0022/°F)~~0.0022/°F (0.0040/°C) (see Table 2).

10. Density

10.1 For the purpose of calculating mass, cross-section, and so forth, the density of aluminum-zirconium alloy shall be taken as ~~2700~~ 0.0980 lb/in.^{3} (2710 kg/m^3 ~~[0.0970 lb/in.)]~~^{3} at ~~20°C [68°F].~~68 °F (20 °C).

10.2 When greater accuracy is desired, the actual density of the aluminum-zirconium alloy may be used. When requested by the purchaser, test reports shall be provided to support the use of a density value different than that specified in 10.1.

11. Diameter

11.1 The diameter of the wire shall be specified in inches to the nearest 0.0001 in. or the diameter of the wire shall be specified in millimeters to the nearest 0.001 mm for wires less than 1.000 mm in diameter, and to the nearest 0.01 mm for wires 1.00 mm in diameter and larger.

11.2 The actual wire diameter shall not vary from the specified diameter by more than the values shown in Table 3.

12. Joints

12.1 Unless otherwise specified at the time of placing the order, wire shall be supplied in one continuous length of reel, coil, or spool. Joints may be made in the drawing stock or wire prior to final drawing by electric-butt welding, cold-pressure welding, or by electric-butt, cold-upset welding.

12.2 If agreed upon between the manufacturer and the purchaser, joints may be made during the final drawing or in the finished wire by electric-butt welding, cold-pressure welding, or electric-butt, cold-upset welding, subject to the following limitations.

12.2.1 For wire sizes from 0.0100 to 0.0555 in. ~~[0.225~~(0.225 to 1.25 ~~mm]~~mm) in diameter not more than three such joints shall be present in any coil, reel, or spool of the specified nominal mass.

12.2.2 For wire sizes greater than 0.0500 in. ~~[1.25 mm]~~(1.25 mm) diameter, not more than 10 % of the coils, reels, or spools shall contain such joints, and no such joint shall be closer than 50 ft ~~[15 m]~~(15 m) to another joint or to either end of the wire. Not more than two such joints shall be present in any coil, reel or spool of the specified nominal mass.

13. Sampling

13.1 *Sampling*—~~For each use of a coil of redraw rod, four~~ Four test specimens shall be ~~obtained from the resulting drawn wire~~

TABLE 2 Temperature Correction Factors for Electrical Resistance

Resistance Temperature (°C)	Multiplying Factor for the conversion to ~~20°C~~20 °C
0	1.080
5	1.060
10	1.040
15	1.020
20	1.000
25	0.980
30	0.960
35	0.940
40	0.920
45	0.900
50	0.880
55	0.860
60	0.840
65	0.820
70	0.800
75	0.780
80	0.760
85	0.740
90	0.720
95	0.700
100	0.680
105	0.660
110	0.640
115	0.620
120	0.600
125	0.580
130	0.560
135	0.540
140	0.520
145	0.500
150	0.480
155	0.460
160	0.440
165	0.420
170	0.400
175	0.380
180	0.360
185	0.340
190	0.320
195	0.300
200	0.280
205	0.260
210	0.240
215	0.220
220	0.200
225	0.180
230	0.160
235	0.140
240	0.120

TABLE 3 Diameter Tolerances

Nominal Diameter	Permissible Variations in Diameter
0.0105 to 0.0359 in. (up to 0.99 mm)	±0.0005 in. (±0.010 mm)
0.0360 to 0.0999 in. (1.00 to 2.99 mm)	±0.0010 in. (±0.030 mm)
0.1000 to 0.2600 in. (3.00 mm and over)	±1 % in. (±1 % mm)

obtained, one from each of four production units or in accordance with Specification B830 (see Explanatory Note 2), and tested to determine compliance with ~~sections~~Sections 6 – 9, and 11.

14. Test Methods

14.1 *Diameter*—Dimensional measurements shall be made with equipment capable of measuring to a graduation of ~~0.0001 in. or 0.001 mm.~~ 0.0001 in. or 0.001 mm. Take two measurements at one location, the second rotated 90° from the first. Average the two measurements to obtain the specimen diameter.