Designation: B 800 – 00

Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes—Annealed and Intermediate Tempers[1]

This standard is issued under the fixed designation B 800; 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 8000 series aluminum alloys fabricated into round wires in annealed or intermediate tempers suitable for stranding into conductors or for solid single conductors, usually to be insulated.

1.2 The values stated in inch-pound or SI units are to be regarded separately as the standard. The values in each system are not exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

1.2.1 For density, resistivity and temperature, the values stated in SI units are to be regarded as the standard.

NOTE 1—Aluminum alloys capable of meeting the requirements of this specification are listed in Table 1.

NOTE 2—The alloy and temper designations conform to ANSI H35.1. Unified Numbering System alloy designations are listed in Table 1 in accordance with Practice E 527.

NOTE 3—Certain aluminum alloys may be subject to patent rights. U.S. patents numbers are shown in Table 1.

TABLE 1 Aluminum Alloys

Alloy Designation		U.S. Patent Number
ANSI-H35.1	*UNS*	
8017	A98017	...
8030	A98030	3711339
8076	A98076	3697260
8130	A98130	...
8176	A98176	RE 28419
		RE 30465
8177	A98177	...

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:*

B 193 Test Method for Resistivity of Electrical Conductor Materials[2]

B 557 Test Methods of Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products[3]

B 830 Specification for Uniform Test Methods and Frequency[2]

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications[4]

E 527 Practice for Numbering Metals and Alloys (UNS)[5]

2.3 *ANSI Standard:*

ANSI H35.1, American National for Alloy and Temper Designation Systems for Aluminum[6]

2.4 *NIST Document:*

NBS *Handbook 100—Copper Wire Tables of the National Bureau of Standards*[7]

NBS *Handbook 109—Aluminum Wire Tables of the National Bureau of Standards*[7]

2.5 *Aluminum Association Document:*

Registration Record of Aluminum Association Designations and Chemical Composition Limits for Wrought Aluminum and Wrought Aluminum Alloys. (The foreward in the document describes the procedure for registering chemical compositions of alloys with the Aluminum Association)[8]

3. Ordering Information

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

3.1.1 Quantity of each size,

3.1.2 Wire size, diameter in inches (See 9.1),

3.1.3 Alloy Designation (See Table 1),

3.1.4 Temper (See 4.2),

3.1.5 Special tension test, if required (See 6.2),

3.1.6 Special jointing procedures, if permitted (See 10.2),

3.1.7 Place of inspection (See 13.2),

3.1.8 Package size and type (See 14.1), and

3.1.9 Special package marking, if required (See 15.1).

4. Materials and Manufacture

4.1 The wire shall be made from drawing stock meeting the

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[2] *Annual Book of ASTM Standards*, Vol 02.03.

[3] *Annual Book of ASTM Standards*, Vol 02.02.

[4] *Annual Book of ASTM Standards*, Vol 14.02.

[5] *Annual Book of ASTM Standards*, Vol 01.01.

[6] Available from the American National Standards Institute, 11 West 42nd St., 13th Floor, New York, NY 10036.

[7] National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

[8] Registration Record available from the Aluminum Association, Inc., 900 19th St., N.W., Washington, DC 20006.

chemical composition limits for alloys shown in Table 2 that are presently registered with Registration Record or for such other alloys which may become available and will meet the requirements of this specification.

4.1.1 This specification applies to alloys that are recognized by Underwriters Laboratories, as "aluminum conductor material."

4.2 Unless otherwise specified, the manufacturer shall have the option of producing the intermediate temper by either strain-hardening only (H1X) or by strain-hardening and partial annealing (H2X) before or after stranding. (Explanatory Note 1 and ANSI H35.1.)

5. Workmanship, Finish, and Appearance

5.1 The wire shall be free of imperfections not consistent with good commercial practice.

6. Tensile Properties

6.1 *Tensile Strength and Elongation*—The wire shall conform to tensile strength and elongation requirements prescribed in Table 3. (Explanatory Note 2.)

6.2 When requested by the purchaser, tension tests of joints so permitted in 10.2 shall be made and the joints shall comply with the minimum tensile requirements shown in Table 3. Sampling shall be as agreed upon between the purchaser and the manufacturer.

7. Resistivity

7.1 The electrical resistivity shall not exceed the values shown in Table 4. (Explanatory Note 3.)

8. Density

8.1 For the purpose of calculating linear density, cross sections, etc., the density of aluminum alloys listed in Table 1 shall be taken as 0.098 lb/in.^{3}(2710 kg/m^3) at 20°C.

NOTE 4—The metric density for Alloy 8177 is 2700 kg/m^3 even though the customary value is 0.098 lb/in.^{3}.

9. Diameter

9.1 The diameter of the wire shall be expressed in decimal fractions of an inch to the nearest 0.1 mil (0.0001 in.) (0.003 mm). The wire shall not vary from the specified diameter by more than the amounts shown in Table 5.

9.2 Standard nominal diameters of wire used for solid conductors are shown in Table 6. Diameters of wires used for stranded conductor shall be as agreed upon between the purchaser and the manufacturer.

10. Joints

10.1 Joints may be made in drawing stock and in the wire prior to final drawing in accordance with good commercial practice.

10.2 If agreed upon between the manufacturer and the purchaser, joints may be made during final drawing or in the finished wire by electrical-butt welding, by cold-pressure welding, or by electric-butt, cold-upset welding with the following provisions:

10.2.1 For sizes 0.0500 to 0.0105 in. (1.270 to 0.267 mm) in diameter, not more than three such joints shall be present in any reel, spool, or coil of the specified nominal mass.

10.2.2 For sizes larger than 0.0500 in. (1.270 mm) in diameter not more than 10 % of the reels, spools, or coils shall contain such joints and no such joints shall be closer than 50 ft. (15 m) to another or to either end of the wire and not more than two such joints shall be present in any reel, spool, or coil of the specified nominal mass.

11. Sampling

11.1 Determine the conformance of the material to the requirements of Sections 6, 7, 9, 10, and 5, by statistical sampling and inspection of each lot of wire presented for inspection in accordance with Specification B 830.(Explanatory Note 4.)

11.2 *Conformance Criteria*:

11.2.1 Failure of a specimen to conform to the applicable requirements of Sections 6, 7, 9, 10, and 5 shall constitute failure of the production unit from which the specimen was taken.

11.2.2 Any lot of wire that has been sampled in accordance with 11.1 and from which the number of specimens failing to comply with the requirements of Sections 6, 7, 9, 10, and 5 does not equal or exceed the appropriate reject number of the

TABLE 2 Chemical Composition Requirements

NOTE 1—When single units are shown, these indicate the maximum amounts permitted.

NOTE 2—Analysis shall regularly be made only for the elements specifically mentioned in this table. If however, the presence of other elements is suspected or indicated in the course of routine analysis, further analysis shall be made to determine that the total of these other elements is not present in excess of the limits specified in the last column of the table.

NOTE 3—The following applies to all specified limits in this table. For purposes of acceptance and rejection, an observed value or a calculated value obtained from analysis should be rounded off to the nearest unit in the last right-hand place of figures used in expressing the specified limit (Practice E 29).

Alloys		Composition,% by Mass							Others	
ANSI	UNS	Aluminum	Silicon	Iron	Copper	Magnesium	Zinc	Boron	Each	Other
8017	A98017	Remainder	0.10	0.55 to 0.8	0.10 to 0.20	0.01–0.05	0.05	0.04	0.03[A]	0.10
8030	A98030	Remainder	0.10	0.30 to 0.8	0.15 to 0.30	0.05	0.05	0.001 to 0.04	0.03	0.10
8076	A98076	Remainder	0.10	0.6 to 0.9	0.04	0.08–0.22	0.05	0.04	0.03	0.10
8130	A98130	Remainder	0.15[B]	0.40 to 1.0[B]	0.05 to 0.15	...	0.10	...	0.03	0.10
8176	A98176	Remainder	0.03–0.15	0.40 to 1.0	...	...	0.10	...	0.05[C]	0.15
8177	A98177	Remainder	0.10	0.25 to 0.45	0.04	0.04 to 0.12	0.05	0.04	0.03	0.10

[A] 0.003 max lithium.
[B] 1.0 max silicon and iron.
[C] 0.03 max gallium.

TABLE 3 Tensile Property Limits

NOTE 1—For purposes of determining conformance with this specification, each calculated value of tensile strength shall be rounded to the nearest 0.1 ksi, (1 MPa) and each value for elongation to the nearest 0.5 % in accordance with the rounding method of Practice E 29.

NOTE 2—The elongation shall be not less than 10 % in 10 in. (250 mm).

Temper	Tensile Strength of Wire		Tensile Strength of Joints, min	
	ksi	MPa	ksi	MPa
−0	8.5 to 16.0	59 to 111	8.5	59
−H1X or −H2X	15.0 to 22.0	103 to 152	11.0	76

TABLE 4 Electrical Resistivity Requirements at 20°C

Electrical Resistivity, max,Ω mm^2/m		Volume Conductivity, min % IACS	
Average for A Lot	Individual Tests	Average for A Lot	Individual Tests
0.028264	0.028450	61.0	60.6

sampling table used in accordance with Specification B 830, shall be considered as complying with the requirements of Sections 6, 7, 9, 10, and 5.

11.2.3 Rejected lots may be screened to remove nonconforming production units by testing one specimen from each production unit in the lot for the failing characteristic.

11.3 *Sample Size*—The sample size shall be the number of production units selected.

12. Test Methods

12.1 *Tensile Strength*—Obtain the tensile strength in accordance with Test Methods B 557. (Explanatory Note 2.)

12.1.1 If any part of the fracture takes place in the jaws of the tension testing machine, or if an examination of the specimen indicates that there was external damage, the value obtained may not be representative of the material. In such cases discard the test and make a new test.

12.2 *Resistivity*—Determine the electrical resistivity of the material in accordance with Test Method B 193. (Explanatory Note 3.)

12.3 *Diameter Measurements*—Measure the diameter with a micrometer caliper graduated in 0.0001 in. (0.003 mm). Make measurements on each specimen selected for this test. Measure the diameter of the wire at two points, spaced approximately 90° apart, around the circumference of the specimen. Take the average of the two readings as the mean diameter of the specimen.

12.4 *Finish*—Make a surface-finish inspection with the unaided eye (normal corrective lenses excepted).

13. Inspection

13.1 Unless otherwise specified in the contract or purchase order, the manufacturer shall be responsible for the performance of all inspection and test requirements specified.

13.2 All inspections and tests shall be made at the place of manufacture unless otherwise especially agreed to between the manufacturer and the purchaser at the time of the purchase.

13.3 The manufacturer shall afford the inspector representing the purchaser all reasonable manufacturer's facilities to satisfy him that the material is being furnished in accordance with this specification.

13.4 *Description of Inspection Terms*:

13.4.1 *Lot*—An inspection lot shall consist of an idendifiable quantity of wire subjected to inspection at one time. Each lot shall consist of units of wire of the same size and temper, manufactured under essentially the same conditions at essentially the same time. The amount in any case is not to exceed 30 000 lbs. (14 000 kg). (See Explanatory Note 5.)

13.4.2 *Sample*—A sample is a quantity of production units (reels, coils, spools) selected at random from the lot for the purpose of determining that the lot meets the requirements of this specification.

13.4.3 *Specimen*—A specimen is a length of wire removed for test purposes from any individual production unit of the sample.

14. Packaging and Package Marking

14.1 Package sizes and types shall be agreed upon between the manufacturer and the purchaser in the placing of individual orders.

14.2 Unless otherwise specified, the wire shall be supplied in one continuous length on each reel, coil, or spool.

14.3 The wire shall be protected against damage in ordinary handling and shipping.

14.4 Each package shall bear a tag showing the manufacturer's name or trademark, alloy, temper, size, and mass of material. If additional information is to be required on the tags, it shall be arranged with the manufacturer at the time of placing the order.

15. Keywords

15.1 aluminum alloy conductors; aluminum conductors; electrical conductors; solid aluminum conductors; 8000-series aluminum alloy conductors

TABLE 5 Permissible Variations in Diameter

Specified Diameter, in. (mm)	Permissible Variation of Mean Diameter from Specified Diameter, ±
0.0100 to under 0.0360 (0.254 to under 0.914)	0.0005 in. (0.013 mm)
0.0360 to under 0.1000 (0.914 to under 2.540)	0.0010 in. (0.025 mm)
0.1000 to 0.7071 incl (2.540 to 17.960 incl)	1 %

TABLE 6 Standard Nominal Diameters,[A] Cross-Sectional Areas, and Linear Densities of Round Aluminum Alloy Wire for Solid Conductors at 20°C

Size AWG	Diameter		Cross-Sectional Area			Linear Density	
	mils	mm	cmil	$in.^2$	mm^2	lb./ 1000 ft	kg/km
0000	460.0	11.684	211 600	0.1662	107.0	195.4	290.9
000	409.6	10.404	167 800	0.1318	85.0	155.0	230.6
00	364.8	9.266	133 100	0.1045	67.4	122.9	182.9
0	324.9	8.252	105 600	0.08291	53.5	97.50	145.1
1	289.3	7.348	83 690	0.06573	42.4	77.30	115.0
2	257.6	6.543	66 360	0.05213	33.6	61.29	91.21
3	229.4	5.827	52 620	0.04133	26.7	48.61	72.33
4	204.3	5.189	41 740	0.03278	21.2	38.55	57.37
5	181.9	4.620	33 090	0.02599	16.8	30.56	45.48
6	162.0	4.115	26 240	0.02061	13.3	24.24	36.07
7	144.3	3.665	20 820	0.01635	10.5	19.23	28.62
8	128.5	3.264	16 510	0.01297	8.37	15.25	22.69
9	114.4	2.906	13 090	0.01028	6.63	12.09	17.99
10	101.9	2.588	10 380	0.008155	5.26	9.501	14.27
11	90.7	2.304	8 230	0.00646	4.17	7.598	11.31
12	80.8	2.052	6 530	0.00513	3.31	6.030	8.974
13	72.0	1.829	5 180	0.00407	2.63	4.788	7.126
14	64.1	1.628	4 110	0.00323	2.08	3.795	5.648

[A] See NBS Handbook 109.

EXPLANATORY NOTES

NOTE 1—The H1X tempers (strain-hardened only) and the H2X tempers (strain-hardened followed by partial annealing) are considered equally suitable for most electrical purposes.

NOTE 2—In tension tests, the values obtained may be affected by testing speed. It is recommended that for conformance criteria the testing speed should not exceed 0.5 mm/mm of gage length or distance between grips per minute.

NOTE 3—Relationships thad may be useful in connection with the values of electrical resistivity prescribed in this specification are shown in Table X1.1. Resistivity units are based on the International Annealed Copper Standard (IACS) adopted by IEC in 1983, which is 1/58 Ω mm^2/m at 20°C for 100 % conductivity. The value of 0.017241 Ω mm^2/m at 20°C is the international equivalent of volume resistivity of annealed copper for 100 % conductivity. A complete discussion of this subject is contained in *NBS Handbook 100*. The use of five significant figures in expressing resistivity does not imply the need for greater accuracy of measurement than that specified in Test Method B 193. The use of five significant figures is required for reasonably accurate reversible conversion from one set of resistivity units to another. The equivalent resistivity values in the tables were derived from the fundamental IEC value (1/58 Ω mm^2/m) computed to seven significant figures and then rounded to five significant figures.

NOTE 4—Cumulative results secured on the product of a single manufacturer, indicating continued adherence to the sampling requirements, are necessary to ensure an overall product meeting the requirements of this specification. The sample sizes and requirements used in accordance with Specification B 830 for the various characteristics are applicable only to lots produced under these conditions.

NOTE 5—A lot should comprise material taken from a product regularly meeting the requirements of this specification. Inspection of individual lots of less than 5000 lb (2300 kg) of wire cannot be justified economically. For small lots of 5000 lb or less the purchaser may agree to the manufacturer's regular inspection of the product as a whole as evidence of acceptability of such small lots.

APPENDIX

(Nonmandatory Information)

X1. EQUIVALENT RESISTIVITY VALUES AT 20°C (See Explanatory Note 3 and Table X1.1)

TABLE X1.1 Equivalent Resistivity Values at 20°C[A]

Material	Volume Conductivity, % IACS	Resistivity Constants			
		Volume			
		Ω cmil/ft	Ω mm^2/m	μ Ω in.	μ Ω cm
Copper	100	10.371	0.017241	0.67879	1.7241
Aluminum	61.0	17.002	0.028264	1.1128	2.8264

[A] The equivalent resistivity values for 100 % IACS (soft copper) were each computed from the fundamental IEC value 1/58 ohms mm^2/m using conversion factors each accurate to at least seven significant figures. Corresponding values for other conductivities (aluminum) were derived from these by multiplying by the reciprocal of the conductivity ratios and when applicable also by the density ratios, both accurate to at least seven significant figures.