Designation: B 400 – 01

Standard Specification for Compact Round Concentric-Lay-Stranded Aluminum 1350 Conductors[1]

This standard is issued under the fixed designation B 400; 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 aluminum 1350-H19 (extra hard), 1350-H16 or -H26 ([n]hard), 1350-H14 or -H24 (½ hard) and 1350-H142 or -H242 (½ hard) bare compact-round concentric-lay-stranded conductors made from round or shaped wires for use as uninsulated electrical conductors or in covered or insulated electrical conductors. These conductors shall be composed of a central core surrounded by one or more roller or die compacted layers of helically applied wires (Explanatory Note 1 and Note 2).

1.2 The values stated in inch-pound or SI units are to be regarded separately as standard. Each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the specification. For conductor sizes designated by AWG or kcmil sizes, the requirements in SI units are numerically converted from the corresponding requirements in inch-pound units. For conductor sizes designation by AWG or kcmil, the requirements in SI units have been numerically converted from corresponding values stated or derived in inch-pound units. For conductor sizes designated by SI units only, the requirements are stated or derived in SI units.

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

NOTE 1—Prior to 1975, aluminum 1350 was designated as EC aluminum.

NOTE 2—The aluminum and temper designations conform to ANSI Standard H35.1. Aluminum 1350 corresponds to Unified Numbering System A91350 in accordance with Practice E 527.

2. Referenced Documents

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

2.2 *ASTM Standards:*

B 230 Specification for Aluminum 1350-H19 Wire for Electrical Purposes[2]

B 231 Specification for Concentric-Lay-Stranded Aluminum 1350 Conductors[2]

B 263 Test Method for Determination of Cross-Sectional Area of Stranded Conductors[2]

B 354 Terminology Relating to Uninsulated Metallic Electrical Conductors[2]

B 609 Specification for Aluminum 1350 Round Wire, Annealed and Intermediate Tempers, for Electrical Purposes[2]

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications[3]

E 527 Practice for Numbering Metals and Alloys (UNS)[4]

2.3 *Other Documents:*

ANSI H35.1 Alloy and Temper Designation Systems for Aluminum[5]

NBS *Handbook 100-Copper Wire Tables, of the National Bureau of Standards*[6]

3. Classification

3.1 For the purpose of this specification, conductors are classified as follows:

3.1.1 *Class AA*—For bare conductors usually used in overhead lines.

3.1.2 *Class A*—For conductors to be covered with weather-resistant materials, and for bare conductors where greater flexibility than is afforded by Class AA is required. Conductors indicated for further fabrication into tree wire or to be insulated and laid helically with or around aluminum or ACSR messengers, shall be regarded as Class A conductors with respect to direction of lay only (see 6.3).

3.1.3 *Class B*—For conductors to be insulated with various materials such as rubber, paper, varnished cloth, etc., and for the conductors indicated under Class A where greater flexibility is required.

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

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

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

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

[6] Available from the National Technical Information Service, 5285 Port Royal Rd., Springfield, VA 22161.

4. Ordering Information

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

4.1.1 Quantity of each size and class (Table 1),

4.1.2 Conductor size; circular-mil area or AWG (Section 7),

4.1.3 Class (Section 3),

4.1.4 Temper (Section 13),

4.1.5 Lay direction if nonstandard (see 6.3 and 6.4), reversed or unidirectional (see 6.4) or special (see 6.5),

4.1.6 Special tension test, if required (see 17.2),

4.1.7 Place of inspection (Section 18), and

4.1.8 Packaging and Package Marking (Section 19).

5. Joints

5.1 *1350-H19 Conductors for Use in Bare Overhead Lines:*

5.1.1 Joints may be made in the six outer wires of seven-strand conductors by cold-pressure welding or by electric-butt, cold-upset welding, but not by electric-butt welding. Joints are not permitted in the finished center wire of seven-stranded conductors.

5.1.2 Joints may be made in any of the wires in conductors of 18 or more wires by electric-butt welding, cold-pressure welding, or electric butt, cold-upset welding.

5.1.3 The minimum distance between a wire joint and another joint either in the same wire or in other wires of the completed conductor shall be 50 ft (15 m).

5.2 *Conductors of All Tempers to Be Insulated or Covered*:

5.2.1 Joints may be made in any of the wires of any stranding by electric-butt welding, cold-pressure welding, or electric-butt, cold-upset welding.

TABLE 1 Construction of Compact-Round Concentric-Lay-Stranded, Aluminum Conductors

NOTE 1—Metric values listed below represent a soft conversion and as such they may not be the same as those metric values which are calculated from the basic metric density.

Conductor Size			Class	Number of Wires	Nominal Compact Conductor Diameter		Nominal Mass per 1000 ft, lb	Nominal Mass per Kilometer, kg[A]	Nominal D-C Resistance at 20°C	
Circular Mils	AWG	mm^2			in.	mm			Ω/1000 ft	Ω/km
1 000 000		507	B	61[B]	1.060	26.9	937	1394	0.0173	0.0563
900 000		456	B	61[B]	0.999	25.4	844	1257	0.0193	0.0632
800 000		405	B	61[B]	0.938	23.8	750	1116	0.0217	0.0712
750 000		380	B	61[B]	0.908	23.1	703	1046	0.0231	0.0759
700 000		355	B	61[B]	0.877	22.3	656	976	0.0248	0.0813
650 000		329	B	61[B]	0.845	21.5	609	906	0.0267	0.0875
600 000		304	B	61[B]	0.813	20.7	563	838	0.0289	0.0948
556 500		282	AA	19[C]	0.780	19.8	521	775	0.0312	0.102
550 000		279	B	61[B]	0.775	19.7	516	768	0.0315	0.103
500 000		253	B	37[D]	0.736	18.7	468	696	0.0347	0.114
500 000		253	AA	19[C]	0.736	18.7	468	696	0.0347	0.114
477 000		242	AA	19[C]	0.722	18.3	447	665	0.0364	0.119
450 000		228	B	37[D]	0.700	17.8	422	628	0.0385	0.126
400 000		203	B	37[D]	0.659	16.7	375	558	0.0434	0.142
397 500		201	AA, A	19[C]	0.659	16.7	372	554	0.0436	0.143
350 000		177	B	37[D]	0.616	15.6	328	488	0.0495	0.162
350 000		177	A	19[C]	0.616	15.6	328	488	0.0495	0.162
336 400		170	A	19[C]	0.603	15.3	315	469	0.0516	0.169
336 400		170	AA	7	0.603	15.3	315	469	0.0516	0.169
300 000		152	B	37[D]	0.570	14.5	281	418	0.0578	0.190
300 000		152	A	19[C]	0.570	14.5	281	418	0.0578	0.190
300 000		152	AA	7	0.570	14.5	281	418	0.0578	0.190
266 800		135	A	19[C]	0.537	13.6	250	372	0.0650	0.213
266 800		135	AA	7	0.537	13.6	250	372	0.0650	0.213
250 000		127	B	37[D]	0.520	13.2	234	348	0.0694	0.228
250 000		127	A	19[C]	0.520	13.2	234	348	0.0694	0.228
250 000		127	AA	7	0.520	13.2	234	348	0.0694	0.228
211 600	0000	107	B	19[C]	0.475	12.1	198	295	0.0820	0.269
211 600	0000	107	AA, A	7	0.475	12.1	198	295	0.0820	0.269
167 800	000	85.0	B	19[C]	0.423	10.7	157	234	0.103	0.338
167 800	000	85.0	AA, A	7	0.423	10.7	157	234	0.103	0.338
133 100	00	67.4	B	19[C]	0.376	9.55	125	186	0.130	0.428
133 100	00	67.4	AA, A	7	0.376	9.55	125	186	0.130	0.428
105 600	0	53.5	B	19[C]	0.336	8.53	98.9	147	0.164	0.539
105 600	0	53.5	AA, A	7	0.336	8.53	98.9	147	0.164	0.539
83 690	1	42.4	B	19[C]	0.299	7.59	78.4	117	0.207	0.680
83 690	1	42.4	AA, A	7	0.299	7.59	78.4	117	0.207	0.680
66 360	2	33.6	AA, A, B	7	0.268	6.81	62.2	92.6	0.261	0.857
52 620	3	26.7	A, B	7	0.238	6.05	49.3	73.3	0.330	1.08
41 740	4	21.2	A, B	7	0.213	5.41	39.1	58.2	0.416	1.36
26 240	6	13.3	A, B	7	0.169	4.29	24.6	36.6	0.661	2.17
16 510	8	8.37	A, B	7	0.134	3.40	15.5	23.1	1.05	3.44

[A] 1 lb/1000 ft = 1.488 kg/km.
[B] 58 wires minimum.
[C] 18 wires minimum.
[D] 35 wires minimum.

5.2.2 Joints in the individual wires in a finished conductor shall be not closer together than 1 ft (0.3 m) for conductors of 19 wires or less, or closer than 1 ft in a layer for conductors of more than 19 wires.

5.3 No joint or splice shall be made in a stranded conductor as a whole.

6. Lay

6.1 The length of lay or each layer for Classes AA and A shall be not less than 11 nor more than 17.5 times the outside diameter of that layer.

6.2 The length of lay of the outer layer for Class B shall be not less than 8 nor more than 16 times the outside diameter of the completed conductor, except that for sizes No. 2 AWG (33.6 mm^2) and smaller the maximum length of lay shall be not more than 17.5 times the outside diameter of the completed conductor.

6.3 The direction of lay of the outer layer shall be right-hand for Classes AA and A, and it shall be reversed in successive layers.

6.4 The direction of lay of the outer layer shall be left-hand for Class B, and it may be reversed or unidirectional/unilay in successive layers.

6.5 Other lay requirements may be furnished by special agreement between the manufacturer and the purchaser.

7. Construction

7.1 The construction of the conductors shall be as shown in Table 1 as to number of wires and cross-sectional area of the completed conductor, and the lay shall be in accordance with Section 6.

7.2 Wire used in the fabrication of conductor shall be of such dimensions as to produce a finished conductor having a nominal cross-sectional area and diameter as prescribed in Table 1.

8. Rated Strength of Conductor

8.1 The rated strength of 1350-H19 conductors shall be taken as the percentage, indicated in Table 2, of the sum of the strengths of the component wires, calculated on the basis of the nominal wire diameter for the corresponding noncompacted construction given in Specification B 231 and the specified minimum average tensile strength given in Specification B 230 for 1350-H19 wire.

8.2 Calculations for rated strengths of 1350-H16, -H26, -H14, -H24, -H142, and -H242 conductors shall be made on the basis of the strengths of the component wires using the nominal wire diameter for the noncompacted construction given in Specification B 231 and the specified maximum and minimum tensile strengths for the appropriate temper of the respective component wires given in Specification B 609. The minimum rated strengths of the conductors shall be taken as the sum of the calculated minimum strengths of the component wires multiplied by the rating factor given in Table 2. The maximum rated strength of the conductors shall be taken as the sum of the calculated maximum strengths of the component wires.

8.3 Rated-strength and breaking-strength values shall be rounded to three significant figures, in the final value only, in accordance with the rounding method of Practice E 29.

8.4 Rated strengths of conductors are given in Table 3.

TABLE 2 Rating Factors

Stranding		
Number of Wires in Conductor	Number of Layers	Rating Factor, %
7	1	96
19[A]	2	93
37[B]	3	91
61[C]	4	90

[A] 18 wires minimum.
[B] 35 wires minimum.
[C] 58 wires minimum.

9. Density

9.1 For the purpose of calculating mass, linear density, cross sections, etc., the density of aluminum 1350 shall be taken as 2705 kg/m^3(0.0975 $lb/in.^3$) at 20°C.

10. Mass and Electrical Resistance

10.1 The mass and electrical resistance of a unit length of stranded conductor are a function of the length of lay. The approximate mass and electrical resistance may be determined using an increment of 2 %. When greater accuracy is desired, the increment based on the specific lay of the conductor may be calculated (Explanatory Note 1).

10.2 The maximum electrical resistance of a unit length of stranded conductor shall not exceed the nominal d-c resistance (Table 1)+2 % (Explanatory Note 1).

10.2.1 When the d-c resistance is measured at other than 20°C, it is to corrected by using the multiplying factor given in Table 4.

10.3 For conductors to be used in covered or insulated wires or cables, direct current (D-C) resistance measurement may be used instead of the method outlined in Section 14 to determine compliance with this specification.

11. Mechanical and Electrical Tests of Conductors Fabricated from Wires other than 1350-H26, -H24, or -H242 and Annealed after Stranding to Meet 1350-H26, -H24, or -H242 Requirements

11.1 The completed conductor shall be tested as a unit. The minimum breaking strength of bare conductors shall be not less than minimum rated strength if failure occurs in the free length at least 1 in. (25 mm) beyond the end of either gripping device, or shall be not less than 95 % of the minimum rated strength if failure occurs inside, or within 1 in. of the end of either gripping device. The maximum breaking strength of 1350-H26, -H24, or -H242 conductors shall be not greater than their maximum rated strengths. The free length between grips of the test specimen shall be not less than 24 in. (600 mm), and care shall be taken to ensure that the wires in the conductor are evenly gripped during the test (Section 8 and Explanatory Note 3).

12. Workmanship, Finish, and Appearance

12.1 The conductor shall be clean and free from imperfections not consistent with good commercial practice.