Designation: B836 – 00 (Reapproved 2015)

Standard Specification for Compact Round Stranded Aluminum Conductors Using Single Input Wire Construction[1]

This standard is issued under the fixed designation B836; 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/single input wire (SIW) stranded conductors made from round or shaped wires for use in covered or insulated electrical wires or cables. These conductors shall be composed of one or more roller or die compacted layers of helically applied wires (Explanatory Note 1, Explanatory Note 2, and Explanatory Note 3).

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.

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

NOTE 1—The aluminum and temper designations conform to ANSI H35.1. Aluminum 1350 and Aluminum-Alloy 8XXX correspond to Unified Numbering System A91350 and A98XXX, in accordance with Practice E527.

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 and health practices and determine the applicability of regulatory limitations prior to use.*

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:*[2]

B230/B230M Specification for Aluminum 1350–H19 Wire for Electrical Purposes

B263 Test Method for Determination of Cross-Sectional Area of Stranded Conductors

B354 Terminology Relating to Uninsulated Metallic Electrical Conductors

B400 Specification for Compact Round Concentric-Lay-Stranded Aluminum 1350 Conductors

B609/B609M Specification for Aluminum 1350 Round Wire, Annealed and Intermediate Tempers, for Electrical Purposes

B800 Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes—Annealed and Intermediate Tempers

B801 Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy for Subsequent Covering or Insulation

B830 Specification for Uniform Test Methods and Frequency

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

E527 Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

2.3 *ANSI Standard:*

ANSI H35.1 Alloy and Temper Designation Systems for Aluminum[3]

2.4 *NIST Standard:*

Handbook 100 Copper Wire Tables NBS [4]

3. Classification

3.1 The conductors described in this specification are intended for subsequent insulation or covering. The classification of these conductors is SIW Compact.

4. Ordering Information

4.1 Orders for material in accordance with 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 Temper (Section 12);

4.1.4 Lay direction, if nonstandard (see 6.2 and 6.3);

4.1.5 Special tension test, if required (see 16.2);

[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.

Current edition approved Oct. 1, 2015. Published October 2015. Originally approved in 1993. Last previous edition approved in 2011 as B836 – 00 (2011). DOI: 10.1520/B0836-00R15.

[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] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[4] Available from National Institute of Standards and Technology (NIST), 100 Bureau Dr., Stop 1070, Gaithersburg, MD 20899-1070, http://www.nist.gov.

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

Conductor Size			Minimum Number of Wires	Nominal Compact Conductor Diameter		Nominal Mass/1000 ft,[A] lb	Nominal Mass/km, kg	Nominal dc Resistance at 20°C	
Circular, mils	AWG	mm^2		in.	mm			Ω/1000 ft	Ω/km
1 000 000	...	507	53	1.060	26.9	937	1394	0.0173	0.0563
900 000	...	456	53	0.999	25.4	844	1257	0.0193	0.0632
800 000	...	405	53	0.938	23.8	750	1116	0.0217	0.0712
750 000	...	380	53	0.908	23.1	703	1046	0.0231	0.0759
700 000	...	355	34	0.877	22.3	656	976	0.0248	0.0813
650 000	...	329	34	0.845	21.5	609	906	0.0267	0.0875
600 000	...	304	34	0.813	20.7	563	838	0.0289	0.0948
550 000	...	279	34	0.775	19.7	516	768	0.0315	0.103
500 000	...	253	30	0.736	18.7	468	696	0.0347	0.114
450 000	...	228	30	0.700	17.8	422	628	0.0385	0.126
400 000	...	203	24	0.659	16.7	375	558	0.0434	0.142
350 000	...	177	24	0.616	15.6	328	488	0.0495	0.162
300 000	...	152	18	0.570	14.5	281	418	0.0578	0.190
250 000	...	127	18	0.520	13.2	234	348	0.0694	0.228
211 600	0000	107	17	0.475	12.1	198	295	0.0820	0.269
167 800	000	85.0	15	0.423	10.7	157	234	0.103	0.338
133 100	00	67.4	12	0.376	9.55	125	186	0.130	0.428
105 600	0	53.5	7	0.336	8.53	98.9	147	0.164	0.539
83 690	1	42.4	7	0.299	7.59	78.4	117	0.207	0.680
66 360	2	33.6	6	0.268	6.81	62.2	92.6	0.261	0.857
52 620	3	26.7	6	0.238	6.05	49.3	73.3	0.330	1.08
41 740	4	21.2	6	0.213	5.41	39.1	58.2	0.416	1.36
26 240	6	13.3	6	0.169	4.29	24.6	36.6	0.661	2.17
16 510	8	8.37	6	0.134	3.40	15.5	23.1	1.05	3.44

[A] Weights are based on Aluminum 1350 with a density of 0.0975 lb/$in.^3$

4.1.6 Place of inspection (Section 17);
4.1.7 Packaging and package marking (Section 18), and
4.1.8 Material for conductor.

5. Joints

5.1 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.

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

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

6. Lay

6.1 The length of lay of each layer for SIW conductors shall not be less than 8 or more than 17.5 times the outside diameter of the finished conductor.

6.2 The direction of lay of the outer layer shall be left-hand and may be reversed or unidirectional in successive layers.

6.3 Other lay requirements may be furnished upon special agreement between the manufacturer and the purchaser.

7. Construction

7.1 The construction of the conductors shall be as given in Table 1.

7.2 Wire used in the fabrication of conductors shall be of such dimensions as to produce a finished conductor as prescribed in Table 1.

8. Rated Strength of Conductor

8.1 The rated strength of SIW conductors made from any and all alloys and tempers covered in this specification 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 equivalent diameter of these wires and the specified minimum average tensile strengths given in Specifications B230/B230M, B609/B609M, and B800.

8.2 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 E29.

8.3 Rated strengths of conductors are given in Table 3 of Specification B400 for conductors made of Aluminum 1350 in all tempers.

8.4 Rated strengths of conductors made from any and all tempers of 8000 series aluminum alloys are given in Table 3 of Specification B801.

9. Density

9.1 For the purpose of calculating mass, cross-sections, and so forth, the density of Aluminum 1350 shall be taken as 2705

TABLE 2 Rating Factors

Stranding Number of Layers	Rating Factor, %
1	96
2	93
3	91
4	90

TABLE 3 Temperature Correction Factors for Conductor Resistance

Temperature,° C	Multiplying Factor for Conversion to 20°C
0	1.088
5	1.064
10	1.042
15	1.020
20	1.000
25	0.980
30	0.961
35	0.943
40	0.925
45	0.908
50	0.892
55	0.876
60	0.851
65	0.846
70	0.832
75	0.818
80	0.805
85	0.792
90	0.780

kg/m^3 (0.0975 lb/in.^{3}) at 20°C, and the density of 8000 series aluminum alloys shall be taken as 2710 kg/m^3 (0.098 lb/in.^{3}) at 20°C.

10. Mass and Resistance

10.1 The mass and electrical resistance of a unit length of stranded conductor is a function of the length of lay. The approximate weight 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 4).

10.2 The maximum electrical resistance of a unit length of stranded conductor shall not exceed the nominal dc resistance (Table 1), plus 2 %.

10.2.1 When the dc resistance is measured at other than 20°C, it is to be corrected by using the multiplying factor given in Table 3.

10.3 For conductors to be used in covered or insulated wires or cables, dc resistance measurement may be used instead of the method outlined in Section 13, to determine compliance with this specification; however, the referee method shall be that outlined in Section 13.

11. Workmanship, Finish, and Appearance

11.1 The conductor shall be clean and free of imperfections not consistent with good commercial practice.

12. Requirements of Wires

12.1 Before stranding and compacting, the round input wire used shall meet the requirements of Specifications B230/B230M, B609/B609M, or B800, whichever is applicable.

12.2 Wire shaped before stranding shall meet the requirements of the appropriate specification listed in 12.1 except for tensile and elongation requirements and diameter tolerance. For the 1350-H19 temper, the minimum tensile and elongation requirements shall be 96 % of those for round wire of the same nominal area, provided the completed conductor is capable of meeting the requirements of Sections 8 and 16.

12.3 For conductors made from all other alloys and tempers covered in this specification with shaped wires, the tensile requirements for the wires shall be the same as those for round input wires of equal nominal area. The area tolerances for shaped wire of all alloys and tempers shall be such that the finished conductor conforms to Section 13.

13. Variation in Area

13.1 The cross-sectional area of the conductor shall not be less than 98 % of the cross-sectional area as specified in Column 1 of Table 1.

13.2 The manufacturer shall determine the cross-sectional area by Test Method B263. In applying this test method, the increment in weight resulting from stranding may be the applicable value specified in 10.1, or it may be calculated from the measured dimensions of the sample under test. In case of a question regarding area compliance, the actual weight increment due to stranding shall be calculated.

NOTE 2—The term "weight" is used in this specification because of established trade usage in place of the technically correct term "mass."

14. Variation in Diameter

14.1 The average diameter of the conductor shall vary by not more than plus 1 % and minus 2 % from the diameter specified in Table 1.

15. Sampling

15.1 The aluminum cross-sectional area (Section 13) and diameter (Section 14) shall be measured on a sample of completed conductor. At least one sample shall be tested on each size of conductor on each order of quantities from 5000 to 100 000 ft (1500 to 30 000 m), and one additional sample shall be tested from each 100 000 ft (30 000 m) thereafter.

15.2 In addition or instead of the acceptance testing outlined in 15.1, the sampling may be in accordance with Specification B830 (see Explanatory Note 5).

16. Mechanical and Electrical Tests of SIW Conductors

16.1 Tests for the mechanical and electrical properties of wire composing the conductor shall be made before, but not after, stranding unless otherwise agreed upon by the manufacturer and the purchaser as provided in 16.2 (Explanatory Note 6).

16.2 At the option of the purchaser, at the time of placing the order, tensile and elongation tests of wire before stranding may be waived, and the completed conductor may be tested as a unit. The minimum breaking strength of the conductors so tested shall not be less than the rated strength of the conductor (per Section 8 of this specification) if failure occurs in the free length at least 1 in. (25 mm) beyond the end of either gripping device, or it shall not be less than 95 % of the rated strength if failure occurs inside, or within, 1 in. (25 mm) of the end of either gripping device. The maximum breaking strength for tempers other than -H19 shall not be greater than their maximum rated strengths as provided in Section 9 of this specification and in Table 3 of Specification B400 and Table 3 of Specification B801. The free length between grips of the test

specimen shall not be less than 24 in. (600 mm), and care shall be taken to ensure that the wires in the conductor are gripped evenly during the test (Section 8 and Explanatory Note 7).

17. Inspection

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

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

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

18. Packaging and Package Marking

18.1 Package sizes for conductors shall be agreed upon by the manufacturer and the purchaser during the placing of individual orders.

18.2 The conductors shall be protected from damage during ordinary handling and shipping.

18.3 There shall be only one length of conductor on a reel unless otherwise agreed upon by the manufacturer and purchaser at the time of placing the order.

18.4 The net weight, length (and number of lengths, if more than one length is included in the package), size, kind of conductor, and purchase order shall be marked on a tag attached to the end of the conductor inside of the package. The same information, together with the manufacturer's serial number (if any) and all shipping marks required by the purchaser, shall appear on the outside of each package.

19. Keywords

19.1 aluminum; aluminum stranded conductors; compact; concentric lay stranded conductors; electrical conductors; reverse concentric; Single Input Wire; SIW; SIW Compact; unidirectional; unilay

EXPLANATORY NOTES

NOTE 1—In this specification, only compact round/SIW conductor constructions are specifically designated. Constructions not included in this specification should be specifically agreed upon by the manufacturer and the purchaser when placing the order.

NOTE 2—For definitions of terms relating to conductors, refer to Terminology B354.

NOTE 3—*Single Input Wire Construction*—A stranded conductor design methodology that varies the number of wires within a range of conductor sizes in order to permit that range of conductor sizes to be constructed from a single wire size.

NOTE 4—The increment of weight or electrical resistance of a completed concentric-lay-stranded conductor (k), in %, is as follows:

$$k = 100\,(m - 1)$$

where m = the stranding factor and is also the ratio of the weight of electrical resistance of a unit length of stranded conductor to that of a solid conductor of the same cross-sectional area or of a stranded conductor with infinite length of lay, that is, all wires parallel to the conductor axis. The stranding factor m for the completed stranded conductor is the numerical average of the stranding factors for each of the individual wires in the conductor, including the straight core wire, if any (for which the stranding factor is unity). The stranding factor (m_{ind}) for any given wire in a concentric-lay-stranded conductor is as follows:

$$m_{\text{ind}}\sqrt{1 + (9.8696/n^2)}$$

where:

$$n = \frac{\text{length of lay}}{\text{diameter of helical path of the wire}}$$

The derivation of the above as given in NBS Handbook 100 is based on round wire constructions that are applicable to compacted wire constructions.

NOTE 5—Cumulative historic results secured on the product of a single manufacturer indicating a record of continual conformance of that product with the requirements of this specification are necessary to ensure that the sample can be assumed to be representative of the lot and that the conformance criteria will largely ensure compliance of the lot with this specification. The sample sizes and conformance criteria are applicable only to lots produced by manufacturers that meet this requirement.

NOTE 6—Individual wires should not be unlaid from compact round conductors for testing purposes. Some physical properties of the individual compacted wires may be altered by the deformation brought about by compacting, unlaying, and straightening for test.

NOTE 7—To test stranded conductors for breaking strength successfully as a unit requires adequate means of gripping the ends of the test specimen without causing damage that may result in a failure below the actual strength of the conductor. Various means are available, such as compression sleeves, split sleeves, and performed grips, but ordinary jaws or clamping devices are usually not suitable.