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Standard Specification for 19 Wire Combination Unilay-Stranded Aluminum Conductors for Subsequent Insulation[1]

This standard is issued under the fixed designation B 786; 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 bare combination unilay-stranded conductors made from round wires of aluminum 1350 and 8000 series of aluminum alloys, for insulated conductors for electrical purposes. Aluminum 1350 wires in tempers -H19 (extra hard), -H16 or -H26 (¾ hard), -H14 or -H24 (½ hard), and -H142 or -H242 (½ hard) and 8000 series aluminum alloys wires in tempers "0" and H1X or H2X are permitted. These conductors shall be constructed with a central core wire surrounded by two layers of helically laid wires, resulting in an outer diameter equal to the compressed-stranded equivalent conductors.

NOTE 1—For the purpose of this specification, combination unilay conductor is defined as follows: a central core wire surrounded by a layer of six helically laid wires of the same diameter as the core wire with a helically laid outer layer containing six smaller wires alternated between six wires of the same diameter as the wires in the layer underneath. Both layers have a common length and direction of lay (see Fig. 1).

1.1.1 For the purpose of this specification, normal conductor classification (Class AA, A, B, C) is not applicable, as these conductors are intended for subsequent insulation. The descriptive term combination unilay-stranded shall be used in place of conductor classification (Note 2 and Note 3).

NOTE 2—Prior to 1975, aluminum 1350 was designated as EC aluminum.

NOTE 3—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. Unified Numbering System alloy designations for 8000 Series aluminum alloys in accordance with Practice E 527 are listed in Table number 1 of Specification B 800.

~~1.2The values stated in inch-pound or SI units are to be regarded separately as 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.~~

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

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

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]

B 193 Test Method for Resistivity of Electrical Conductor Materials

B 230/B 230M Specification for Aluminum ~~1350-H19~~1350H19 Wire for Electrical Purposes

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

B 609/B 609M Specification for Aluminum 1350 Round Wire, Annealed and Intermediate Tempers, for Electrical Purposes

B 800 Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes—Annealed and Intermediate Tempers

B 801 Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy for Subsequent Covering or Insulation

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

E 527~~Practice for Numbering Metals and Alloys (UNS)~~ Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

[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* ~~, Vol 02.03.~~volume information, refer to the standard's Document Summary page on the ASTM website.

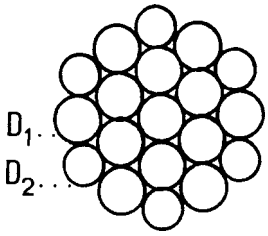

FIG. 1 Cross Section of Conductor

2.3 *ANSI Standard:*

~~ANSI H35.1~~ANSI H35.1/H35.1(M) Alloy and Temper Designation Systems for Aluminum[3]

2.4 *NIST Standard:*

NBS Handbook 100[4]

3. Ordering Information

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

3.1.1 Conductor alloy,

3.1.2 Quantity of each size,

3.1.3 Conductor size: Circular-mil area or American Wire Gage, AWG (Section 6 and Table 1),

3.1.4 Stranding (see Explanatory Note 1),

3.1.5 Temper (see Section 11),

3.1.6 Details of special-purpose lays, if required (see 5.2),

3.1.7 When physical tests shall be made (see Sections 7 and 8),

3.1.8 Package size (see 16.1),

3.1.9 Heavy wood lagging, if required (see 17.2),

3.1.10 Special package marking, if required (Section 17), and

3.1.11 Place of inspection (Section 15).

4. Joints

4.1 Electric-butt welds, cold pressure welds, or electric-butt cold-upset welds may be made in the finished individual wires composing the conductor but shall not be closer together than 1 ft (Explanatory Note 2).

5. Lay

5.1 For combination unilay conductors the lay of a layer of wires shall be not less than 8 nor more than 16 times the outside diameter of the outer layer.

5.2 Other lays for special purposes shall be furnished by special agreement between the manufacturer and the purchaser.

NOTE 4—Certain types of insulation conductors may require shorter lay than other conductors. It is expected that special requirements regarding length of lay will be specified by the purchaser in such instances.

5.3 The direction of lay shall be left-hand unless the direction of lay is specified otherwise by the purchaser.

6. Construction (Explanatory Note 1)

6.1 The areas of cross section, numbers, and diameters of wires in the various conductors shall conform to the requirements prescribed in Table 1 (Note 3) (see Fig. 1).

6.2 The diameters of the wires listed in Table 2 are nominal. In order to produce an essentially round 19-wire construction, the outer 12-wire layer in the combination unilay product is comprised of 6 wires of the same diameter as the wires in the 7-wire core, and 6 wires approximately 25 % smaller. The 2-wire sizes are alternated around the 7-wire core.

7. Mechanical and Electrical Tests of Conductors not Annealed after Stranding

7.1 Wires composing the conductors shall be tested prior to stranding in accordance with the applicable specification (see 11.1.2), and tests on the completed conductor are not required. However, when requested by the purchaser and agreed to by the manufacturer at time of ordering, the tension tests of wires before stranding may be waived and the completed conductor tested in accordance with 7.2, or wires removed from the completed conductor tested in accordance with 7.5.

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

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

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

[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 Requirements for 19-Wire Combination Unilay Stranded Aluminum Conductors

Area of Cross-Section, cmil	Size, American (or Brown and Sharpe) Wire Gage	Wire D_1[A] Diameter		Wire D_2[B] Diameter	
		mils	mm	mils	mm
556 500		185.3	4.71	135.6	3.44
500 000		175.6	4.46	128.5	3.26
477 000		171.5	4.36	125.5	3.19
450 000		166.6	4.23	121.9	3.10
397 500		156.6	3.99	114.6	2.91
397 500		156.6	3.98	114.6	2.91
350 000		146.9	3.98	107.5	2.73
350 000		146.9	3.73	107.5	2.73
336 400		144.0	3.73	105.4	2.68
336 400		144.0	3.66	105.4	2.68
300 000		136.0	3.66	99.6	2.53
300 000		136.0	3.45	99.6	2.53
266 800		128.3	3.45	93.9	2.38
266 800		128.3	3.26	93.9	2.38
250 000		124.2	3.26	90.9	2.31
250 000		124.2	3.15	90.9	2.31
211 600	0000	114.2	3.15	83.6	2.12
211 600	0000	114.2	2.90	83.6	2.12
167 800	000	101.7	2.90	74.5	1.89
167 800	000	101.7	2.58	74.5	1.89
133 100	00	90.6	2.58	66.3	1.68
133 100	00	90.6	2.30	66.3	1.68
105 600	0	80.7	2.30	59.1	1.50
105 600	0	80.7	2.05	59.1	1.50
83 690	1	71.8	2.05	52.6	1.34
83 690	1	71.8	1.82	52.6	1.34
66 360	2	64.0	1.82	46.8	1.19
66 360	2	64.0	1.63	46.8	1.19
52 620	3	57.0	1.62	41.7	1.06
52 620	3	57.0	1.45	41.7	1.06
41 740	4	50.7	1.45	37.1	0.94
41 740	4	50.7	1.29	37.1	0.94
33 090	5	45.2	1.29	33.1	0.84
33 090	5	45.2	1.15	33.1	0.84
26 240	6	40.2	1.15	29.4	0.75
26 240	6	40.2	1.02	29.4	0.75
20 820	7	35.8	1.02	26.2	0.67
20 820	7	35.8	0.91	26.2	0.67
16 510	8	31.9	0.81	23.4	0.59
13 090	9	28.4	0.72	20.8	0.53
10 380	10	25.3	0.64	18.5	0.47
6 530	12	20.1	0.51	14.7	0.37

[A] Equation to calculate D_1:

$$D_1 = \sqrt{\frac{\text{Cross-Sectional Area}}{16.2149}}$$

[B] Equation to calculate D_2:

$$D_2 = D_1 \times 0.732.$$

7.2 When the completed conductor is tested as a unit, the breaking strength shall be not less than the rated strength of 1350-H19 conductors or the minimum rated strength of 1350-H16, -H26, -H14, -H24, -H142, and -H242 conductors if failure occurs in the free length at least 1 in. (25 mm) beyond the end of either gripping device. The strength shall be not less than 95 % of the rated or minimum rated strength if failure occurs inside, or within 1 in. of the end of either gripping device. The breaking strength of 1350-H16, -H26, -H14, -H24, -H142, and -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 (Explanatory Note 3).

7.3 The rated strength of 1350-H19 conductors and the minimum rated strength of 1350-H16, -H26, -H14, -H24, -H142, and -H242 conductors shall be taken as 93 % of the sum of the specified minimum average tensile strengths of the component wires for 1350-H19 conductors, as prescribed in Table 1, Tensile Requirements, of Specification B 230/B 230M, and of the sum of the specified minimum tensile strengths of the component wires for 1350-H16, -H26, -H14, -H24, -H142, and -H242 conductors, as prescribed in Specification B 609/B 609M, as applicable. The maximum rated strength of the 1350-H16, -H26, -H14, -H24, -H142 and -H242 conductors shall be taken as the sum of the specified maximum strengths of the component wires, as prescribed in Specification B 609/B 609M, as applicable. The rated strengths shall be calculated using specified nominal wire diameters.

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