



Designation: B786/B786M – 08 (Reapproved 2023)

# Standard Specification for 19 Wire Combination Unilay-Stranded Aluminum Conductors for Subsequent Insulation<sup>1</sup>

This standard is issued under the fixed designation B786/B786M; 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 ( $\epsilon$ ) 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 ( $\frac{3}{4}$  hard), -H14 or -H24 ( $\frac{1}{2}$  hard), and -H142 or -H242 ( $\frac{1}{2}$  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 E527. Unified Numbering System alloy designations for 8000 Series aluminum alloys in accordance with Practice E527 are listed in Table number 1 of Specification B800.

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.

1.3 *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 date of material purchase form a part of this specification to the extent referenced herein.

### 2.2 ASTM Standards:<sup>2</sup>

B193 Test Method for Resistivity of Electrical Conductor Materials

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

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

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:<sup>3</sup>

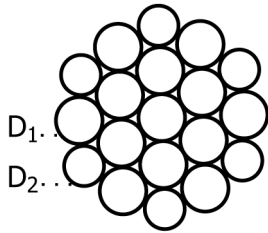
ANSI H35.1/H35.1(M) Alloy and Temper Designation Systems for Aluminum

<sup>1</sup> 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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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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



**FIG. 1 Cross Section of Conductor**

**TABLE 1 Construction Requirements for 19-Wire Combination Unilay Stranded Aluminum Conductors**

| Area of Cross-Section, cmil | Size, American (or Brown and Sharpe) Wire Gauge | 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                 | 3.98 | 114.6                 | 2.91 |
| 350 000                     |                                                 | 146.9                 | 3.73 | 107.5                 | 2.73 |
| 336 400                     |                                                 | 144.0                 | 3.66 | 105.4                 | 2.68 |
| 300 000                     |                                                 | 136.0                 | 3.45 | 99.6                  | 2.53 |
| 266 800                     |                                                 | 128.3                 | 3.26 | 93.9                  | 2.38 |
| 250 000                     |                                                 | 124.2                 | 3.15 | 90.9                  | 2.31 |
| 211 600                     | 0000                                            | 114.2                 | 2.90 | 83.6                  | 2.12 |
| 167 800                     | 000                                             | 101.7                 | 2.58 | 74.5                  | 1.89 |
| 133 100                     | 00                                              | 90.6                  | 2.30 | 66.3                  | 1.68 |
| 105 600                     | 0                                               | 80.7                  | 2.05 | 59.1                  | 1.50 |
| 83 690                      | 1                                               | 71.8                  | 1.82 | 52.6                  | 1.34 |
| 66 360                      | 2                                               | 64.0                  | 1.63 | 46.8                  | 1.19 |
| 52 620                      | 3                                               | 57.0                  | 1.45 | 41.7                  | 1.06 |
| 41 740                      | 4                                               | 50.7                  | 1.29 | 37.1                  | 0.94 |
| 33 090                      | 5                                               | 45.2                  | 1.15 | 33.1                  | 0.84 |
| 26 240                      | 6                                               | 40.2                  | 1.02 | 29.4                  | 0.75 |
| 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 |

<sup>A</sup> Equation to calculate  $D_1$ :

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

<sup>B</sup> Equation to calculate  $D_2$ :

$$D_2 = D_1 \times 0.732.$$

2.4 *NIST Standard*.<sup>4</sup>

**NBS Handbook 100 —Copper Wire Tables**

### 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 Gauge, 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),

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

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.

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