Designation: B 231/B 231M – 04

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

This standard is issued under the fixed designation B 231/B 231M; 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.

*This standard has been approved for use by agencies of the Department of Defense.*

## 1. Scope

1.1 This specification covers aluminum 1350-H19 (extra hard), 1350-H16 or -H26 (¾ hard), 1350-H14 or -H24 (½ hard), and 1350-H142 or -H242 (½ hard), bare concentric-lay-stranded conductors constructed with a straight round central wire surrounded by one or more layers of helically layed wires. The conductors are for general use for electrical purposes (Explanatory Note 1 and Note 2).

1.2 The 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.

1.2.1 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/H35.1M. Aluminum 1350 corresponds to Unified Numbering System A91350 in accordance with Practice E 527.

NOTE 3—Sealed conductors that are intended to prevent longitudinal water propagation and are further covered/insulated are also permitted within the guidelines of this specification.

## 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 Wire for Electrical Purposes

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

B 354 Terminology Relating to Uninsulated Metallic Electrical Conductors

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

B 682 Specification for Standard Metric Sizes of Electrical Conductors

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

E 527 Practice for Numbering Metals and Alloys (UNS)

2.3 *ANSI Documents:* [3]

ANSI H35.1 American National Standard Alloy and Temper Designation System for Aluminum

ANSI H35.1M American National Standard Alloy and Temper Designation Systems for Aluminum [Metric]

2.4 *NIST Document:*[4]

*NBS Handbook 100—Copper Wire Tables*

2.5 *Aluminum Association Document:*[5]

Publication 50, Code Words for Overhead Aluminum Electrical Conductors

## 3. Classification

3.1 For the purpose of this specification, conductors are classified as follows (Explanatory Note 1 and Note 2):

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 intended for further fabrication into tree wire or to be insulated

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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* 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.

[4] Available from National Technical Information Service (NTIS), U.S. Department of Commerce, 5285 Port Royal Rd., Springfield, VA 22161.

[5] Available from the Aluminum Association, Inc., 900 19th Street, NW, Suite 300, Washington, DC 20006.

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 7.4).

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

3.1.4 *Classes C and D*—For conductors where greater flexibility is required than is provided by Class B conductors.

**TABLE 1 Construction Requirements and Recommended Reel Sizes and Shipping Lengths of Aluminum Conductors, Concentric-Lay-Stranded, Class AA, and Class A**

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

| Conductor Size | | | | Required Construction | | | Mass | | Rated Strength | | Recommended Package Sizes[A] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cmils[B] or AWG | mm² | Code Words[C] | Class | Number of Wires | Diameter of Wire | | Per 1000 ft, lb | Per km, kg | kips | kN | Reel Designation[D] | Nominal Length of Each Piece, ft[B] | Nominal Mass of Each Length, lb[B] |
| | | | | | in. | mm | | | | | | | |
| 3 500 000 | 1773 | Bluebonnet | A | 127 | 0.1660 | 4.22 | 3345 | 4977 | 58.7 | 261 | RMT 90.45 | 2840 | 9530 |
| 3 000 000 | 1520 | Trillium | A | 127 | 0.1537 | 3.90 | 2840 | 4226 | 50.3 | 223 | RMT 90.45 | 3350 | 9530 |
| 2 750 000 | 1393 | Bitterroot | A | 91 | 0.1738 | 4.42 | 2602 | 3872 | 46.1 | 205 | RMT 90.45 | 3490 | 9100 |
| 2 500 000 | 1267 | Lupine | A | 91 | 0.1657 | 4.21 | 2365 | 3519 | 41.9 | 186 | RMT 90.45 | 3840 | 9100 |
| 2 250 000 | 1140 | Sagebrush | A | 91 | 0.1572 | 3.99 | 2128 | 3166 | 37.7 | 167 | RMT 90.45 | 4270 | 9100 |
| 2 000 000 | 1013 | Cowslip | A | 91 | 0.1482 | 3.77 | 1873 | 2787 | 34.2 | 153 | RMT 90.45 | 4850 | 9100 |
| 1 750 000 | 886.7 | Jessamine | AA | 61 | 0.1694 | 4.30 | 1641 | 2442 | 29.7 | 132 | RMT 90.45 | 5940 | 9760 |
| 1 590 000 | 805.7 | Coreopsis | AA | 61 | 0.1614 | 4.10 | 1489 | 2216 | 27.0 | 120 | RMT 90.45 | 6540 | 9760 |
| | | | | | | | | | | | RM 68.38 | 3270 | 4880 |
| 1 510 500 | 765.4 | Gladiolus | AA, A | 61 | 0.1574 | 4.00 | 1417 | 2108 | 25.6 | 114 | RMT 90.45 | 6880 | 9760 |
| | | | | | | | | | | | RM 68.38 | 3440 | 4880 |
| 1 431 000 | 725.1 | Carnation | AA, A | 61 | 0.1532 | 3.89 | 1342 | 1997 | 24.3 | 108 | RMT 90.45 | 7270 | 9760 |
| | | | | | | | | | | | RM 68.38 | 3635 | 4880 |
| 1 351 000 | 694.8 | Columbine | AA, A | 61 | 0.1488 | 3.78 | 1266 | 1884 | 23.4 | 104 | RMT 90.45 | 7690 | 9760 |
| | | | | | | | | | | | RM 68.38 | 3845 | 4880 |
| 1 272 000 | 644.5 | Narcissus | AA, A | 61 | 0.1444 | 3.67 | 1192 | 1774 | 22.0 | 98.1 | RMT 90.45 | 8170 | 9760 |
| | | | | | | | | | | | RM 68.38 | 4085 | 4880 |
| 1 192 500 | 604.2 | Hawthorn | AA, A | 61 | 0.1398 | 3.55 | 1117 | 1662 | 21.1 | 93.5 | RMT 90.45 | 9340 | 9760 |
| | | | | | | | | | | | RM 68.38 | 4360 | 4880 |
| 1 113 000 | 564.0 | Marigold | AA, A | 61 | 0.1351 | 3.43 | 1044 | 1553 | 19.7 | 87.3 | RMT 90.45 | 9340 | 9760 |
| | | | | | | | | | | | RM 68.38 | 4670 | 4880 |
| 1 033 500 | 523.7 | Bluebell | AA | 37 | 0.1671 | 4.25 | 968.4 | 1441 | 17.7 | 78.8 | RMT 84.45 | 7630 | 7400 |
| | | | | | | | | | | | RM 66.32 | 3815 | 3700 |
| | | | | | | | | | | | NR 48.28 | 1910 | 1850 |
| 1 033 500 | 523.7 | Larkspur | A | 61 | 0.1302 | 3.31 | 969.2 | 1442 | 18.3 | 81.3 | RMT 90.45 | 10 060 | 9760 |
| | | | | | | | | | | | RM 68.38 | 5030 | 4880 |
| 1 000 000 | 506.7 | Hawkweed | AA | 37 | 0.1644 | 4.18 | 937.3 | 1395 | 17.2 | 76.2 | RMT 84.45 | 7880 | 7400 |
| | | | | | | | | | | | RM 66.32 | 3940 | 3700 |
| | | | | | | | | | | | NR 48.28 | 1970 | 1850 |
| 1 000 000 | 506.7 | Camellia | A | 61 | 0.1280 | 3.25 | 936.8 | 1394 | 17.7 | 78.3 | RMT 90.45 | 10 400 | 9760 |
| | | | | | | | | | | | RM 68.38 | 5200 | 4880 |
| 954 000 | 483.4 | Magnolia | AA | 37 | 0.1606 | 4.08 | 894.5 | 1331 | 16.4 | 72.6 | RMT 84.45 | 8260 | 7400 |
| | | | | | | | | | | | RM 66.32 | 4130 | 3700 |
| | | | | | | | | | | | NR 48.28 | 2065 | 1850 |
| 954 000 | 483.4 | Goldenrod | A | 61 | 0.1251 | 3.18 | 894.8 | 1331 | 16.9 | 75.0 | RMT 90.45 | 10 900 | 9760 |
| | | | | | | | | | | | RM 68.38 | 5450 | 4880 |
| 900 000 | 456.0 | Cockscomb | AA | 37 | 0.1560 | 3.96 | 844.0 | 1256 | 16.4 | 68.4 | RMT 84.45 | 8760 | 7400 |
| | | | | | | | | | | | RM 66.32 | 4390 | 3700 |
| | | | | | | | | | | | NR 48.28 | 2190 | 1850 |
| 900 000 | 456.0 | Snapdragon | A | 61 | 0.1215 | 3.09 | 844.0 | 1256 | 15.9 | 70.8 | RMT 90.45 | 11 550 | 9760 |
| | | | | | | | | | | | RM 68.38 | 5775 | 4880 |
| 795 00 | 402.8 | Arbutus | AA | 37 | 0.1466 | 3.72 | 745.3 | 1109 | 13.9 | 61.8 | RMT 84.45 | 9920 | 7400 |
| | | | | | | | | | | | RM 66.32 | 4960 | 3700 |
| | | | | | | | | | | | NR 48.28 | 2480 | 1850 |
| 795 000 | 402.8 | Lilac | A | 61 | 0.1142 | 2.90 | 745.7 | 1110 | 14.3 | 63.8 | RMT 90.45 | 13 080 | 9760 |
| | | | | | | | | | | | RM 68.38 | 6540 | 4880 |
| 750 000 | 380.0 | Petunia | AA | 37 | 0.1424 | 3.62 | 703.2 | 1046 | 13.1 | 58.6 | RMT 84.45 | 10 510 | 7400 |
| | | | | | | | | | | | RM 66.32 | 5255 | 3700 |
| | | | | | | | | | | | NR 48.28 | 2630 | 1850 |
| 750 000 | 380.0 | Cattail | A | 61 | 0.1109 | 2.82 | 703.2 | 1046 | 13.5 | 60.3 | RMT 90.45 | 13 860 | 9760 |
| | | | | | | | | | | | RM 68.38 | 6930 | 4880 |
| 715 500 | 362.6 | Violet | AA | 37 | 0.1391 | 3.53 | 671 | 998.5 | 12.8 | 56.7 | RTM 84.45 | 11 020 | 7400 |
| | | | | | | | | | | | RM 66.32 | 5510 | 3700 |
| | | | | | | | | | | | NR 48.28 | 2755 | 1850 |

**TABLE 1** *Continued*

| Conductor Size | | | | Required Construction | | | Mass | | Rated Strength | | Recommended Package Sizes[A] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cmils[B] or AWG | mm² | Code Words[C] | Class | Number of Wires | Diameter of Wire | | Per 1000 ft, lb | Per km, kg | kips | kN | Reel Designation[D] | Nominal Length of Each Piece, ft[B] | Nominal Mass of Each Length, lb[B] |
| | | | | | in. | mm | | | | | | | |
| 715 500 | 362.6 | Nasturtium | A | 61 | 0.1083 | 2.75 | 671 | 998.5 | 13.1 | 58.4 | RMT 90.45 | 14 530 | 9760 |
| | | | | | | | | | | | RM 68.38 | 7265 | 4880 |
| 700 000 | 354.7 | Verbena | AA | 37 | 0.1375 | 3.49 | 655.7 | 975.7 | 12.5 | 55.4 | RMT 84.45 | 11 260 | 7400 |
| | | | | | | | | | | | RM 66.32 | 5630 | 3700 |
| | | | | | | | | | | | NR 48.28 | 2815 | 1850 |
| 700 000 | 354.7 | Flag | A | 61 | 0.1071 | 2.72 | 655.8 | 975.8 | 12.9 | 57.1 | RMT 90.45 | 14 850 | 9760 |
| | | | | | | | | | | | RM 68.38 | 7425 | 4880 |
| 650 000 | 329.4 | Heuchera | AA | 37 | 0.1326 | 3.37 | 609.8 | 907.4 | 11.6 | 51.7 | RMT 84.45 | 12 130 | 7400 |
| | | | | | | | | | | | RM 66.32 | 6065 | 3700 |
| | | | | | | | | | | | NR 48.28 | 3035 | 1850 |
| 636 000 | 322.3 | Orchid | AA, A | 37 | 0.1311 | 3.33 | 596.0 | 886.9 | 11.4 | 50.4 | RMT 84.45 | 12 400 | 7400 |
| | | | | | | | | | | | RM 66.32 | 6200 | 3700 |
| | | | | | | | | | | | NR 48.28 | 3100 | 1850 |
| 600 000 | 304.0 | Meadowsweet | AA, A | 37 | 0.1273 | 3.23 | 562.0 | 836.3 | 10.7 | 47.5 | RMT 84.45 | 13 140 | 7400 |
| | | | | | | | | | | | RM 66.32 | 6570 | 3700 |
| | | | | | | | | | | | NR 48.28 | 3285 | 1850 |
| 556 500 | 282.0 | Dahlia | AA | 19 | 0.1711 | 4.35 | 521.4 | 775.8 | 9.75 | 43.3 | RM 66.32 | 7270 | 3800 |
| | | | | | | | | | | | NR 48.28 | 3635 | 1900 |
| | | | | | | | | | | | NR 42.28 | 2425 | 1265 |
| 556 500 | 282.0 | Mistletoe | A | 37 | 0.1226 | 3.12 | 521.3 | 775.7 | 9.94 | 44.3 | RMT 84.45 | 14 170 | 7400 |
| | | | | | | | | | | | RM 66.32 | 7085 | 3700 |
| | | | | | | | | | | | NR 48.28 | 3545 | 1850 |
| 500 000 | 253.3 | Zinnia | AA | 19 | 0.1622 | 4.12 | 468.5 | 697.1 | 8.76 | 38.9 | RM 66.32 | 8100 | 3800 |
| | | | | | | | | | | | NR 48.28 | 4050 | 1900 |
| | | | | | | | | | | | NR 42.28 | 2700 | 1265 |
| 500 000 | 253.3 | Hyacinth | A | 37 | 0.1162 | 2.95 | 468.3 | 696.8 | 9.11 | 40.5 | RMT 84.45 | 15 760 | 7400 |
| | | | | | | | | | | | RM 66.32 | 7880 | 3700 |
| | | | | | | | | | | | NR 48.28 | 3940 | 1850 |
| 477 000 | 241.7 | Cosmos | AA | 19 | 0.1584 | 4.02 | 446.8 | 664.8 | 8.36 | 37.0 | RM 66.32 | 8490 | 3800 |
| | | | | | | | | | | | NR 48.28 | 4245 | 1900 |
| | | | | | | | | | | | NR 42.28 | 2830 | 1265 |
| 477 000 | 241.7 | Syringa | A | 37 | 0.1135 | 2.88 | 446.8 | 664.8 | 8.69 | 38.6 | RMT 84.45 | 16 530 | 7400 |
| | | | | | | | | | | | RM 66.32 | 8265 | 3700 |
| | | | | | | | | | | | NR 48.28 | 4135 | 1850 |
| 450 000 | 228.0 | Goldentuft | AA | 19 | 0.1539 | 3.91 | 421.8 | 627.6 | 7.89 | 35.0 | RM 66.32 | 9000 | 3800 |
| | | | | | | | | | | | NR 48.28 | 4500 | 1900 |
| | | | | | | | | | | | NR 42.28 | 3000 | 1265 |
| 397 500 | 201.4 | Canna | AA, A | 19 | 0.1447 | 3.67 | 372.9 | 554.9 | 7.11 | 31.6 | RM 66.32 | 10 180 | 3800 |
| | | | | | | | | | | | NR 48.28 | 5090 | 1900 |
| | | | | | | | | | | | NR 42.28 | 3395 | 1265 |
| 350 000 | 177.3 | Daffodil | A | 19 | 0.1357 | 3.45 | 327.9 | 487.9 | 6.39 | 28.4 | RM 66.32 | 11 560 | 3800 |
| | | | | | | | | | | | NR 48.28 | 5780 | 1900 |
| | | | | | | | | | | | NR 42.28 | 3855 | 1265 |
| 336 400 | 170.5 | Tulip | A | 19 | 0.1331 | 3.38 | 315.5 | 469.5 | 6.15 | 27.3 | RM 66.32 | 12 030 | 3800 |
| | | | | | | | | | | | NR 48.28 | 6015 | 1900 |
| | | | | | | | | | | | NR 42.28 | 4010 | 1265 |
| 300 000 | 152.0 | Peony | A | 19 | 0.1257 | 3.19 | 281.4 | 418.3 | 5.48 | 24.3 | RM 66.32 | 13 490 | 3800 |
| | | | | | | | | | | | NR 48.28 | 6745 | 1900 |
| | | | | | | | | | | | NR 42.28 | 4495 | 1265 |
| 266 800 | 135.2 | Daisy | AA | 7 | 0.1953 | 4.96 | 250.2 | 372.3 | 4.83 | 21.4 | NR 42.28 | 5590 | 1400 |
| | | | | | | | | | | | NR 36.22 | 2795 | 700 |
| 266 800 | 135.2 | Laurel | A | 19 | 0.1185 | 3.01 | 250.1 | 372.2 | 4.97 | 22.1 | RM 66.32 | 15 170 | 3800 |
| | | | | | | | | | | | NR 48.28 | 7585 | 1900 |
| | | | | | | | | | | | NR 42.28 | 5055 | 1265 |
| 250 000 | 126.7 | Sneezewort | AA | 7 | 0.1890 | 4.80 | 234.4 | 348.8 | 4.52 | 20.1 | NR 42.28 | 5970 | 1400 |
| | | | | | | | | | | | NR 36.22 | 2985 | 700 |
| 250 000 | 126.7 | Valerian | A | 19 | 0.1147 | 2.91 | 234.3 | 348.6 | 4.66 | 20.7 | RM 66.32 | 16 190 | 3800 |
| | | | | | | | | | | | NR 48.28 | 8095 | 1900 |
| | | | | | | | | | | | NR 42.28 | 5395 | 1265 |
| 4/0 | 107.2 | Oxlip | AA, A | 7 | 0.1739 | 4.42 | 198.4 | 295.2 | 3.83 | 17.0 | NR 42.28 | 7050 | 1400 |
| | | | | | | | | | | | NR 36.22 | 3525 | 700 |
| 3/0 | 85.0 | Phlox | AA, A | 7 | 0.1548 | 3.93 | 157.2 | 233.9 | 3.04 | 13.5 | NR 42.28 | 8890 | 1400 |
| | | | | | | | | | | | NR 36.22 | 4445 | 700 |
| 2/0 | 67.4 | Aster | AA, A | 7 | 0.1379 | 3.50 | 124.8 | 185.7 | 2.51 | 11.1 | NR 42.28 | 11 210 | 1400 |
| | | | | | | | | | | | NR 36.22 | 5605 | 700 |