



Designation: B231/B231M – 04

Standard Specification for Concentric-Lay-Stranded Aluminum 1350 Conductors¹

This standard is issued under the fixed designation B231/B231M; 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 ($\frac{3}{4}$ hard), 1350-H14 or -H24 ($\frac{1}{2}$ hard), and 1350-H142 or -H242 ($\frac{1}{2}$ 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 [E527](#).

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

[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](#)

[B354 Terminology Relating to Uninsulated Metallic Electrical Conductors](#)

[B609/B609M Specification for Aluminum 1350 Round Wire, Annealed and Intermediate Tempers, for Electrical Purposes](#)

[B682 Specification for Metric Sizes of Electrical Conductors](#)

[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 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 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](#)).

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* 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.



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.

Table with columns: Conductor Size (cmils or AWG, mm²), Code Words, Class, Required Construction (Number of Wires, Diameter of Wire in mm), Mass (Per 1000 ft, Per km), Rated Strength (kips, kN), and Recommended Package Sizes (Reel Designation, Nominal Length of Each Piece, Nominal Mass of Each Length).



TABLE 1 Continued

Conductor Size		Code Words ^C	Class	Required Construction		Mass		Rated Strength		Recommended Package Sizes ^A			
cmils ^B or AWG	mm ²			Number of Wires	Diameter of Wire		Per 1000 ft, lb	Per km, kg	kips	kN	Reel Designation ^D	Nominal Length of Each Piece, ft ^E	Nominal Mass of Each Length, lb ^B
					in.	mm							
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
											NR 48.28	3100	1850
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
											RM 66.32	15 170	3800
266 800	135.2	Laurel	A	19	0.1185	3.01	250.1	372.2	4.97	22.1	NR 48.28	7585	1900
											NR 42.28	5055	1265
											NR 42.28	5970	1400
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
											RM 66.32	16 190	3800
250 000	126.7	Valerian	A	19	0.1147	2.91	234.3	348.6	4.66	20.7	NR 48.28	8095	1900
											NR 42.28	5395	1265
											NR 42.28	7050	1400
4/0	107.2	Oxlip	AA, A	7	0.1739	4.42	198.4	295.2	3.83	17.0	NR 42.28	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



TABLE 1 Continued

Conductor Size				Required Construction		Mass		Rated Strength		Recommended Package Sizes ^A				
cmils ^B or AWG	mm ²	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 ^E	Nominal Mass of Each Length, lb ^F	
					in.	mm								
1/0	53.5	Poppy	AA, A	7	0.1228	3.12	98.9	147.2	1.99	8.84	NR 42.28	14 130	1400	
1	42.4	Pansy	AA, A	7	0.1093	2.78	78.4	116.6	1.64	7.30	NR 36.22	7065	700	
											NR 42.28	17 830	1400	
2	33.6	Iris	AA, A	7	0.0974	2.47	62.2	92.6	1.35	5.99	NR 36.22	8915	700	
											NR 42.28	22 470	1400	
4	21.1	Rose	A	7	0.0772	1.96	39.1	58.2	0.881	3.91	NR 36.22	11 235	700	
											NR 42.28	35 710	1400	
6	13.3	Peachbell	A	7	0.0612	1.56	24.6	36.6	0.563	2.53	NR 36.22	17 855	700	
											NR 42.28	56 910	1400	
											NR 36.22	28 455	700	

^A For information only.

^B Conversion factors: 1 cmil = 5.067 E-04 mm², 1 mil + 2.54 E-02 mm, 1 lb/1000 ft = 1.488 E+00 kg/km, 1 ft = 3.048 E-01 m, 1 lb = 4.536 E-01 kg, 1 lbf = 4.448 E-03 kN.

^C Code words shown in this column are from, "Publication 50, Code Words for Overhead Aluminum Electrical Conductors," by the Aluminum Association. They are provided here for information only.

^D See Table 9 for dimensions of standard reels.

4. Ordering Information

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

- 4.1.1 Quantity,
- 4.1.2 Conductor size: square millimetres, if cross-sectional area is specified as a requirement (Section 8 and Tables 1-4),
 - 4.1.2.1 Conductor size, number, and diameter of wires for Class B, C, or D conductors, if cross-sectional area is not specified as a requirement (see 8.2),
- 4.1.3 Class (see 3.1),
- 4.1.4 Temper (see 5.1),
- 4.1.5 Details of special-purpose lays, when required (see 7.2 through 7.5),
- 4.1.6 Special tension tests if required (see 14.1 and 15.1),
- 4.1.7 Package size and type (see 17.1 and Table 1 or Table 2),
- 4.1.8 Special package marking, if required (Section 19),
- 4.1.9 Heavy wood lagging, if required (see 18.2),
- 4.1.10 Place of inspection (Section 17), and
- 4.1.11 Method of cross-sectional area determination if not optional (see 12.1).

5. Requirements for Wires

5.1 Aluminum wire employed in Classes AA and A conductors shall be 1350-H19, unless otherwise specified. The purchaser shall designate the temper of conductors of Classes B, C, and D.

5.1.1 For conductor tempers other than 1350-H19, when temper designations are not more specific in the inquiry and purchase order, the manufacturer shall have the following options on manufacturing method:

- 5.1.1.1 Strand the conductor from wires drawn to final temper;
- 5.1.1.2 Strand the conductor from wires drawn to H19 temper and annealed to final temper prior to stranding;
- 5.1.1.3 Strand the conductor from 1350-H19 wires and anneal the stranded conductor to final temper.

5.2 Before stranding, the aluminum wire used shall meet the requirements of Specifications B230/B230M or B609/B609M, whichever is applicable.

5.3 All wires in the conductor shall be of the same temper.

6. Joints

6.1 Only cold-pressure joints or electric-butt, cold-upset joints may be made in the six outer finished wires of (1) Class AA conductors composed of seven wires or (2) Class A conductors composed of seven wires used in overhead lines. In other conductors, electric-butt welds, cold-pressure welds, or electric-butt, cold-upset welds may be made in the finished wires composing conductors, but such welds shall not be closer than prescribed in Table 5 (Explanatory Note 3).

7. Lay

7.1 For Class AA conductors composed of seven wires or more, the preferred lay of a layer of wires is 13.5 times the outside diameter of that layer, but the lay shall be not less than 10 nor more than 16 times this diameter.

7.2 For all other classes the lay of a layer of wires shall be not less than 8 nor more than 16 times the outside diameter of that layer, except that for conductors composed of 37 wires or more, this requirement shall apply only to the two outer layers. The lay of the layers other than the two outer layers shall be at the option of the manufacturer, unless otherwise agreed upon.

7.2.1 For conductors to be used in covered or insulated wires or cables, the lay length of the wires shall not be less than 8 nor more than 16 times the outer diameter of the finished conductor. For conductors of 37 wires or more, this requirement shall apply to the wires in the outer two layers. The lay of the layers other than the outer two layers shall be at the option of the manufacturer, unless otherwise agreed upon.

7.3 Other lays for special purposes shall be furnished by special agreement between the manufacturer and the purchaser (Explanatory Note 4).

7.4 The direction of lay of the outer layer shall be right-hand for Classes AA and A and left-hand for other classes, unless the direction of lay is specified otherwise by the purchaser.

TABLE 2 Construction Requirements and Recommended Reel Sizes and Shipping Lengths of Aluminum Conductors, Concentric Lay-Stranded, Classes AA and A

NOTE 1—Sizes selected from Specification B682.

Conductor Size, mm ²	Class	Stranding			Rated Strength 1350-H19, kN	Recommended Package Sizes ^A		
		Number of Wires	Diameter, mm	Mass, kg/km		Reel Designation ^B	Nominal Length of Each Piece, m	Nominal Mass of Each Length, kg
2000	A	127	4.48	5632	294	RMT 90.45	770	4325
1600	A	127	4.01	4512	236	RMT 90.45	960	4325
1250	A	91	4.18	3479	183	RMT 90.45	1185	4130
1120	A	91	3.96	3123	165	RMT 90.45	1320	4130
1000	A	91	3.74	2785	151	RMT 90.45	1495	4130
900	AA	61	4.33	2478	133	RMT 90.45	1785	4425
800	AA, A	61	4.09	2211	119	RMT 90.45	2000	4425
						RM 68.38	1000	2215
710	AA, A	61	3.85	1959	105	RMT 90.45	2260	4425
						RM 68.38	1130	2215
630	AA, A	61	3.63	1742	96.6	RMT 90.45	2540	4425
						RM 68.38	1270	2215
560	AA, A	61	3.42	1546	85.7	RMT 90.45	2860	4425
						RM 68.38	1430	2215
500	AA	37	4.15	1381	75.1	RMT 84.45	2430	3355
						RM 66.32	1215	1680
						NR 48.28	610	840
500	A	61	3.23	1379	76.5	RMT 90.45	3210	4425
						RM 68.38	1605	2215
450	AA	37	3.94	1245	67.7	RMT 84.45	2695	3355
						RM 66.32	1350	1680
						NR 48.28	675	840
450	A	61	3.06	1238	68.6	RMT 90.45	3575	4425
						RM 68.38	1790	2215
400	AA	37	3.71	1104	61.9	RMT 84.45	3040	3355
						RM 66.32	1520	1680
						NR 48.28	760	840
400	A	61	2.89	1104	63.0	RMT 90.45	4010	4425
						RM 68.38	2005	2215
355	AA	37	3.50	982	55.1	RMT 84.45	3415	3355
						RM 66.32	1710	1680
						NR 48.28	855	840
355	A	61	2.72	978	57.4	RMT 90.45	4525	4425
						RM 68.38	2265	2215
315	AA, A	37	3.29	868	48.7	RMT 84.45	3865	3355
						RM 66.32	1935	1680
						NR 48.28	970	840
280	AA	19	4.33	772	42.9	RM 66.32	2235	1725
						NR 48.28	1115	860
						NR 42.28	745	575
280	A	37	3.10	771	43.2	RMT 84.45	4350	3355
						RM 66.32	2180	1680
						NR 48.28	1090	840
250	AA	19	4.09	689	38.3	RM 66.32	2505	1725
						NR 48.28	1250	860
						NR 42.28	835	575
250	A	37	2.93	688	39.7	RMT 84.45	875	3355
						RM 66.32	2440	1680
						NR 48.28	1220	840
224	AA	19	3.87	617	34.3	RM 66.32	2795	1725
						NR 48.28	1395	860
						NR 42.28	930	575
200	AA, A	19	3.66	552	31.6	RM 66.32	3125	1725
						NR 48.28	1560	860
						NR 42.28	1040	575
180	A	19	3.47	496	28.4	RM 66.32	3480	1725
						NR 48.28	1730	860
						NR 42.28	1160	575
160	A	19	3.27	440	25.2	RM 66.32	3920	1725
						NR 48.28	1955	860
						NR 42.28	1305	575
140	AA	7	5.05	387.0	22.2	NR 42.28	1640	635
						NR 36.22	830	320
140	A	19	3.06	386	22.1	RM 66.32	4470	1725
						NR 48.28	2230	860
						NR 42.28	1490	575
125	AA	7	4.77	345	19.8	NR 42.28	1840	635
						NR 36.22	930	320



TABLE 3 Construction Requirements of Aluminum Conductors, Concentric-Lay-Stranded, Class B, C, and D

Table with columns: Conductor Size, Hard-Drawn Copper Equivalent, Stranding (Class B, C, D), Reverse Concentric Compressed Class B, Unilay Compressed Class B, and Direct Current Resistance at 20°C. Rows list various conductor sizes from 4 000 000 to 1020.

A See Footnote B of Table 1.

B This size is sensibly equivalent to size 1 033 500 cmils within a difference of 3.24 %.

C These sizes are sensibly equivalent to sizes 1 590 000; 1 272 000; 795 000; and 397 500 cmil respectively within the cross-sectional area tolerances stipulated by this specification and associated Specifications B230/B230M and B609/B609M.