



Designation: B524/B524M – 23

# Standard Specification for Concentric-Lay-Stranded Aluminum Conductors, Aluminum-Alloy Reinforced (ACAR, 1350/6201)<sup>1</sup>

This standard is issued under the fixed designation B524/B524M; 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 concentric-lay-stranded conductors made from round aluminum 1350-H19 (extra hard) wires and round aluminum-alloy 6201-T81 (hard: solution heat treated, cold worked, and then artificially aged) core wires for use as overhead electrical conductors (Explanatory Note 1).

NOTE 1—The aluminum, alloy, and temper designations conform to ANSI H35.1/ANSI H35.1[M]. Aluminum 1350 and Alloy 6201 correspond to unified numbering system A91350 and A96201, respectively, in accordance with Practice E527.

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.

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

1.4 *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:

<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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## 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/B263M Test Method for Determination of Cross-Sectional Area of Stranded Conductors

B354 Terminology Relating to Uninsulated Metallic Electrical Conductors

B398/B398M Specification for Aluminum-Alloy 6201-T81 and 6201-T83 Wire for Electrical Purposes

B682 Specification for Standard 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 Standard:

ANSI H35.1 American National Standard for Alloy and Temper Designation Systems for Aluminum<sup>3</sup>

ANSI H35.1[M] American National Standard for Alloy and Temper Designation Systems for Aluminum<sup>3</sup>

## 2.4 NIST Document:

NBS Handbook 100—Copper Wire Tables<sup>4</sup>

## 3. Ordering Information

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

3.1.1 Quantity of each size and stranding;

3.1.2 Conductor size (see 7.1);

3.1.3 Total number of wires, aluminum 1350 and aluminum alloy 6201 (Table 1 or Table 2);

3.1.4 Direction of lay of outer layer of wires if other than right-hand (see 6.3);

3.1.5 Special tension test, if required (see 8.2);

<sup>2</sup> 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.

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

<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.



TABLE 1 Construction Requirements of Concentric-Lay-Stranded Aluminum Conductors, Aluminum Alloy Reinforced

Conductor Size			Required Construction					Recommended Package Sizes <sup>A</sup>				
			Number of Wires <sup>B</sup>	Diameter of Wires		Nominal Outside Diameter		Reel Designation	Approximate Length of Each Piece		Approximate Mass of Each Length <sup>C</sup>	
cmil	AWG	mm <sup>2</sup>		in.	mm	in.	mm		ft	m	lb	kg
3 000 000		1520	91	0.1816	4.613	1.998	50.74	RMT 90.45	3 200	975	9 100	4130
2 750 000		1393	91	0.1738	4.415	1.912	48.56	RMT 90.45	3 490	1065	9 100	4130
2 500 000		1267	91	0.1657	4.209	1.823	46.30	RMT 90.45	3 840	1170	9 100	4130
2 493 000		1263	91	0.1655	4.204	1.8207	46.25	RMT 96.60	6 500	1981	15 400	6970
2 338 000		1185	61	0.1958	4.973	1.7620	44.75	RMT 96.60	7 500	2286	16 700	7540
2 250 000		1140	91	0.1572	3.993	1.729	43.92	RMT 90.45	4 270	1300	9 100	4130
2 000 000		1013	91	0.1482	3.764	1.630	41.40	RMT 90.45	4 850	1480	9 100	4130
2 000 000		1013	61	0.1811	4.600	1.630	41.40	RMT 90.45	5 200	1585	9 760	4425
1 933 000		979	61	0.1780	4.522	1.6021	40.69	RMT 96.60	9 200	2804	16 700	7570
1 900 000		963	61	0.1765	4.483	1.588	40.35	RMT 90.45	5 470	1665	9 760	4425
1 800 000		912	61	0.1718	4.364	1.546	39.28	RMT 90.45	5 780	1760	9 760	4425
1 798 000		911	61	0.1717	4.361	1.5452	39.25	RMT 96.60	9 200	2804	15 600	7040
1 750 000		887	61	0.1694	4.303	1.525	38.73	RMT 90.45	5 940	1810	9 760	4425
1 703 000		863	61	0.1671	4.244	1.8380	46.68	RMT 96.60	9 000	2743	14 400	6530
1 700 000		861	61	0.1669	4.239	1.502	38.15	RMT 90.45	6 120	1865	9 760	4425
1 600 000		811	61	0.1620	4.115	1.458	37.04	RMT 90.45	6 500	1980	9 760	4425
1 534 400		777	61	0.1586	4.028	1.4274	36.26	RMT 96.60	10 000	3048	14 400	6530
1 500 000		760	61	0.1568	3.983	1.411	35.85	RMT 90.45	6 930	2110	9 760	4425
1 400 000		709	61	0.1515	3.848	1.364	34.63	RMT 90.45	7 430	2265	9 760	4425
1 361 500		690	61	0.1494	3.795	1.3446	34.15	RMT 96.60	11 250	3429	14 400	6530
1 300 000		659	61	0.1460	3.708	1.314	33.37	RMT 90.45	8 000	2440	9 760	4425
1 300 000		659	37	0.1874	4.760	1.312	33.32	RMT 84.45	6 065	1850	7 400	3355
1 277 000		647	61	0.1447	3.675	1.3022	33.08	RMT 96.60	12 000	3658	14 400	6520
1 250 000		633	61	0.1431	3.635	1.288	32.72	RMT 90.45	8 320	2535	9 760	4425
1 250 000		633	37	0.1838	4.669	1.287	32.70	RMT 84.45	6 310	1920	7 400	3355
1 200 000		608	61	0.1403	3.564	1.263	32.08	RMT 90.45	8 660	2640	9 760	4425
1 200 000		608	37	0.1801	4.575	1.261	32.02	RMT 84.45	6 565	2000	7 400	3355
1 198 000		607	37	0.1799	4.570	1.2596	31.99	RMT 96.60	12 850	3917	14 500	6550
1 172 000		594	37	0.1780	4.521	1.2458	31.64	RMT 96.60	14 400	4389	15 900	7180
1 109 000		562	37	0.1731	4.397	1.2119	30.78	RMT 96.60	13 850	4221	14 500	6540
1 100 000		557	61	0.1343	3.411	1.209	30.70	RMT 90.45	9 450	2880	9 760	4425
1 100 000		557	37	0.1724	4.379	1.207	30.65	RMT 84.45	7 160	2180	7 400	3355
1 080 600		548	37	0.1709	4.341	1.1963	30.39	RMT 96.60	15 600	4755	15 800	7170
1 024 500		519	37	0.1664	4.227	1.1648	29.59	RMT 96.60	15 000	4572	14 500	6540
1 000 000		507	61	0.1280	3.251	1.152	29.26	RMT 90.45	10 400	3170	9 760	4425
1 000 000		507	37	0.1644	4.176	1.151	29.23	RMT 84.45	7 880	2400	7 400	3355
950 000		481	37	0.1602	4.069	1.121	28.48	RMT 84.45	8 300	2530	7 400	3355
927 200		470	37	0.1583	4.021	1.1081	28.15	RMT 90.45	10 400	3170	9 050	4110
900 000		456	37	0.1560	3.962	1.092	27.73	RMT 84.45	8 760	2670	7 400	3355
853 700		433	37	0.1519	3.858	1.0633	27.01	RMT 96.60	18 000	5486	14 500	6540
850 000		431	37	0.1516	3.851	1.061	26.96	RMT 84.45	9 270	2825	7 400	3355
800 000		405	37	0.1470	3.734	1.029	26.14	RMT 84.45	9 850	3000	7 400	3355
750 000		380	37	0.1424	3.617	0.997	25.32	RMT 84.45	10 510	3200	7 400	3355
739 800		375	37	0.1414	3.592	0.9898	25.14	RMT 90.45	13 010	3965	9 020	4090
700 000		355	37	0.1375	3.493	0.962	24.45	RMT 84.45	11 260	3430	7 400	3355
653 100		331	19	0.1854	4.709	0.9270	23.55	RMT 84.45	9 910	3021	6 070	2760
650 000		329	37	0.1325	3.366	0.928	23.56	RMT 84.45	12 130	3695	7 400	3355
649 500		329	37	0.1325	3.365	0.9274	23.56	NR 66.28	6 890	2100	4 200	1910
600 000		304	37	0.1273	3.233	0.891	22.63	RMT 84.45	13 140	4005	7 400	3355
600 000		304	19	0.1777	4.513	0.888	22.56	RM 66.32	6 750	2060	3 800	1725
								NR 66.28				
587 200		298	19	0.1758	4.465	0.8790	22.33	NR 66.28	8 030	2448	4 430	2010
550 000		279	37	0.1219	3.096	0.853	21.67	RMT 84.45	14 330	4365	7 400	3355
550 000		279	19	0.1701	4.321	0.850	21.60	RM 66.32	7 360	2245	3 800	1725
								NR 66.28				
503 600		255	19	0.1628	4.135	0.8140	20.68	NR 66.28	8 030	2448	3 800	1730
500 000		253	37	0.1162	2.951	0.813	20.66	RMT 84.45	15 765	4805	7 400	3355
500 000		253	19	0.1622	4.120	0.811	20.60	RM 66.32	8 100	2470	3 800	1725
								NR 66.28				
450 000		228	19	0.1539	3.909	0.770	19.54	RM 66.32	9 000	2745	3 800	1725
								NR 66.28				
400 000		203	19	0.1451	3.685	0.726	18.42	RM 66.32	10 120	3085	3 800	1725
								NR 66.28				
350 000		177	19	0.1357	3.447	0.678	17.24	RM 66.32	11 560	3530	3 800	1725
								NR 66.28				
300 000		152	19	0.1257	3.193	0.628	15.96	RM 66.32	13 490	4115	3 800	1725
								NR 66.28				
250 000		127	19	0.1147	2.913	0.574	14.56	RM 66.32	16 190	4940	3 800	1725
								NR 66.28				

**TABLE 1** *Continued*

Conductor Size			Required Construction					Recommended Package Sizes <sup>A</sup>					
			Number of Wires <sup>B</sup>	Diameter of Wires		Nominal Outside Diameter		Reel Designation	Approximate Length of Each Piece		Approximate Mass of Each Length <sup>C</sup>		
cmil	AWG	mm <sup>2</sup>		in.	mm	in.	mm		ft	m	lb	kg	
246	900		125	7	0.1878	4.770	0.563	14.31	NR 36.22	3 020	920	700	318
211	600	4/0	107	7	0.1739	4.417	0.522	13.25	NR 36.22	3 525	1075	700	318
195	700		99.1	7	0.1672	4.247	0.502	12.74	NR 36.22	3 810	1165	700	318
167	800	3/0	85.0	7	0.1548	3.932	0.464	11.80	NR 36.22	4 445	1355	700	318
155	400		78.7	7	0.1490	3.785	0.447	11.35	NR 36.22	4 800	1465	700	318
133	100	2/0	67.4	7	0.1379	3.503	0.414	10.52	NR 36.22	5 605	1710	700	318
123	300		62.5	7	0.1327	3.371	0.398	10.11	NR 36.22	6 050	1845	700	318
105	600	1/0	53.5	7	0.1228	3.119	0.368	9.35	NR 36.22	7 065	2155	700	318
77	470		39.3	7	0.1052	2.672	0.316	8.03	NR 36.22	9 630	2940	700	318
66	360	2	33.6	7	0.0974	2.474	0.292	7.42	NR 36.22	11 235	3430	700	318
48	690		24.7	7	0.0834	2.118	0.250	6.35	NR 36.22	15 315	4675	700	318
41	740	4	21.2	7	0.0772	1.961	0.232	5.89	NR 36.22	17 855	5455	700	318
30	580		15.5	7	0.0661	1.679	0.198	5.03	NR 36.22	24 390	7445	700	318

<sup>A</sup> See Table 4 for dimensions of standard reels.

<sup>B</sup> Recommended standard stranding combinations are shown in Table 5.

<sup>C</sup> See Table 7 for mass per unit length for each stranding.

- 3.1.6 Place of inspection (see 14.2);
- 3.1.7 Package size and type (see 16.1);
- 3.1.8 Heavy wood lagging, if required (Section 16); and
- 3.1.9 Special package marking, if required (Section 15).

#### 4. Requirement for Wires

- 4.1 Before stranding, the 1350-H19 wire used shall meet the requirements of Specification B230/B230M.
- 4.2 Before stranding, the 6201-T81 wire used shall meet the requirements of Specification B398/B398M.

#### 5. Joints

5.1 In conductors composed of seven wires, only cold-pressure welds and electric butt, cold-upset welds may be made in the six outer finished wires. No welds are permitted in the center core wire. In other conductors, cold-pressure welds, electric-butt, cold-upset welds, or electric-butt welds may be made in the finished wires. Such joints in the same wire or any other wire in the conductor shall be not closer than prescribed in Table 3. Following welding, electric-butt welds in 6201 wires shall be annealed for a distance of at least 6 in. (150 mm) on each side of the weld (Explanatory Note 2).

#### 6. Lay

- 6.1 The length of lay of a layer of wires shall not be less than 10 nor more than 16 times the outside diameter of that layer.
- 6.2 In a conductor having multiple layers of aluminum wires, the length of lay of any aluminum layer shall not be less than the length of lay of the aluminum layer immediately beneath it.
- 6.3 The direction of lay of the outer layer shall be right-hand unless specified otherwise by the purchaser. The direction of lay shall be reversed in successive layers.

#### 7. Construction

- 7.1 The number and diameter of wires and the areas of cross section of conductors shall conform to the requirements prescribed in Table 1 or Table 2.
- 7.2 Recommended standard strandings are as shown in Table 4.
- 7.3 The nominal wire diameter shall be as specified in Table 1 and this diameter shall be referred to as the “mean diameter”. The nominal outside diameter of the conductor shall be calculated by summing the mean diameter of the core wire and twice the mean diameter of each layer. The minimum and maximum outside diameter shall be based on calculations made using the method described above and the mean diameter tolerances as specified by Specification B230/B230M and Specification B398/B398M for the corresponding mean diameter of each layer.

#### 8. Strength of Conductor

8.1 The rated strength of completed conductors shall be taken as the aggregate strength of the aluminum 1350 and the aluminum-alloy 6201 components, calculated as follows. The strength contribution of the aluminum 1350 wires shall be taken as the percentage indicated in Table 6, of the sum of the strengths of the aluminum 1350 wires, calculated from their specified nominal wire diameter and the appropriate specified minimum average tensile strength given in Specification B230/B230M. The strength contribution of the aluminum-alloy 6201 wires shall be taken as that percentage, according to the number of layers of aluminum-alloy 6201 wires, indicated in Table 6, of the sum of the strengths of the aluminum-alloy 6201 wires, calculated from their specified nominal wire diameter and the minimum stress at 1 % extension. This shall be considered to be 95 % of the minimum average tensile strength specified for the wire diameter in Specification B398/B398M.