Designation: B 549 – 00

Standard Specification for Concentric-Lay-Stranded Aluminum Conductors, Aluminum-Clad Steel Reinforced (ACSR/AW)[1]

This standard is issued under the fixed designation B 549; 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 concentric-lay-stranded conductors made from round aluminum 1350-H19 (extra hard) aluminum wires and round aluminum-clad steel core wires for use as overhead electrical conductors (Explanatory Note 1 and Note 2).

1.2 The SI values of density and resistivity are to be regarded as standard. For all other properties the inch-pound units are regarded as standard and the SI units may be approximate.

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:*

B 230 Specification for Aluminum 1350-H19 Wire for Electrical Purposes[2]

B 263 Test Method for Determination of Cross-Sectional Area of Stranded Conductors[2]

B 354 Terminology Relating to Uninsulated Metallic Electrical Conductors[2]

B 502 Specification for Aluminum-Clad Steel Core Wire for Aluminum Conductors, Aluminum-Clad Steel Reinforced[2]

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications[3]

2.3 *ANSI Standards:*[4]

ANSI C 42.100 Dictionary of Electrical and Electronics Terms

ANSI H 35.1 American National Standard Alloy and Temper Designation Systems for Aluminum

2.4 *Other Standard:*

NBS Handbook 100—Copper Wire Tables of the National Bureau of Standards[5]

3. Terminology

3.1 *Description of Terms Specific to This Standard*

3.1.1 ACSR covered by this specification has one type of steel core wire which is designated by the following abbreviation (Explanatory Note 2):

3.1.1.1 *ACSR/AW*—ACSR using aluminum-clad steel wire (Explanatory Note 2).

4. Classification

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

4.1.1 *Class AA*—For bare conductors usually used in overhead lines. These conductors are used as follows:

4.1.1.1 Conductors used for regular overhead line construction and

4.1.1.2 Conductors having a high ratio of mechanical strength to current-carrying capacity used for overhead ground wires and for extra-long span construction.

4.1.2 *Class A*—For conductors to be covered with weather-resistant (weatherproof) materials.

5. Ordering Information

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

5.1.1 Quantity of each size, stranding, and class,

5.1.2 Conductor size: circular mil area or AWG of aluminum wires (Section 9 and Table 1),

5.1.3 Number of wires, aluminum and aluminum-clad steel (Table 1),

5.1.4 Direction of lay of outer layer of aluminum wires if other than right-hand (see 8.2),

5.1.5 Special tests, if required (see 15.3 and 15.5),

5.1.6 Package size (see 17.1 and Explanatory Note 5),

5.1.7 Special package marking, if required (Section 17),

5.1.8 Lagging, if required (see 17.3), and

5.1.9 Place of inspection (Section 16).

6. Requirement for Wires

6.1 Before stranding, the aluminum wires used shall meet

[1] This specification is under the jurisdiction of ASTM Committee B-1 on Electrical Conductors and is the direct responsibility of Subcommittee B01.07 on Conductors of Light Metals.

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[2] *Annual Book of ASTM Standards*, Vol 02.03.

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

[4] Available from the American National Standards Institute, 11 West 42nd St., 13th Floor, New York, NY 10036.

[5] Available from the National Technical Information Service, 5285 Port Royal Rd., Springfield, VA 22161.

all the requirements of Specification B 230.

6.2 Before stranding, the aluminum-clad steel core wires used shall meet all the requirements of Specification B 502.

7. Joints

7.1 Electric-butt welds, cold-pressure welds, or electric-butt, cold-upset welds in the finished individual aluminum wires composing the conductor may be made during the stranding process. No weld shall occur within 50 ft (15 m) of a weld in the same wire or in any other wire of the completed conductor (Explanatory Note 1).

7.2 There shall be no joints of any kind made in the finished aluminum-clad steel wires.

TABLE 1 Construction Requirements of Concentric-Lay-Stranded Aluminum Conductors, Aluminum-Clad Steel Reinforced[A]

NOTE 1—The size in boldface indicate more commonly used sizes. (+) indicates conductors with high strength to current capacity ratios.

Conductor Size (Aluminum Wire)					Stranding						Rated Strength		Mass per Unit Length	
					Aluminum			Aluminum-Clad Steel						
cmil	Code Name	AWG	mm	Class	Number of Wires	Nominal Diameter		Number of Wires	Nominal Diameter		kip (1000 lbf)	kN	lb/1000 ft	kg/km
						in.	mm		in.	mm				
2312000	Thrasher/AW	. . .	1171.49	AA	76	0.1744	4.4298	19	0.0814	2.068	55.3	246.0	2472	3679
2167000	Kiwi/AW	. . .	1098.02	AA	72	0.0174	0.4407	7	0.1157	2.939	49.1	218.4	2262	3366
2156000	**Bluebird/AW**	**. . .**	**1092.45**	**AA**	**84**	**0.1602**	**4.0691**	**19**	**0.0961**	**2.441**	**59.0**	262.4	**2437**	**3627**
1780000	**Chukar/AW**	**. . .**	**901.93**	**AA**	**84**	**0.1456**	**3.6982**	**19**	**0.0874**	**2.220**	**49.4**	219.7	**2013**	**2996**
1590000	**Falcon/AW**	**. . .**	**805.65**	**AA**	**54**	**0.1716**	**4.3586**	**19**	**0.1030**	**2.616**	**53.0**	235.7	**1960**	**2917**
1590000	**Lapwing/AW**	**. . .**	**805.65**	**AA**	**45**	**0.1880**	**4.7752**	**7**	**0.1253**	**3.183**	41.8	185.9	**1746**	**2598**
1510500	Parrot/AW	. . .	765.37	AA	54	0.1672	4.2469	19	0.1003	2.548	50.3	223.7	1860	2768
1510500	Nuthatch/AW	. . .	765.37	AA	45	0.1832	4.6533	7	0.1221	3.101	39.7	176.8	1658	2467
1431000	**Plover/AW**	**. . .**	**725.09**	**AA**	**54**	**0.1628**	**4.1351**	**19**	**0.0977**	**2.482**	**47.7**	212.2	**1764**	**2625**
1431000	**Bobolink/AW**	**. . .**	**725.09**	**AA**	**45**	**0.1783**	**4.5288**	**7**	**0.1189**	**3.020**	**37.6**	167.2	**1570**	**2336**
1351500	Martin/AW	. . .	684.81	AA	54	0.1582	4.0183	19	0.0949	2.410	45.1	200.6	1665	2478
1351500	Dipper/AW	. . .	684.81	AA	45	0.1733	4.4018	7	0.1155	2.934	35.5	157.9	1483	2207
1272000	Pheasant/AW	. . .	644.52	AA	54	0.1535	3.8989	19	0.0921	2.339	42.4	188.6	1568	2333
1272000	**Bittern/AW**	**. . .**	**644.52**	**AA**	**45**	**0.1681**	**4.2697**	**7**	**0.1121**	**2.847**	**33.4**	148.6	**1396**	**2078**
1272000	**Skylark/AW**	**. . .**	**644.52**	**AA**	**36**	**0.1880**	**4.7752**	**1**	**0.1880**	**4.775**	**25.7**	114.3	**1272**	**1893**
1192500	Grackle/AW	. . .	604.24	AA	54	0.1486	3.7744	19	0.0892	2.266	40.2	178.8	1470	2188
1192500	Bunting/AW	. . .	604.24	AA	45	0.1628	4.1351	7	0.1085	2.756	31.3	139.2	1309	1948
1113000	**Finch/AW**	**. . .**	**563.96**	**AA**	**54**	**0.1436**	**3.6474**	**19**	**0.0862**	**2.189**	**37.5**	166.8	**1373**	**2043**
1113000	**Bluejay/AW**	**. . .**	**563.96**	**AA**	**45**	**0.1573**	**3.9954**	**7**	**0.1049**	**2.664**	**29.3**	130.3	**1222**	**1819**
1033500	Curlew/AW	. . .	523.67	AA	54	0.1383	3.5128	7	0.1383	3.513	35.6	158.3	1274	1896
1033500	Ortolan/AW	. . .	523.67	AA	45	0.1515	3.8481	7	0.1010	2.565	27.1	120.5	1134	1688
1033500	Tanager/AW	. . .	523.67	AA	36	0.1694	4.3028	1	0.1694	4.303	21.1	93.9	1033	1537
954000	**Cardinal/AW**	**. . .**	**483.39**	**AA**	**54**	**0.1329**	**3.3757**	**7**	**0.1329**	**3.376**	**32.9**	146.3	**1177**	**1752**
954000	**Rail/AW**	**. . .**	**483.39**	**AA**	**45**	**0.1456**	**3.6982**	**7**	**0.0971**	**2.466**	**25.4**	113.0	**1047**	**1558**
954000	Catbrid/AW	. . .	483.39	AA	36	0.1628	4.1351	1	0.1628	4.135	19.5	86.7	954	1420
900000	Canary/AW	. . .	456.03	AA	54	0.1291	3.2791	7	0.1291	3.279	31.0	137.9	1111	1653
900000	Ruddy/AW	. . .	456.03	AA	45	0.1414	3.5916	7	0.0943	2.395	24.0	106.8	988	1470
795000	Mallary/AW	. . .	402.83	AA	30	0.1628	4.1351	19	0.0977	2.482	37.1	165.0	1160	1726
795000	Condor/AW	. . .	402.83	AA	54	0.1213	3.0810	7	0.1213	3.081	27.8	123.7	980	1458
795000	**Tern/AW**	**. . .**	**402.83**	**AA**	**45**	**0.1329**	**3.3757**	**7**	**0.0886**	**2.250**	**21.5**	95.6	**872**	**1298**
795000	**Drake/AW**	**. . .**	**402.83**	**AA**	**26**	**0.1749**	**4.4425**	**7**	**0.1360**	**3.454**	**30.5**	135.7	**1041**	**1549**
795000	**Cuckoo/AW**	**. . .**	**402.83**	**AA**	**24**	**0.1820**	**4.6228**	**7**	**0.1213**	**3.081**	**27.5**	122.3	**981**	**1460**
795000	Coot/AW	. . .	402.83	AA	36	0.1486	3.7744	1	0.1486	3.774	16.6	73.8	795	1183
715500	Redwing/AW	. . .	362.54	AA	30	0.1544	3.9218	19	0.0926	2.352	33.4	148.6	1043	1552
715500	Starling/AW	. . .	362.54	AA	26	0.1659	4.2139	7	0.1290	3.277	27.5	122.3	936	1393
715500	Stilt/AW	. . .	362.54	AA	24	0.1727	4.3866	7	0.1151	2.924	24.8	110.3	883	1314
666600	Gannet/AW	. . .	337.77	AA	26	0.1601	4.0665	7	0.1245	3.162	26.0	115.6	872	1298
666600	Flamingo/AW	. . .	337.77	AA	24	0.1667	4.2342	7	0.1111	2.822	23.1	102.7	823	1225
636000	Egret/AW	. . .	322.26	AA	30	0.1456	3.6982	19	0.0874	2.220	29.9	133.0	928	1381
636000	Sooter/AW	. . .	322.26	AA	30	0.1456	3.6982	7	0.1456	3.698	29.3	130.3	935	1391
636000	**Grosbeak/AW**	**. . .**	**322.26**	**AA**	**26**	**0.1564**	**3.9726**	**7**	**0.1216**	**3.089**	**24.8**	110.3	**832**	**1238**
636000	**Rook/AW**	**. . .**	**322.26**	**AA**	**24**	**0.1628**	**4.1351**	**7**	**0.1085**	**2.756**	**22.0**	97.9	**785**	**1168**
636000	Swift/AW	. . .	322.26	AA	36	0.1329	3.3757	1	0.1329	3.376	13.6	60.5	636	946
636000	**Kingbird/AW**	**. . .**	**322.26**	**AA**	**18**	**0.1880**	**4.7752**	**1**	**0.1880**	**4.775**	**15.0**	66.7	**676**	**1006**
605000	Teal/AW	. . .	306.55	AA	30	0.1420	3.6068	19	0.0852	2.164	28.5	126.8	883	1314
605000	Wood Duck/AW	. . .	306.55	AA	30	0.1420	3.6068	7	0.1420	3.607	28.4	126.3	889	1323

TABLE 1 *Continued*

Conductor Size (Aluminum Wire)					Stranding						Rated Strength		Mass per Unit Length	
					Aluminum			Aluminum-Clad Steel						
cmil	Code Name	AWG	mm	Class	Number of Wires	Nominal Diameter		Number of Wires	Nominal Diameter		kip (1000 lbf)	kN	lb/1000 ft	kg/km
						in.	mm		in.	mm				
605000	Squab/AW	. . .	306.55	AA	26	0.1525	3.8735	7	0.1186	3.012	23.6	105.0	791	1177
605000	Peacock/AW	. . .	306.55	AA	24	0.1588	4.0335	7	0.1059	2.690	21.0	93.4	747	1112
556500	Eagle/AW	. . .	281.98	AA	30	0.1362	3.4595	7	0.1362	3.459	26.8	119.2	818	1217
556500	**Dove/AW**	**. . .**	**281.98**	**AA**	**26**	**0.1463**	**3.7160**	**7**	**0.1138**	**2.891**	**21.9**	97.4	**728**	**1083**
556500	**Parakeet/AW**	**. . .**	**281.98**	**AA**	**24**	**0.1523**	**3.8684**	**7**	**0.1015**	**2.578**	**19.3**	85.8	687	**1022**
556500	**Ospray/AW**	**. . .**	**281.98**	**AA**	**18**	**0.1758**	**4.4653**	**1**	**0.1758**	**4.465**	**13.2**	58.7	**591**	**880**
477000	**Hen/AW**	**. . .**	**241.70**	**AA**	**30**	**0.1261**	**3.2029**	**7**	**0.1261**	**3.203**	23.4	104.1	**701**	**1043**
477000	**Hawk/AW**	**. . .**	**241.70**	**AA**	**26**	**0.1354**	**3.4392**	**7**	**0.1053**	**2.675**	**18.9**	84.1	**624**	**929**
477000	**Flicker/AW**	**. . .**	**241.70**	**AA**	**24**	**0.1410**	**3.5814**	**7**	**0.0940**	**2.388**	**16.7**	74.3	**589**	**877**
477000	**Pelican/AW**	**. . .**	**241.70**	**AA**	**18**	**0.1628**	**4.1351**	**1**	**0.1628**	**4.135**	**11.5**	51.2	**507**	**755**
397500	Lark/AW	. . .	201.41	AA	30	0.1151	2.9235	7	0.1151	2.924	19.6	87.2	584	869
397500	**Ibis/AW**	**. . .**	**201.41**	**AA**	**26**	**0.1236**	**3.1394**	**7**	**0.0961**	**2.441**	**15.8**	70.3	**520**	**774**
397500	**Brant/AW**	**. . .**	**201.41**	**AA**	**24**	**0.1287**	**3.2690**	**7**	**0.0858**	**2.179**	**14.1**	62.7	**491**	**731**
397500	**Chickadee/AW**	**. . .**	**201.41**	**AA**	**18**	**0.1486**	**3.7744**	**1**	**0.1486**	**3.774**	**9.8**	43.5	**422**	**628**
336400	**Oriole/AW**	**. . .**	**170.45**	**AA**	**30**	**0.1059**	**2.6899**	**7**	**0.1059**	**2.690**	**16.7**	74.3	**495**	**737**
336400	**Linnet/AW**	**. . .**	**170.45**	**AA**	**26**	**0.1137**	**2.8880**	**7**	**0.0884**	**2.245**	**13.5**	60.0	**440**	**655**
336400	**Merlin/AW**	**. . .**	**170.45**	**AA**	**18**	**0.1367**	**3.4722**	**1**	**0.1367**	**3.472**	**8.5**	38.0	**357**	**531**
300000	**Ostrich/AW**	**. . .**	**152.01**	**AA**	**26**	**0.1074**	**2.7280**	**7**	**0.0835**	**2.121**	**12.1**	53.8	**392**	**583**
266800	**Partridge/AW**	**. . .**	**135.19**	**AA**	**26**	**0.1013**	**2.5730**	**7**	**0.0788**	**2.002**	**10.8**	48.0	**349**	**519**
266800	**Waxwing/AW**	**. . .**	**135.19**	**AA**	**18**	**0.1217**	**3.0912**	**1**	**0.1217**	**3.091**	**6.8**	30.3	**283**	**421**
211600	**Penguin/AW**	**0000**	**107.22**	**AA,A**	**6**	**0.1878**	**4.7701**	**1**	**0.1878**	**4.770**	**7.7**	34.2	**277**	**412**
211300		0000	107.07	AA(+)	12	0.1327	3.3706	7	0.1327	3.371	19.8	88.1	477	710
203200		0000	102.96	AA(+)	16	0.1127	2.8626	19	0.0977	2.482	27.1	120.5	601	894
190800		0000	96.68	AA(+)	12	0.1261	3.2029	7	0.1261	3.203	18.3	81.4	431	641
176900		0000	89.64	AA(+)	12	0.1214	3.0836	7	0.1214	3.084	16.9	75.2	399	594
167800	**Pigeon/AW**	**000**	**85.02**	**AA,A**	**6**	**0.1672**	**4.2469**	**1**	**0.1672**	**4.247**	**6.3**	28.0	**219**	**326**
159000		000	80.57	AA(+)	12	0.1151	2.9235	7	0.1151	2.924	15.3	68.1	359	534
152500		000	77.27	AA(+)	5	0.1747	4.4374	2	0.1747	4.437	9.7	43.0	281	418
141300		000	71.60	AA(+)	4	0.1880	4.7752	3	0.1880	4.775	14.2	63.2	373	555
134600		000	68.20	AA(+)	12	0.1059	2.6899	7	0.1059	2.690	13.0	57.8	304	452
133100	**Quail/AW**	**00**	**67.44**	**AA,A**	**6**	**0.1489**	**3.7821**	**1**	**0.1489**	**3.782**	**5.1**	22.8	**174**	**259**
121000		00	61.31	AA(+)	5	0.1556	3.9522	2	0.1556	3.952	8.0	35.7	223	332
112100		00	56.80	AA(+)	4	0.1674	4.2520	3	0.1674	4.252	11.9	52.9	296	441
110800		00	56.14	AA(+)	12	0.0961	2.4409	7	0.0961	2.441	10.8	48.0	250	372
105600	**Raven/AW**	**0**	**53.51**	**AA,A**	**6**	**0.1327**	**3.3706**	**1**	**0.1327**	**3.371**	**4.3**	18.9	**138**	**205**
101800		0	51.58	AA(+)	12	0.0921	2.3393	7	0.0921	2.339	9.9	44.1	230	342
99830		0	50.58	AA(+)	3	0.1824	4.6330	4	0.1824	4.633	16.4	72.9	395	588
95910		0	48.60	AA(+)	5	0.1385	3.5179	2	0.1385	3.518	6.6	29.3	177	263
88840		0	45.02	AA(+)	4	0.1429	3.6297	3	0.1490	3.785	9.7	43.1	234	348
83690	Robin/AW	1	42.41	AA,A	6	0.1181	2.9997	1	0.1181	3.000	3.5	15.3	109	162
80000		1	40.54	AA(+)	8	0.1000	2.5400	1	0.1670	4.242	4.9	21.8	138	205
79130		1	40.10	AA(+)	3	0.1624	4.1250	4	0.1624	4.125	13.8	61.4	313	466
76080		1	38.55	AA(+)	5	0.1234	3.1344	2	0.1234	3.134	5.5	24.2	140	208
70480		1	35.71	AA(+)	4	0.1327	3.3706	3	0.1327	3.371	8.1	36.0	186	277
66360	**Sparate/AW**	**2**	**33.62**	**AA,A**	**7**	**00974**	**2.4740**	**1**	**0.1299**	**3.299**	**3.5**	15.6	**100**	**149**
66360	**Sparrow/AW**	**2**	**33.62**	**AA,A**	**6**	**0.1052**	**2.6721**	**1**	**0.1052**	**2.672**	**2.8**	12.3	**8608**	**12810**
64920		2	32.89	AA(+)	2	0.1802	4.5771	5	0.1802	4.577	19.5	86.7	430	640
62770		2	31.81	AA(+)	3	0.1446	3.6728	4	0.1446	3.673	11.2	49.8	248	369
60340		2	30.57	AA(+)	5	1.1099	28.1915	2	0.1099	2.791	4.4	19.4	111	165
55890		2	28.32	AA(+)	4	0.1182	3.0023	3	0.1182	3.002	6.6	29.4	147	219
52620	Swallow/AW	3	26.66	A	6	0.0937	2.3800	1	0.0937	2.380	2.2	9.9	69	103
51500		3	26.10	AA(+)	2	0.1605	4.0767	5	0.1605	4.077	16.5	73.4	341	507
49780		3	25.22	AA(+)	3	0.1288	3.2715	4	0.1288	3.272	9.7	43.1	197	293
47850		3	24.25	AA(+)	5	0.0978	2.4841	2	0.0978	2.484	3.5	15.6	88	131
44320		3	22.46	AA(+)	4	1.1053	28.0746	3	0.1053	2.675	5.3	23.4	117	174
41740	**Swanate/AW**	**4**	**21.15**	**AA,A**	**7**	**0.0772**	**1.9609**	**1**	**0.1029**	**2.614**	**2.3**	10.1	62.7	**93**

TABLE 1 *Continued*

Conductor Size (Aluminum Wire)					Stranding						Rated Strength		Mass per Unit Length	
					Aluminum			Aluminum-Clad Steel						
cmil	Code Name	AWG	mm	Class	Number of Wires	Nominal Diameter		Number of Wires	Nominal Diameter		kip (1000 lbf)	kN	lb/1000 ft	kg/km
						in.	mm		in.	mm				
41740	**Swan/AW**	**4**	**21.15**	**AA,A**	**6**	**0.0834**	**2.1184**	**1**	**0.0834**	**2.118**	**1.8**	7.9	**54.5**	81
40840		4	20.69	AA(+)	2	0.1429	3.6297	5	0.1429	3.630	13.5	60.0	270	402
39470		4	20.00	AA(+)	3	0.1147	2.9134	4	0.1147	2.913	7.7	34.3	156	232
37950		4	19.23	AA(+)	5	0.0871	2.2123	2	0.0871	2.212	2.8	12.4	69.8	104
35150		4	17.81	AA(+)	4	0.0937	2.3800	3	0.0937	2.380	4.2	18.6	92.6	138
32390		4	16.41	AA(+)	2	0.1273	3.2334	5	0.1273	3.233	11.3	50.3	215	320
31300		4	15.86	AA(+)	3	0.1022	2.5959	4	0.1022	2.596	6.1	27.3	124	185
25690		4	13.02	AA(+)	2	0.1133	2.8778	5	0.1133	2.878	9.0	39.9	170	253

[A]Conversion factors:
1 cmil = 5.067 E-04 mm^2.
1 in. = 25.4 mm.
1 lb/1000 ft = 1.488 kg/km.
1 kip = 4.448 kN.

8. Lay

8.1 The length of lay of the various layers of wires in a conductor shall conform to Table 2 (Explanatory Note 5).

8.2 The direction of lay of the outside layer of wires shall be right hand unless otherwise specified in the purchase order. The direction of lay of the aluminum and aluminum-clad steel wires shall be reversed in successive layers.

9. Construction

9.1 The number and diameter of aluminum and steel wires and the areas of cross section of aluminum wires shall conform to the requirements prescribed in Table 1 and Fig. 1.

9.2 Where compressed stranding is required in order to insulate the conductor properly, one or more aluminum layers of any stranded conductor consisting of 7 wires or more may be slightly compressed, thereby reducing the outside diameter of the conductor by not more than 3 %, provided that the area of cross section after compressing is in accordance with Section 13.

10. Rated Strength of Conductor

10.1 The rated strength of a completed conductor shall be taken as the aggregate strength of the aluminum and aluminum-clad steel components, calculated as follows. The strength contribution of the aluminum wires shall be taken as the percentage, according to the number of layers of aluminum wires, indicated in Table 3, of the sum of the strengths of the 1350-H19 wires, calculated from their specified nominal wire diameter and the appropriate specified minimum average tensile strength given in Specification B 230. The strength contribution of the aluminum-clad steel core wires shall be taken as the percentage according to the number of layers of aluminum-clad steel wires, indicated in Table 3, of the sum of the strengths of the aluminum-clad steel wires, calculated from their specified nominal wire diameter and the appropriate specified minimum stress at 1 % extension given in Specification B 502.

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

11. Density

11.1 For the purpose of calculating mass, cross sections, etc., the density of aluminum 1350 shall be taken as 2705

TABLE 2 Lay Factors for Aluminum Conductors, Aluminum-Clad Steel Reinforced, Concentric-Lay-Stranded

Stranding Class	Stranding	Ratio of Length of Lay of a Layer to Nominal Outside Diameter of that Layer															
		Aluminum Wire Layers										Aluminum-Clad Steel Wire Layers					
		First (outside)			Second			Third		Fourth (inside)		12-Strand			6-Strand		
		min	pref[A]	max	min	pref	max	min	max	min	max	min	pref	max	min	pref	max
A	6/1, 7/1	8	...	16	...	...	...	...	...	...	...	...	...	...	...	...	...
AA	76/19, 84/19	10	11	13	10	13	16	10	17	10	17	16	20	24	18	25	30
	72/7	10	11	13	10	13	16	10	17	10	17	...	...	...	18	25	30
	54/19	10	11	13	10	13	16	10	17	...	...	16	20	24	18	25	30
	54/7, 48/7, 45/7, 42/7	10	11	13	10	13	16	10	17	...	...	...	...	...	18	25	30
	36/1	10	11	13	10	13	16	10	17	...	...	...	...	...	...	...	...
	30/19	10	11	13	10	13	16	...	...	...	...	16	20	24	18	25	30
	30/7, 26/7, 24/7	10	11	13	10	13	16	...	...	...	...	...	...	...	18	25	30
	18/1	10	11	13	10	13	16	...	...	...	...	...	...	...	...	...	...
	16/19	10	12.5	14.5	...	...	...	...	...	...	...	16	20	24	18	25	30
	12/7	10	12.5	14.5	...	...	...	...	...	...	...	...	...	...	18	25	30
	6/1, 7/1, 8/1	12	14	16	...	...	...	...	...	...	...	...	...	...	...	...	...
	5/2, 4/3, 3/4, 2/5	12[B]	14[B]	16[B]	...	...	...	...	...	...	...	...	...	...	12[B]	14[B]	16[B]

[A] Preferred (pref).
[B] Mixed aluminum and aluminum-clad steel (Fig. 1).

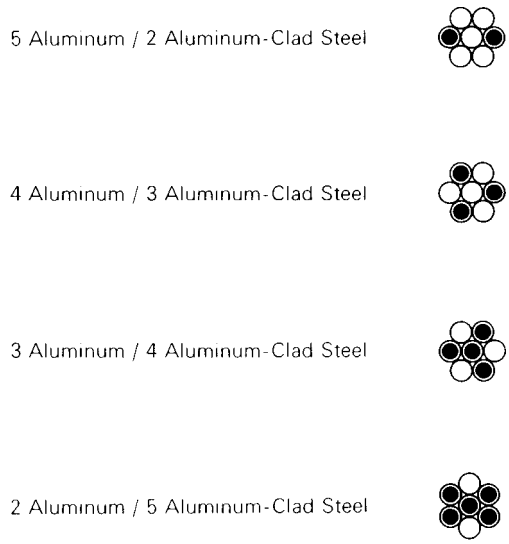

FIG. 1 Suggested Configurations for Conductors with Mixed Wire Layers

TABLE 3 Rating Factors

Stranding				Rating Factor, %	
Number of Wires		Number of Layers[A]			
Aluminum	Aluminum-Clad Steel	Aluminum	Aluminum-Clad Steel	Aluminum	Aluminum-Clad Steel
2	5	1	1	96	96
3	4	1	1	96	96
4	3	1	1	96	96
5	2	1	1	96	96
6	1	1	[B]	96	
7	1	1	[B]	96	
8	1	1	[B]	96	
18	1	2	[B]	93	
36	1	3	[B]		
		1	1	96	96
	7	2	1	93	96
	7	2	1	93	96
	7	2	1	93	96
	7	3	1	91	96
	7	3	1	91	96
	7	3	1	91	96
	7	3	1	91	96
	7	4	1	90	96
16	19	1	2	96	93
30	19	2	2	93	93
54	19	3	2	91	93
76	19	4	2	90	93
84	19	4	2	90	93

[A] For purposes of determining strength rating factors, mixed layers are considered to be full layers for each material.

[B] Central aluminum-clad steel wire only; the 96 % rating factor is applied to the single aluminum-clad steelwire core as a factor of safety in the event the aluminum-clad steel wire contains a weld (made prior to drawing).

kg/m^3 (0.0975 lb/in.^{3}) at 20°C (68°F) (Explanatory Note 6).

11.2 For the purpose of calculating mass, cross sections, etc., the density of aluminum-clad steel wire shall be taken as 6590 kg/m^3(0.2381 lb/in.^{3}) at 20°C (68°F).

12. Mass and Electrical Resistance

12.1 The mass and electrical resistance of a unit length of stranded conductor are a function of the length of lay. The approximate mass and electrical resistance may be determined using the standard increments shown in Table 4. When greater accuracy is desired, the increment based on the specific lay of the conductor may be calculated (Explanatory Note 7).

12.2 In the calculation of the electrical resistance of a completed conductor, the resistivity of the aluminum-clad steel core wire shall be taken as 0.08480 Ω·mm^2/m (51.01 Ω·cmil/ft) at 20°C (68°F).

13. Variation in Area

13.1 The area of cross section of the aluminum wires of a conductor shall be not less than 98 % of the area specified. Unless otherwise specified by the purchaser, the manufacturer may have the option of determining the cross-sectional area by either of the following methods, except that in case of question regarding area compliance, the method in 13.1.2 shall be used:

13.1.1 The area of cross section may be determined by calculations from diameter measurements, expressed to four decimal places, of the component aluminum wires at any point when measured perpendicularly to their axes.

13.1.2 The area of cross section of the aluminum wires of a conductor may be determined by Test Method B 263. In applying that method the increment in mass resulting from stranding may be the applicable value specified in 12.1 or may be calculated from the measured component dimensions of the sample under test. In case of question regarding area compliance, the actual mass increment due to stranding shall be calculated.

14. Finish

14.1 The conductor shall be free of all imperfections not consistent with good commercial practice.

TABLE 4 Standard Increments Due to Stranding

Stranding of ACSR/AW Number of Wires		Increment (Increase), % Mass and Electrical Resistance	
Aluminum	Aluminum-Clad Steel	Aluminum	Aluminum-Clad Steel
2	5	0.75	1.5
3	4	1.5	1.1
4	3	1.1	1.5
5	2	1.2	1.5
6	1	1.5	0
7	1	1.5	0
8	1	2.0	0
18	1	2.0	0
36	1	2.0	0
12	7	2.5	0.4
24	7	2.5	0.4
26	7	2.5	0.4
30	7	2.75	0.4
42	7	2.5	0.4
45	7	2.5	0.4
48	7	2.5	0.4
54	7	2.5	0.4
72	7	3.0	0.4
16	19	2.5	0.6
30	19	2.75	0.6
54	19	3.0	0.6
76	19	3.0	0.6
84	19	3.0	0.6

15. Mechanical and Electrical Tests

15.1 Tests for mechanical and electrical properties of aluminum wires shall be made before stranding (Explanatory Note 8).

15.2 All aluminum wires composing the conductors shall be capable of meeting the bending properties stated in Specification B 230 after stranding. Routine production testing after stranding is not required.

15.3 Routine production testing after stranding is not required. However, when such tests are requested by the purchaser and agreed upon by the manufacturer at the time of ordering (or made for other reasons) aluminum wires removed from the completed conductor shall have tensile strengths of not less than 95 % of the minimum tensile strength specified for the wire before stranding. The electrical resistivity shall meet the minimum resistivity specified for wire before stranding. Elongation tests may be made for information purposes only and no minimum values are assigned (Explanatory Note 8). The frequency of these tests shall be decided upon between the purchaser and the manufacturer.

15.4 Tests for all properties of aluminum-clad steel wires shall be made before stranding (Explanatory Note 8).

15.5 Tests for demonstration of rated strength of the completed conductor are not required by this specification but may be made if agreed upon by the manufacturer and the purchaser at the time of placing an order. If tested, the breaking strength of the completed conductor shall be not less than the rated strength if failure occurs in the free length at least 1 in. (25 mm) beyond the end of either gripping device, or shall be not less than 95 % of the rated strength if failure occurs inside, or within 1 in. (25 mm) of the end of either gripping device (Explanatory Note 9).

16. Inspection

16.1 Unless otherwise specified in the contract or purchase order, the manufacturer shall be responsible for the performance of all inspection and test requirements specified.

16.2 All inspections and tests shall be made at the place of manufacture unless otherwise agreed to between the manufacturer and the purchaser at the time of purchase.

16.3 The manufacturer shall afford the inspector representing the purchaser all reasonable facilities to satisfy the inspector that the material is being furnished in accordance with this specification.

17. Packaging and Package Marking

17.1 Package sizes and kind of package, reels or coils, shall be agreed upon between the manufacturer and the purchaser (Explanatory Note 5).

17.2 There shall be only one length of conductor on a reel.

17.3 The conductors shall be protected against damage in ordinary handling and shipping. If heavy wood lagging is required, it shall be specified by the purchaser at the time of placing the purchase order.

17.4 The net mass, length size, kind of conductors, stranding, type of coating, and any other necessary identification shall be marked on a tag attached to the end of the conductor inside the package. This same information, together with the purchase order number, the manufacturer's serial number (if any) and all shipping marks and other information required by the purchaser shall appear on the outside of the package.

NOTE 1—Multiple lengths per package are allowable only when the bare conductor is intended for re-manufacture, such as adding a covering or insulation. In such cases the position of each end of a length shall be clearly marked and the length of each portion shall be shown on the tag attached to the end of the conductor.

18. Keywords

18.1 aluminum clad steel reinforced; aluminum conductor; aluminum conductor—steel-reinforced; electrical conductor; electrical conductor—aluminum; stranded aluminum conductor; stranded electrical conductor

EXPLANATORY NOTES

NOTE 1—In this specification only concentrically-stranded aluminum conductors, aluminum-clad steel reinforced, are specifically designated. Conductor constructions not included in this specification shall be specifically agreed upon between the manufacturer and the purchaser when placing the order.

NOTE 2—For definitions of terms relating to conductors, reference should be made to ANSI C42.100 and ASTM Terminology B 354.

NOTE 3—Owing to the variation in coil weights, etc., it is common practice to allow a permissible variation in length of ± 10 %. It is also common practice to allow an amount not exceeding 10 % of the total weight of any one order to be shipped in random lengths with no piece shorter than 50 % of the standard length ordered.

NOTE 4—The behavior of properly spaced wire joints in stranded conductors is related to both their tensile strength and elongation. Because of its higher elongation properties, the lower-strength electric-butt weld gives equivalent overall performance to that of a cold-pressure weld or an electric-butt, cold-upset weld in stranded conductors.

NOTE 5—The preferred ratio of the lay with respect to the outside diameter of a layer of wires varies for different layers and for different diameters of the conductor, being larger for the inside layers than for the outside layer, and larger for conductors of small diameter than for those of large diameter.

NOTE 6—This density is based upon aluminum of 99.50 % purity.

NOTE 7—The increment of mass or electrical resistance of a completed concentric-lay-stranded conductor, *k*, in percent is

$$k = 100\,(m - 1) \tag{1}$$

where *m* is the stranding factor, and is also the ratio of the mass or electrical resistance of a unit length of stranded conductor to that of a solid conductor of the same cross-sectional area or of a stranded conductor with infinite length of stranding, that is, all wires parallel to the conductor axis. The stranding factor *m* for the completed stranded conductor is the *numerical average* of the stranding factors for each of the individual wires in the conductor, including the straight core wire, if any (for which the stranding factor is unity). The stranding factor (m_{ind}) for any given wire in a concentric-lay-stranded conductor is

$$m_{ind} = \sqrt{1 + (9.8696/n^2)} \tag{2}$$

where:

n = length of lay/diameter of helical path of the wire.

The derivation of the above is given in *NBS Handbook 100*.[5]

The factors k and m for composite conductors are to be determined separately for each different material involved.

NOTE 8—Wires unlaid from conductors may have different physical properties from those of the wire when prepared for cabling, on account of the deformation brought about by stranding and again straightening for test. If tests of aluminum-clad steel wires are to be made after stranding, the purchaser and the manufacturer at the time of placing the order should agree on the properties to be met.

NOTE 9—To test ACSR/AW, for breaking strength successfully as a unit requires special devices for gripping the ends of the aluminum and aluminum-clad steel wires without causing damage that may result in failure below the actual strength of the conductor. Various special dead-end devices are available such as compression sleeves and split sleeves, but ordinary jaws or clamping devices usually are not suitable.