



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:²

B 230 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 502 Specification for Aluminum-Clad Steel Core Wire for Aluminum Conductors, Aluminum-Clad Steel Reinforced

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

2.3 ANSI Standards:³

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 Standards⁴

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

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.

Current edition approved Sept. 1, 2004. Published September 2004. Originally approved in 1971. Last previous edition approved in 2000 as B 549 – 00.

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.

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

Code Name ^B	Conductor Size				Class ^C	Stranding						Conductor Rated Strength		Conductor Mass per Unit Length	
	Cross-sectional Area Using Only Aluminum Strand Wires	Approximate Cross-sectional Area Including Nominal Aluminum Area in AW Strand Wires ^D	Aluminum			Aluminum-Clad Steel									
			Num- ber of Wires	Nominal Diameter		Num- ber of Wires	Nominal Diameter								
				in.			mm	in.	mm	(1000 lbf)	kN	lb/ 1000 ft	kg/km		
Thrasher/AW	2312000	1171	2324300	1178	AA	76	0.1744	4.43	19	0.0814	2.07	55.3	246	2472	3679
Kiwi/AW	2167000	1098	2176100	1103	AA	72	0.1735	4.41	7	0.1157	2.94	49.1	218	2262	3366
Bluebird/AW	2156000	1092	2173100	1101	AA	84	0.1602	4.07	19	0.0961	2.44	59.0	262	2437	3627
Chukar/AW	1780000	902	1795200	910	AA	84	0.1456	3.70	19	0.0874	2.22	49.4	220	2013	2996
Falcon/AW	1590000	806	1609800	816	AA	54	0.1716	4.36	19	0.1030	2.62	53.0	236	1960	2917
Lapwing/AW	1590000	806	1601200	811	AA	45	0.1880	4.78	7	0.1253	3.18	41.8	186	1746	2598
Parrot/AW	1510500	765	1528200	774	AA	54	0.1672	4.25	19	0.1003	2.55	50.3	224	1860	2768
Nuthatch/AW	1510500	765	1520500	770	AA	45	0.1832	4.65	7	0.1221	3.10	39.7	177	1658	2467
Plover/AW	1431000	725	1448900	734	AA	54	0.1628	4.14	19	0.0977	2.48	47.7	212	1764	2625
Bobolink/AW	1431000	725	1440200	730	AA	45	0.1783	4.53	7	0.1189	3.02	37.6	167	1570	2336
Martin/AW	1351500	685	1367700	693	AA	54	0.1582	4.02	19	0.0949	2.41	45.1	201	1665	2478
Dipper/AW	1351500	685	1360100	689	AA	45	0.1733	4.40	7	0.1155	2.93	35.5	158	1483	2207
Pheasant/AW	1272000	645	1287700	652	AA	54	0.1535	3.90	19	0.0921	2.34	42.4	189	1568	2333
Bittern/AW	1272000	645	1280600	649	AA	45	0.1681	4.27	7	0.1121	2.85	33.4	149	1396	2078
Skylark/AW	1272000	645	1275400	646	AA	36	0.1880	4.78	1	0.1880	4.78	25.7	114	1272	1893
Grackle/AW	1192500	604	1206700	611	AA	54	0.1486	3.77	19	0.0892	2.27	40.2	179	1470	2188
Bunting/AW	1192500	604	1201000	609	AA	45	0.1628	4.14	7	0.1085	2.76	31.3	139	1309	1948
Finch/AW	1113000	564	1127800	571	AA	54	0.1436	3.65	19	0.0862	2.19	37.5	167	1373	2043
Bluejay/AW	1113000	564	1120500	568	AA	45	0.1573	4.00	7	0.1049	2.66	29.3	130	1222	1819
Curlew/AW	1033500	524	1046100	530	AA	54	0.1383	3.51	7	0.1383	3.51	35.6	158	1274	1896
Ortolan/AW	1033500	524	1040000	527	AA	45	0.1515	3.85	7	0.1010	2.57	27.1	121	1134	1688
Tanager/AW	1033500	524	1035800	525	AA	36	0.1694	4.30	1	0.1694	4.30	21.1	94	1033	1537
Cardinal/AW	954000	483	966100	490	AA	54	0.1329	3.38	7	0.1329	3.38	32.9	146	1177	1752
Rail/AW	954000	483	960400	487	AA	45	0.1456	3.70	7	0.0971	2.47	25.4	113	1047	1558
Catbrid/AW	954000	483	956600	485	AA	36	0.1628	4.14	1	0.1628	4.14	19.5	87	954	1420
Canary/AW	900000	456	911400	462	AA	54	0.1291	3.28	7	0.1291	3.28	31.0	138	1111	1653
Ruddy/AW	900000	456	906100	459	AA	45	0.1414	3.59	7	0.0943	2.40	24.0	107	988	1470
Mallary/AW	795000	403	812700	412	AA	30	0.1628	4.14	19	0.0977	2.48	37.1	165	1160	1726
Condor/AW	795000	403	805000	408	AA	54	0.1213	3.08	7	0.1213	3.08	27.8	124	980	1458
Tern/AW	795000	403	800400	406	AA	45	0.1329	3.38	7	0.0886	2.25	21.5	96	872	1298
Drake/AW	795000	403	807600	409	AA	26	0.1749	4.44	7	0.1360	3.45	30.5	136	1041	1549
Cuckoo/AW	795000	403	805000	408	AA	24	0.1820	4.62	7	0.1213	3.08	27.5	122	981	1460
Coot/AW	795000	403	797200	404	AA	36	0.1486	3.77	1	0.1486	3.77	16.6	74	795	1183
Redwing/AW	715500	363	730900	370	AA	30	0.1544	3.92	19	0.0926	2.35	33.4	149	1043	1552
Starling/AW	715500	363	727400	369	AA	26	0.1659	4.21	7	0.1290	3.28	27.5	122	936	1393
Stilt/AW	715500	363	725000	367	AA	24	0.1727	4.39	7	0.1151	2.92	24.8	110	883	1314
Gannet/AW	666600	338	676600	343	AA	26	0.1601	4.07	7	0.1245	3.16	26.0	116	872	1298
Flamingo/AW	666600	338	675400	342	AA	24	0.1667	4.23	7	0.1111	2.82	23.1	103	823	1225
Egret/AW	636000	322	650200	329	AA	30	0.1456	3.70	19	0.0874	2.22	29.9	133	928	1381
Sooter/AW	636000	322	650500	330	AA	30	0.1456	3.70	7	0.1456	3.70	29.3	130	935	1391
Grosbeak/AW	636000	322	646100	327	AA	26	0.1564	3.97	7	0.1216	3.09	24.8	110	832	1238
Rook/AW	636000	322	644000	326	AA	24	0.1628	4.14	7	0.1085	2.76	22.0	98	785	1168
Swift/AW	636000	322	637700	323	AA	36	0.1329	3.38	1	0.1329	3.38	13.6	61	636	946
Kingbird/AW	636000	322	639400	324	AA	18	0.1880	4.78	1	0.1880	4.78	15.0	67	676	1006
Teal/AW	605000	307	618400	313	AA	30	0.1420	3.61	19	0.0852	2.16	28.5	127	883	1314
Wood Duck/AW	605000	307	618800	314	AA	30	0.1420	3.61	7	0.1420	3.61	28.4	126	889	1323
Squab/AW	605000	307	614600	311	AA	26	0.1525	3.87	7	0.1186	3.01	23.6	105	791	1177
Peacock/AW	605000	307	612700	310	AA	24	0.1588	4.03	7	0.1059	2.69	21.0	93	747	1112
Eagle/AW	556500	282	569700	289	AA	30	0.1362	3.46	7	0.1362	3.46	26.8	119	818	1217
Dove/AW	556500	282	564800	286	AA	26	0.1463	3.72	7	0.1138	2.89	21.9	97	728	1083
Parakeet/AW	556500	282	564000	286	AA	24	0.1523	3.87	7	0.1015	2.58	19.3	86	687	1022
Ospray/AW	556500	282	559000	283	AA	18	0.1758	4.47	1	0.1758	4.47	13.2	59	591	880
Hen/AW	477000	242	487900	247	AA	30	0.1261	3.20	7	0.1261	3.20	23.4	104	701	1043
Hawk/AW	477000	242	484600	246	AA	26	0.1354	3.44	7	0.1053	2.68	18.9	84	624	929
Flicker/AW	477000	242	483000	245	AA	24	0.1410	3.58	7	0.0940	2.39	16.7	74	589	877

TABLE 1 *Continued*

Code Name ^B	Conductor Size				Class ^C	Stranding						Conductor Rated Strength		Conductor Mass per Unit Length	
	Cross-sectional Area Using Only Aluminum Strand Wires	Approximate Cross-sectional Area Including Nominal Aluminum Area in AW Strand Wires ^D	Aluminum			Aluminum-Clad Steel									
			Num- ber of Wires	Nominal Diameter		Num- ber of Wires	Nominal Diameter								
								in.	mm	in.	mm				
	cmil	mm ²	cmil	mm ²								(1000 lbf)	kN	lb/ 1000 ft	kg/km
Pelican/AW	477000	242	479600	243	AA	18	0.1628	4.14	1	0.1628	4.14	11.5	51	507	755
Lark/AW	397500	201	406000	206	AA	30	0.1151	2.92	7	0.1151	2.92	19.6	87	584	869
Ibbs/AW	397500	201	403300	204	AA	26	0.1236	3.14	7	0.0961	2.44	15.8	70	520	774
Brant/AW	397500	201	403000	204	AA	24	0.1287	3.27	7	0.0858	2.18	14.1	63	491	731
Chickadee/AW	397500	201	399200	202	AA	18	0.1486	3.77	1	0.1486	3.77	9.8	44	422	628
Oriole/AW	336400	170	343700	174	AA	30	0.1059	2.69	7	0.1059	2.69	16.7	74	495	737
Linnet/AW	336400	170	341300	173	AA	26	0.1137	2.89	7	0.0884	2.25	13.5	60	440	655
Merlin/AW	336400	170	337800	171	AA	18	0.1367	3.47	1	0.1367	3.47	8.5	38	357	531
Ostrich/AW	300000	152	304800	154	AA	26	0.1074	2.73	7	0.0835	2.12	12.1	54	392	583
Partridge/AW	266800	135	271200	137	AA	26	0.1013	2.57	7	0.0788	2.00	10.8	48	349	519
Waxwing/AW	266800	135	268400	136	AA	18	0.1217	3.09	1	0.1217	3.09	6.8	30	283	421
#4/0 Penguin/ AW	211600	107	215400	109	AA,A	6	0.1878	4.77	1	0.1878	4.77	7.7	34	277	412
Cochin/AW	211300	107	223000	113	AA(+)	12	0.1327	3.37	7	0.1327	3.37	19.8	88	477	710
Brahma/AW	203200	103	220700	112	AA(+)	16	0.1127	2.86	19	0.0977	2.48	27.1	121	601	894
Dorking/AW	190800	96.7	201900	102	AA(+)	12	0.1261	3.20	7	0.1261	3.20	18.3	81	431	641
Dotterel/AW	176900	89.6	187100	95	AA(+)	12	0.1214	3.08	7	0.1214	3.08	16.9	75	399	594
#3/0 Pigeon/ AW	167800	85.0	170700	86.5	AA,A	6	0.1672	4.25	1	0.1672	4.25	6.3	28	219	326
Guinea/AW	159000	80.6	168000	85.1	AA(+)	12	0.1151	2.92	7	0.1151	2.92	15.3	68	359	534
#3/0 (5/2) AWAC*	152500	77.3	159000	80.6	AA(+)	5	0.1747	4.44	2	0.1747	4.44	9.7	43	281	418
#3/0 (12/7) AWAC*	141300	71.6	151300	76.7	AA(+)	4	0.1880	4.78	3	0.1880	4.78	14.2	63	373	555
Leghorn/AW	134600	68.2	142700	72.3	AA(+)	12	0.1059	2.69	7	0.1059	2.69	13.0	58	304	452
#2/0 Quail/AW	133100	67.4	135200	68.5	AA,A	6	0.1489	3.78	1	0.1489	3.78	5.1	23	174	259
#2/0 (5/2) AWAC*	121000	61.3	125700	63.7	AA(+)	5	0.1556	3.95	2	0.1556	3.95	8.0	36	223	332
#2/0 (4/3) AWAC*	112100	56.8	120200	60.9	AA(+)	4	0.1674	4.25	3	0.1674	4.25	11.9	53	296	441
Minorca/AW	110800	56.1	117300	59.4	AA(+)	12	0.0961	2.44	7	0.0961	2.44	10.8	48	250	372
#1/0 Raven/AW	105600	53.5	107700	54.6	AA,A	6	0.1327	3.37	1	0.1327	3.37	4.3	19	138	205
Petrel/AW	101800	51.6	107800	54.6	AA(+)	12	0.0921	2.34	7	0.0921	2.34	9.9	44	230	342
#2/0 (3/4) AWAC*	99830	50.6	113000	57.3	AA(+)	3	0.1824	4.63	4	0.1824	4.63	16.4	73	395	588
#1/0 (5/2) AWAC*	95910	48.6	99700	50.5	AA(+)	5	0.1385	3.52	2	0.1385	3.52	6.6	29	177	263
#1/0 (4/3) AWAC*	88800	45.0	95500	48.4	AA(+)	4	0.1490	3.79	3	0.1490	3.79	9.7	43	234	348
#1 Robin/AW	83690	42.4	85400	43.3	AA,A	6	0.1181	3.00	1	0.1181	3.00	3.5	15	109	162
Grouse/AW	80000	40.5	82700	41.9	AA(+)	8	0.1000	2.54	1	0.1670	4.24	4.9	22	138	205
#1/0 (3/4) AWAC*	79130	40.1	89300	45.2	AA(+)	3	0.1624	4.13	4	0.1624	4.13	13.8	61	313	466
#1 (5/2) AWAC*	76080	38.6	79000	40.0	AA(+)	5	0.1234	3.13	2	0.1234	3.13	5.5	24	140	208
#1 (4/3) AWAC*	70480	35.7	75200	38.1	AA(+)	4	0.1327	3.37	3	0.1327	3.37	8.1	36	186	277
#2 Sparate/AW	66360	33.6	67600	34.3	AA,A	7	0.0974	2.47	1	0.1299	3.30	3.5	16	100	149
#2 Sparrow/ AW	66360	33.6	67100	34.0	AA,A	6	0.1052	2.67	1	0.1052	2.67	2.8	12	87	129
#1/0 (2/5) AWAC*	64920	32.9	80800	40.9	AA(+)	2	0.1802	4.58	5	0.1802	4.58	19.5	87	430	640
#1 (3/4) AWAC*	62770	31.8	71200	36.1	AA(+)	3	0.1446	3.67	4	0.1446	3.67	11.2	50	248	369
#2 (5/2) AWAC*	60340	30.6	62400	31.6	AA(+)	5	0.1099	2.79	2	0.1099	2.79	4.4	19	111	165

TABLE 1 *Continued*

Code Name ^B	Conductor Size				Class ^C	Stranding						Conductor Rated Strength		Conductor Mass per Unit Length	
	Cross-sectional Area Using Only Aluminum Strand Wires	Approximate Cross-sectional Area Including Nominal Aluminum Area in AW Strand Wires ^D	Aluminum			Aluminum-Clad Steel									
			Num- ber of Wires	Nominal Diameter		Num- ber of Wires	Nominal Diameter								
				in.			mm	in.	mm	(1000 lbf)	kN	lb/ 1000 ft	kg/km		
#2 (4/3) AWAC*	55890	28.3	60100	30.5	AA(+)	4	0.1182	3.00	3	0.1182	3.00	6.6	29	147	219
#3 Swallow/AW	52620	26.7	53900	27.3	A	6	0.0937	2.38	1	0.0937	2.38	2.2	10	69	103
	51500	26.1	64600	32.7	AA(+)	2	0.1605	4.08	5	0.1605	4.08	16.5	73	341	507
#2 (3/4) AWAC*	49780	25.2	56500	28.6	AA(+)	3	0.1288	3.27	4	0.1288	3.27	9.7	43	197	293
#3 (5/2) AWAC*	47850	24.3	49900	25.3	AA(+)	5	0.0978	2.48	2	0.0978	2.48	3.5	16	88	131
#3 (4/3) AWAC*	44320	22.5	47200	23.9	AA(+)	4	0.1053	2.68	3	0.1053	2.68	5.3	23	117	174
#4 Swanate/ AW	41740	21.2	43000	21.8	AA,A	7	0.0772	1.96	1	0.1029	2.61	2.3	10	62.7	93
#4 Swan/AW	41740	21.2	42700	21.6	AA,A	6	0.0834	2.12	1	0.0834	2.12	1.8	8	54.5	81
	40840	20.7	51000	25.8	AA(+)	2	0.1429	3.63	5	0.1429	3.63	13.5	60	270	402
#3 (3/4) AWAC*	39470	20.0	44100	22.3	AA(+)	3	0.1147	2.91	4	0.1147	2.91	7.7	34	156	232
#4 (5/2) AWAC*	37950	19.2	39500	20.0	AA(+)	5	0.0871	2.21	2	0.0871	2.21	2.8	12	69.8	104
#4 (4/3) AWAC*	35150	17.8	37600	19.1	AA(+)	4	0.0937	2.38	3	0.0937	2.38	4.2	19	92.6	138
#3 (2/5) AWAC*	32390	16.4	39900	20.2	AA(+)	2	0.1273	3.23	5	0.1273	3.23	11.3	50	215	320
#4 (3/4) AWAC*	31300	15.9	35100	17.8	AA(+)	3	0.1022	2.60	4	0.1022	2.60	6.1	27	124	185
#4 (2/5) AWAC*	25690	13.0	32300	16.4	AA(+)	2	0.1133	2.88	5	0.1133	2.88	9.0	40	170	253

^A Metric Conversion Factors—the following conversion factors were used in building the table:

1 cmil = 5.067 E-04 mm²

1 in. = 25.4 mm

1 lb/1000 ft = 1.488 kg/km

1 kip (1000 lbf) = 4.448 kN

^B The Code Name denoted with the letters "AWAC" represents a product made with strand wires comprised of aluminum and aluminum clad steel wires. The numbers in the parenthesis in front of the "AWAC" letters represent the number of aluminum and aluminum clad steel wires in the construction. The first number in the sequence is the approximate AWG size for the total aluminum cross-sectional area present in the conductor. "AWAC" is a registered trade name of US Alumoweld Corporation.

^C The "+" marking beside the stranding class indicates a conductor with a high strength to current capacity ratio.

^D The cmil area of the aluminum in the aluminum clad steel wire is calculated based on the requirement that the minimum thickness of aluminum is 10 % of the nominal wire radius (as per Specification B 502 requirements for the aluminum clad steel wire component). The approximate total cross-sectional area for both the aluminum strands and the aluminum in the aluminum clad steel strands is provided for information purposes only.

5.1.9 Place of inspection (Section 16).

6. Requirement for Wires

6.1 Before stranding, the aluminum wires used shall meet 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.

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.

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).

5 Aluminum / 2 Aluminum-Clad Steel



4 Aluminum / 3 Aluminum-Clad Steel



3 Aluminum / 4 Aluminum-Clad Steel



2 Aluminum / 5 Aluminum-Clad Steel



○ ALUMINUM ● ALUMINUM-CLAD STEEL

FIG. 1 Suggested Configurations for Conductors with Mixed Wire Layers

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.

TABLE 3 Rating Factors

Stranding					
Number of Wires		Number of Layers ^A		Rating Factor, %	
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	center ^B	96	96
7	1	1	center ^B	96	96
8	1	1	center ^B	96	96
18	1	2	center ^B	93	96
36	1	3	center ^B	91	96
12	7	1	1	96	96
24	7	2	1	93	96
26	7	2	1	93	96
30	7	2	1	93	96
42	7	3	1	91	96
46	7	3	1	91	96
48	7	3	1	91	96
54	7	3	1	91	96
72	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).

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 kg/m³ (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/m³ (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·mm²/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.

13.2 The approximate cross sectional area of the aluminum in the aluminum clad steel wire is calculated based on the requirement that the minimum thickness of aluminum is 10 % of the nominal wire radius (as per Specification B 502). The minimum aluminum thickness value can also be expressed as 5 % of the nominal aluminum clad steel wire diameter.

14. Finish

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

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.

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

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, and so forth, it is common practice to allow a permissible variation in length of $\pm 10\%$. 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

$$k = 100 (m - 1) \quad (1)$$

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

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

where:

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

The derivation of the above is given in *NBS Handbook 100*.⁴

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

The helical path of the wire may be defined as the pitch diameter and may be calculated as:

$$\text{helical path of the wire} = \frac{(\text{diameter over the layer} + \text{diameter under the layer})}{2} \quad (3)$$

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.



ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org).