



Standard Specification for Concentric-Lay-Stranded Aluminum Conductors, Coated-Steel Reinforced (ACSR)¹

This standard is issued under the fixed designation B 232/B 232M; 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.

^{ε1} NOTE—In Table 1, the code word for the 795 000 (24/7) construction was editorially corrected to “Cuckoo.”

1. Scope

1.1 This specification covers concentric-lay-stranded conductors made from round aluminum 1350-H19 (extra hard) wires and round, coated steel core wire(s) for use as overhead electrical conductors (Explanatory Note 1 and Explanatory Note 2).

1.2 ACSR covered by this specification has nine types of coated steel core wire which are designated by abbreviations as follows (Explanatory Note 2):

1.2.1 *ACSR/GA-ACSR* using Class A zinc-coated steel wire,

1.2.2 *ACSR/GB-ACSR* using Class B zinc-coated steel wire,

1.2.3 *ACSR/GC-ACSR* using Class C zinc-coated steel wire,

1.2.4 *ACSR/MA-ACSR* using Class A Zn-5A1-MM coated steel wire,

1.2.5 *ACSR/MB-ACSR* using Class B Zn-5A1-MM coated steel wire,

1.2.6 *ACSR/MC-ACSR* using Class C Zn-5A1-MM coated steel wire,

1.2.7 *ACSR/HS-ACSR* using Class A zinc-coated high-strength steel wires,

1.2.8 *ACSR/MS-ACSR* using Class A Zn-5A1-MM coated high-strength steel wires, and

1.2.9 *ACSR/AZ-ACSR* using aluminum-coated (aluminized) steel wire.

1.3 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.

1.3.1 For density, resistivity and temperature, the values stated in SI units are to be regarded as standard.

NOTE 1—The aluminum and temper designations conform to ANSI Standard H35.1/H35.1M; Aluminum 1350 corresponds to UNS No. A91350 in accordance with Practice E 527.

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/B 230M Specification for Aluminum 1350-H19 Wire for Electrical Purposes²

B 263 Test Method for Determination of Cross-Sectional Area of Stranded Conductors²

B 341/B 341M Specification for Aluminum-Coated (Aluminized) Steel Core Wire for Aluminum Conductors, Steel Reinforced (ACSR/AZ)²

B 354 Terminology Relating to Uninsulated Metallic Electrical Conductors²

B 498/B 498M Specification for Zinc-Coated (Galvanized) Steel Core Wire for Aluminum Conductors, Steel Reinforced (ACSR)²

B 500 Specification for Metallic Coated Stranded Steel Core for Aluminum Conductors, Steel-Reinforced (ACSR)²

B 606 Specification for High-Strength Zinc-Coated (Galvanized) Steel Core Wire for Aluminum and Aluminum-Alloy Conductors, Steel Reinforced²

B 682 Specification for Standard Metric Sizes of Electrical Conductors²

B 802/B 802M Specification for Zinc-5 % Aluminum-Mischmetal Alloy-Coated Steel Core Wire for Aluminum Conductors, Steel Reinforced (ACSR)²

B 803 Specification for High-Strength Zinc-5 % Aluminum-Mischmetal Alloy-Coated Steel Core Wire for Aluminum and Aluminum-Alloy Conductors, Steel Reinforced²

E 29 Practice for Using Significant Digits in Test Data to

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 *Annual Book of ASTM Standards*, Vol 02.03.

Determine Conformance with Specifications³

E 527 Practice for Numbering Metals and Alloys (UNS)⁴

2.3 *ANSI Documents:*

ANSI H35.1 American National Standard Alloy and Temper Designation Systems for Aluminum⁵

ANSI H35.1M American National Standard for Alloy and Temper Designations Systems for Aluminum [Metric]⁵

2.4 *NIST Document:*

NBS Handbook 100—Copper Wire Tables⁶

2.5 *Aluminum Association Document:*

Publication 50, Code Words for Overhead Aluminum Electrical Conductors⁷

3. Terminology

3.1 *Definitions:*

3.1.1 *Galvanized*—zinc coated.

3.1.2 *Aluminized*—aluminum coated.

3.2 *Abbreviations: Abbreviations:*

3.2.1 *Zn-5Al-MM*—zinc-5 % aluminum-mischmetal alloy.

3.2.2 *ACSR*—aluminum conductor, steel reinforced.

3.2.3 *ACSR/GA*—reinforced with galvanized steel core wire, coating Class A in accordance with Specification B 498/B 498M.

3.2.4 *ACSR/GB*—reinforced with galvanized steel core wire, coating Class B in accordance with Specification B 498/B 498M.

3.2.5 *ACSR/GC*—reinforced with galvanized steel core wire, coating Class C in accordance with Specification B 498/B 498M.

3.2.6 *ACSR/HS*—reinforced with high-strength galvanized steel core wire in accordance with Specification B 606.

3.2.7 *ACSR/MA*—reinforced with Zn-5Al-MM coated steel core wire, coating Class A in accordance with Specification B 802/B 802M.

3.2.8 *ACSR/MB*—reinforced with Zn-5Al-MM coated steel core wire, coating Class B in accordance with Specification B 802/B 802M.

3.2.9 *ACSR/MC*—reinforced with Zn-5Al-MM coated steel core wire, coating Class C in accordance with Specification B 802/B 802M.

3.2.10 *ACSR/MS*—reinforced with high-strength Zn-5Al-MM coated steel core wire in accordance with Specification B 803.

3.2.11 *ACSR/AZ*—reinforced with aluminized steel core wire in accordance with Specification B 341/B 341M.

4. Classification

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

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

4.1.1.1 Conductors used for regular over-head 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 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 (Section 9 and Table 1),

³ Annual Book of ASTM Standards, Vol 14.02.

⁴ Annual Book of ASTM Standards, Vol 01.01.

⁵ Available from the American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036.

⁶ Available from the National Institute of Standards and Technology (NIST), Gaithersburg, MD 20899.

⁷ Available from the Aluminum Association, Inc., 900 19th Street, NW, Suite 300, Washington, DC 20006.

TABLE 1 Construction Requirements of Aluminum Conductors, Steel Reinforced (ACSR)

Size		Code Words ^A	Class	Stranding Design Aluminum/ Steel	Stranding						Nominal O.D. of Conductors, in.	Mass, lb/1000 ft
cmil ^B	AWG				Aluminum Wires			Steel Wires				
		Number	Diameter, in. ^C	Layers	Number	Diameter, in. ^C	Layers					
2 312 000	...	Thrasher	AA	76/19	76	0.1744	4	19	0.0814	2	1.802	2523
2 167 000	...	Kiwi	AA	72/7	72	0.1735	4	7	0.1157	1	1.735	2301
2 156 000	...	Bluebird	AA	84/19	84	0.1602	4	19	0.0961	2	1.762	2508
1 780 000	...	Chukar	AA	84/19	84	0.1456	4	19	0.0874	2	1.602	2072
1 590 000	...	Falcon	AA	54/19	54	0.1716	3	19	0.1030	2	1.545	2042
1 590 000	...	Lapwing	AA	45/7	45	0.1880	3	7	0.1253	1	1.504	1790
1 510 500	...	Parrot	AA	54/19	54	0.1672	3	19	0.1003	2	1.505	1938
1 510 500	...	Nuthatch	AA	45/7	45	0.1832	3	7	0.1221	1	1.466	1700
1 431 000	...	Plover	AA	54/19	54	0.1628	3	19	0.0977	2	1.465	1838
1 431 000	...	Bobolink	AA	45/7	45	0.1783	3	7	0.1189	1	1.427	1611
1 351 500	...	Martin	AA	54/19	54	0.1582	3	19	0.0949	2	1.424	1735
1 351 500	...	Dipper	AA	45/7	45	0.1733	3	7	0.1155	1	1.386	1521
1 272 000	...	Pheasant	AA	54/19	54	0.1535	3	19	0.0921	2	1.382	1634
1 272 000	...	Bittern	AA	45/7	45	0.1681	3	7	0.1121	1	1.345	1432
1 272 000	...	Skylark	AA	36/1	36	0.1880	3	1	0.1880	0	1.316	1286
1 192 500	...	Grackle	AA	54/19	54	0.1486	3	19	0.0892	2	1.338	1531
1 192 500	...	Bunting	AA	45/7	45	0.1628	3	7	0.1085	1	1.302	1342
1 113 000	...	Finch	AA	54/19	54	0.1436	3	19	0.0862	2	1.293	1430

TABLE 1 *Continued*

Size		Code Words ^A	Class	Stranding Design Aluminum/ Steel	Stranding						Nominal O.D. of Conductors, in.	Mass, lb/1000 ft
cmil ^B	AWG				Aluminum Wires			Steel Wires				
					Number	Diameter, in. ^C	Layers	Number	Diameter, in. ^C	Layers		
1 113 000	...	Bluejay	AA	45/7	45	0.1573	3	7	0.1049	1	1.259	1254
1 033 500	...	Curlew	AA	54/7	54	0.1383	3	7	0.1383	1	1.245	1329
1 033 500	...	Ortolan	AA	45/7	45	0.1515	3	7	0.1010	1	1.212	1163
1 033 500	...	Tanager	AA	36/1	36	0.1694	3	1	0.1694	0	1.186	1044
954 000	...	Cardinal	AA	54/7	54	0.1329	3	7	0.1329	1	1.196	1227.1
954 000	...	Rail	AA	45/7	45	0.1456	3	7	0.0971	1	1.165	1074
954 000	...	Catbird	AA	36/1	36	0.1628	3	1	0.1628	0	1.140	964
900 000	...	Canary	AA	54/7	54	0.1291	3	7	0.1291	1	1.162	1158
900 000	...	Ruddy	AA	45/7	45	0.1414	3	7	0.0943	1	1.131	1013
795 000	...	Mallard	AA	30/19	30	0.1628	2	19	0.0977	2	1.140	1233.9
795 000	...	Condor	AA	54/7	54	0.1213	3	7	0.1213	1	1.092	1022
795 000	...	Tern	AA	45/7	45	0.1329	3	7	0.0886	1	1.063	895
795 000	...	Drake	AA	26/7	26	0.1749	2	7	0.1360	1	1.108	1093
795 000	...	Cuckoo	AA	24/7	24	0.1820	2	7	0.1213	1	1.092	1023
795 000	...	Coot	AA	36/1	36	0.1486	3	1	0.1486	0	1.040	803.6
715 500	...	Redwing	AA	30/19	30	0.1544	2	19	0.0926	2	1.081	1109.3
715 500	...	Starling	AA	26/7	26	0.1659	2	7	0.1290	1	1.051	983.7
715 500	...	Stilt	AA	24/7	24	0.1727	2	7	0.1151	1	1.036	921
666 600	...	Gannet	AA	26/7	26	0.1601	2	7	0.1245	1	1.014	916.2
666 600	...	Flamingo	AA	24/7	24	0.1667	2	7	0.1111	1	1.000	857.9
636 000	...	Egret	AA	30/19	30	0.1456	2	19	0.0874	2	1.019	987.2
636 000	...	Scoter	AA	30/7	30	0.1456	2	7	0.1456	1	1.019	995.1
636 000	...	Grosbeak	AA	26/7	26	0.1564	2	7	0.1216	1	0.990	874.2
636 000	...	Rook	AA	24/7	24	0.1628	2	7	0.1085	1	0.977	818.2
636 000	...	Swift	AA	36/1	36	0.1329	3	1	0.1329	0	0.930	642.8
636 000	...	Kingbird	AA	18/1	18	0.1880	2	1	0.1880	0	0.940	689.9
605 000	...	Teal	AA	30/19	30	0.1420	2	19	0.0852	2	0.994	938.6
605 000	...	Wood Duck	AA	30/7	30	0.1420	2	7	0.1420	1	0.994	946.5
605 000	...	Squab	AA	26/7	26	0.1525	2	7	0.1186	1	0.966	831.3
605 000	...	Peacock	AA	24/7	24	0.1588	2	7	0.1059	1	0.953	778.8
556 500	...	Eagle	AA	30/7	30	0.1362	2	7	0.1362	1	0.953	870.7
556 500	...	Dove	AA	26/7	26	0.1463	2	7	0.1138	1	0.927	765.2
556 500	...	Parakeet	AA	24/7	24	0.1523	2	7	0.1015	1	0.914	716.1
556 500	...	Osprey	AA	18/1	18	0.1758	2	1	0.1758	0	0.879	603.3
477 000	...	Hen	AA	30/7	30	0.1261	2	7	0.1261	1	0.883	746.4
477 000	...	Hawk	AA	26/7	26	0.1354	2	7	0.1053	1	0.858	655.3
477 000	...	Flicker	AA	24/7	24	0.1410	2	7	0.0940	1	0.846	613.9
477 000	...	Pelican	AA	18/1	18	0.1628	2	1	0.1628	0	0.814	517.3
397 500	...	Lark	AA	30/7	30	0.1151	2	7	0.1151	1	0.806	621.8
397 500	...	Ibis	AA	26/7	26	0.1236	2	7	0.0961	1	0.783	546.0
397 500	...	Brant	AA	24/7	24	0.1287	2	7	0.0858	1	0.772	511.4
397 500	...	Chickadee	AA	18/1	18	0.1486	2	1	0.1486	0	0.743	431.0
336 400	...	Oriole	AA	30/7	30	0.1059	2	7	0.1059	1	0.741	526.4
336 400	...	Linnet	AA	26/7	26	0.1137	2	7	0.0884	1	0.720	462.0
336 400	...	Merlin	AA	18/1	18	0.1367	2	1	0.1367	0	0.684	364.8
300 000	...	Ostrich	AA	26/7	26	0.1074	2	7	0.0835	1	0.680	412.2
266 800	...	Partridge	AA	26/7	26	0.1013	2	7	0.0788	1	0.642	366.9
266 800	...	Waxwing	AA	18/1	18	0.1217	2	1	0.1217	0	0.609	289.1
211 600	0000	Penguin ^C	AA, A	6/1	6	0.1878	1	1	0.1878	0	0.563	290.8
211 300	...	Cochin	AA (HS)	12/7	12	0.1327	1	7	0.1327	1	0.664	526.8
203 200	...	Brahma	AA (HS)	16/19	16	0.1127	1	19	0.0977	2	0.714	674.6
190 800	...	Dorking	AA (HS)	12/7	12	0.1261	1	7	0.1261	1	0.631	475.7
176 900	...	Dotterel	AA (HS)	12/7	12	0.1214	1	7	0.1214	1	0.607	440.9
167 800	000	Pigeon ^C	AA, A	6/1	6	0.1672	1	1	0.1672	0	0.502	230.5
159 000	...	Guinea	AA (HS)	12/7	12	0.1151	1	7	0.1151	1	0.576	396.3
134 600	...	Leghorn	AA (HS)	12/7	12	0.1059	1	7	0.1059	1	0.530	335.5
133 100	00	Quail ^C	AA, A	6/1	6	0.1489	1	1	0.1489	0	0.447	182.8
110 800	...	Minorca	AA (HS)	12/7	12	0.0961	1	7	0.0961	1	0.481	276.3
105 600	0	Raven ^C	AA, A	6/1	6	0.1327	1	1	0.1327	0	0.398	145.2

TABLE 1 *Continued*

Size		Code Words ^A	Class	Stranding Design Aluminum/ Steel	Stranding						Nominal O.D. of Conductors, in.	Mass, lb/1000 ft
cmil ^B	AWG				Aluminum Wires			Steel Wires				
					Number	Diameter, in. ^C	Layers	Number	Diameter, in. ^C	Layers		
101 800	...	Petrel	AA (HS)	12/7	12	0.0921	1	7	0.0921	1	0.461	253.8
83 690	1	Robin ^C	AA, A	6/1	6	0.1181	1	1	0.1181	0	0.354	115.0
80 000	...	Grouse	AA (HS)	8/1	8	0.1000	1	1	0.1670	0	0.367	148.8
66 360	2	Sparate ^C	AA, A	7/1	7	0.0974	1	1	0.1299	0	0.325	106.63
66 360	2	Sparrow ^C	AA, A	6/1	6	0.1052	1	1	0.1052	0	0.316	91.2
41 740	4	Swanate ^C	AA, A	7/1	7	0.0772	1	1	0.1029	0	0.257	66.95
41 740	4	Swan ^C	AA, A	6/1	6	0.0834	1	1	0.0834	0	0.250	57.35
33 090	5	...	A	6/1	6	0.0743	1	1	0.0743	0	0.223	45.51
26 240	6	Turkey ^C	AA, A	6/1	6	0.0661	1	1	0.0661	0	0.198	36.02

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

^B Conversion factors:

1 cmil = 5.067 E - 0.4 mm²

1 in. = 2.54 E + 01 mm

1 lb/1000ft = 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 - 03LN

^C These code names apply to Class AA Bare Aluminum Conductors, Steel Reinforced (ACSR) as shown above. They do not apply to Class A products shown in the above table.

5.1.3 Number of wires, aluminum and steel (see Tables 1-5),

5.1.4 Type of steel core wire and type and area density (if applicable) of coating (see 6.2),

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

5.1.6 Special tension test, if desired (see 15.3),

5.1.7 Place of inspection (Section 16),

5.1.8 Package size and type (see 17.1),

5.1.9 Heavy wood lagging, if required (see 17.3), and

5.1.10 Special package marking, if required (see 17.4).

6. Requirement for Wires

6.1 Before stranding, the aluminum wire used shall meet the requirements of Specification B 230/B 230M.

6.2 Before stranding, the steel core wire used shall meet the requirements of Specification B 341/B 341M, B 498/B 498M, B 606, B 802/B 802M, or B 803, whichever is applicable.

TABLE 2 Construction Requirements—Aluminum Conductors, Steel Reinforced (ACSR)

Size, mm ²	Class	Stranding Design	Stranding						Nominal Outside Diameter of Conductors, mm	Mass, kg/km
			Aluminum Wires			Steel Wires				
			Number	Diameter, mm	Layers	Number	Diameter, mm	Layers		
1250	AA	84/19	84	4.35	4	19	2.61	2	47.85	4274
1250	AA	76/19	76	4.58	4	19	2.14	2	47.34	4023
1250	AA	72/7	72	4.70	4	7	3.13	1	46.99	3901
1120	AA	84/19	84	4.12	4	19	2.47	2	45.31	3833
1120	AA	76/19	76	4.33	4	19	2.02	2	44.74	3595
1120	AA	72/7	72	4.45	4	7	2.97	1	44.51	3499
1000	AA	84/19	84	3.89	4	19	2.33	2	42.77	3416
1000	AA	72/7	72	4.21	4	7	2.81	1	42.11	3132
900	AA	84/19	84	3.69	4	19	2.21	2	40.57	3073
900	AA	72/7	72	3.99	4	7	2.66	1	39.9	2812
800	AA	54/19	54	4.34	3	19	2.60	2	39.04	3015
800	AA	45/7	45	4.76	3	7	3.17	1	38.07	2652
710	AA	54/19	54	4.09	3	19	2.45	2	36.79	2678
710	AA	45/7	45	4.48	3	7	2.99	1	35.85	2351
630	AA	54/19	54	3.85	3	19	2.31	2	34.65	2375
630	AA	45/7	45	4.22	3	7	2.81	1	33.75	2084
560	AA	54/19	54	3.63	3	19	2.18	2	32.68	2112
560	AA	45/7	45	3.98	3	7	2.65	1	31.83	1854
500	AA	54/7	54	3.43	3	7	3.43	1	30.87	1889
500	AA	45/7	45	3.76	3	7	2.51	1	30.09	1656
450	AA	54/7	54	3.26	3	7	3.26	1	29.34	1706
450	AA	45/7	45	3.57	3	7	2.38	1	28.56	1492

**B 232/B 232M****TABLE 2** *Continued*

Size, mm ²	Class	Stranding Design	Stranding						Nominal Outside Diameter of Conductors, mm	Mass, kg/km
			Aluminum Wires			Steel Wires				
			Number	Diameter, mm	Layers	Number	Diameter, mm	Layers		
400	AA	30/19	30	4.12	2	19	2.47	2	28.83	1824
400	AA	26/7	26	4.43	2	7	3.45	1	28.07	1622
400	AA	24/7	24	4.61	2	7	3.07	1	27.65	1515
355	AA	30/19	30	3.88	2	19	2.33	2	27.17	1620
355	AA	26/7	26	4.17	2	7	3.24	1	26.4	1435
355	AA	24/7	24	4.34	2	7	2.89	1	26.03	1343
315	AA	30/19	30	3.66	2	19	2.20	2	25.64	1443
315	AA	26/7	26	3.93	2	7	3.06	1	24.9	1277
315	AA	24/7	24	4.09	2	7	2.73	1	24.55	1194
315	AA	18/1	18	4.72	2	1	4.72	0	23.6	1014
280	AA	30/7	30	3.45	2	7	3.45	1	24.15	1291
280	AA	26/7	26	3.70	2	7	2.88	1	23.44	1131
280	AA	24/7	24	3.85	2	7	2.57	1	23.11	1058
280	AA	18/1	18	4.45	2	1	4.45	0	22.25	901.0
250	AA	30/7	30	3.26	2	7	3.26	1	22.82	1152
250	AA	26/7	26	3.50	2	7	2.72	1	22.16	1011
250	AA	24/7	24	3.64	2	7	2.43	1	21.85	946.0
250	AA	18/1	18	4.21	2	1	4.21	0	21.05	806.4
224	AA	30/7	30	3.08	2	7	3.08	1	21.56	1029
224	AA	26/7	26	3.31	2	7	2.57	1	20.95	904.0
224	AA	24/7	24	3.45	2	7	2.30	1	20.7	849.2
224	AA	18/1	18	3.98	2	1	3.98	0	19.9	720.7
200	AA	30/7	30	2.91	2	7	2.91	1	20.37	918.2
200	AA	26/7	26	3.13	2	7	2.43	1	19.81	808.3
200	AA	24/7	24	3.26	2	7	2.17	1	19.55	757.6
200	AA	18/1	18	3.76	2	1	3.76	0	18.8	643.2
180	AA	30/7	30	2.76	2	7	2.76	1	19.32	826.0
180	AA	26/7	26	2.97	2	7	2.31	1	18.81	728.6
180	AA	24/7	24	3.09	2	7	2.06	1	18.54	681.2
180	AA	18/1	18	3.57	2	1	3.57	0	17.85	579.9
160	AA	30/7	30	2.61	2	7	2.61	1	18.27	738.6
160	AA	26/7	26	2.80	2	7	2.18	1	17.74	648.0
160	AA	24/7	24	2.91	2	7	1.94	1	17.46	604.2
160	AA	18/1	18	3.36	2	1	3.36	0	16.8	513.7
140	AA	26/7	26	2.62	2	7	2.04	1	16.6	567.4
140	AA	24/7	24	2.73	2	7	1.82	1	16.38	531.8
140	AA	18/1	18	3.15	2	1	3.15	0	15.75	451.5
125	AA	26/7	26	2.47	2	7	1.92	1	15.64	503.7
125	AA	24/7	24	2.58	2	7	1.72	1	15.48	474.9
125	AA	18/1	18	2.97	2	1	2.97	0	14.85	401.3
100	AA (HS)	16/19	16	2.82	1	19	2.44	2	17.84	972.4
100	AA (HS)	12/7	12	3.26	1	7	3.26	1	16.3	734.1
100	AA, A	6/1	6	4.61	1	1	4.61	0	13.83	404.8
90	AA (HS)	12/7	12	3.09	1	7	3.09	1	15.45	659.5
80	AA (HS)	12/7	12	2.91	1	7	2.91	1	14.55	584.9
80	AA, A	6/1	6	4.12	1	1	4.12	0	12.36	323.3
71	AA (HS)	12/7	12	2.74	1	7	2.74	1	13.7	518.6
63	AA (HS)	12/7	12	2.59	1	7	2.59	1	12.95	463.4
63	AA, A	6/1	6	3.66	1	1	3.66	0	10.98	255.2
56	AA (HS)	12/7	12	2.44	1	7	2.44	1	12.2	411.2
50	AA (HS)	12/7	12	2.30	1	7	2.30	1	11.5	365.4
50	AA, A	6/1	6	3.26	1	1	3.26	0	9.78	202.4
40	AA (HS)	8/1	8	2.52	1	1	4.20	0	9.24	217.9
40	AA, A	6/1	6	2.91	1	1	2.91	0	8.73	161.3
31.5	AA, A	7/1	7	2.39	1	1	3.19	0	7.97	148.4
31.5	AA, A	6/1	6	2.59	1	1	2.59	0	7.77	127.8
25	AA, A	7/1	7	2.13	1	1	2.84	0	7.1	117.8
25	AA, A	6/1	6	2.30	1	1	2.30	0	6.9	100.8

TABLE 2 *Continued*

Size, mm ²	Class	Stranding Design	Stranding						Nominal Outside Diameter of Conductors, mm	Mass, kg/km
			Aluminum Wires			Steel Wires				
			Number	Diameter, mm	Layers	Number	Diameter, mm	Layers		
20	AA, A	7/1	7	1.91	1	1	2.55	0	6.37	94.80
20	AA, A	6/1	6	2.06	1	1	2.06	0	6.18	80.83
16	AA, A	6/1	6	1.84	1	1	1.84	0	5.52	64.49
12.5	AA, A	6/1	6	1.63	1	1	1.63	0	4.89	50.61

TABLE 3 **Rated Strength Aluminum Conductors, Steel Reinforced (ACSR)**

Size			Stranding Design Aluminum/Steel	Rated Strength (by type of steel core wire)				
cmil	AWG	Class		ACSR/GA ACSR/MA, kips	ACSR/GB ACSR/MB, kips	ACSR/GC ACSR/MC, kips	ACSR/HS ACSR/MS, kips	ACSR/AZ, kips
2 312 000	...	AA	76/19	56.7	55.8	54.8	58.5	54.8
2 167 000	...	AA	72/7	49.8	49.1	48.4	51.3	48.1
2 156 000	...	AA	84/19	60.3	59.0	57.7	62.8	57.1
1 780 000	...	AA	84/19	51.0	49.9	48.9	53.1	48.9
1 590 000	...	AA	54/19	54.5	53.0	51.6	57.5	50.8
1 590 000	...	AA	45/7	42.2	41.4	40.5	43.9	39.7
1 510 000	...	AA	54/19	51.7	50.3	48.9	54.5	48.2
1 510 000	...	AA	45/7	40.1	39.3	38.5	41.6	37.7
1 431 000	...	AA	54/19	49.1	47.7	46.4	51.7	45.7
1 431 000	...	AA	45/7	38.3	37.6	36.9	39.8	36.5
1 351 000	...	AA	54/19	46.3	45.1	43.8	48.8	43.2
1 351 000	...	AA	45/7	36.2	35.5	34.8	37.6	34.4
1 272 000	...	AA	54/19	43.6	42.4	41.2	46.0	40.7
1 272 000	...	AA	45/7	34.1	33.4	32.8	35.4	32.4
1 272 000	...	AA	36/1	26.4	26.1	26.0	27.0	25.4
1 192 500	...	AA	54/19	41.9	40.8	39.7	44.1	39.7
1 192 500	...	AA	45/7	32.0	31.3	30.7	33.2	30.4
1 113 000	...	AA	54/19	39.1	38.1	37.0	41.2	37.0
1 113 000	...	AA	45/7	29.8	29.3	28.7	31.0	28.4
1 033 500	...	AA	54/7	36.6	35.6	34.6	38.6	33.6
1 033 500	...	AA	45/7	27.7	27.1	26.6	28.8	26.3
1 033 500	...	AA	36/1	21.4	21.2	21.1	21.9	20.6
954 000	...	AA	54/7	33.8	32.9	32.0	35.7	31.0
954 000	...	AA	45/7	25.9	25.4	24.9	26.9	24.7
954 000	...	AA	36/1	19.8	19.6	19.5	20.3	19.1
900 000	...	AA	54/7	31.9	31.0	30.2	33.7	29.3
900 000	...	AA	45/7	24.4	24.0	23.5	25.4	23.3
795 000	...	AA	30/19	38.4	37.1	35.8	41.1	35.1
795 000	...	AA	54/7	28.2	27.4	26.6	29.7	25.8
795 000	...	AA	45/7	22.1	21.7	21.2	22.9	21.2
795 000	...	AA	26/7	31.5	30.5	29.6	33.5	28.6
795 000	...	AA	24/7	27.9	27.1	26.4	29.5	25.6
795 000	...	AA	36/1	16.8	16.6	16.5	17.2	16.3
715 500	...	AA	30/19	34.6	33.4	32.2	36.9	31.6
715 500	...	AA	26/7	28.4	27.5	26.6	30.1	25.7
715 500	...	AA	24/7	25.5	24.8	24.1	26.9	23.7
666 600	...	AA	26/7	26.4	25.6	24.8	28.0	24.0
666 600	...	AA	24/7	23.7	23.1	22.4	25.0	22.1
636 000	...	AA	30/19	31.5	30.5	29.4	33.6	29.4
636 000	...	AA	30/7	30.4	29.3	28.7	33.2	27.6
636 000	...	AA	26/7	25.2	24.4	23.6	26.8	22.9
636 000	...	AA	24/7	22.6	22.0	21.4	23.9	21.1
636 000	...	AA	36/1	13.8	13.6	13.5	14.0	13.4
636 000	...	AA	18/1	15.7	15.4	15.3	16.3	14.8
605 000	...	AA	30/19	30.0	29.0	28.0	32.0	28.0
605 000	...	AA	30/7	28.9	27.9	27.3	31.6	26.3
605 000	...	AA	26/7	24.3	23.6	22.8	25.8	22.5
605 000	...	AA	24/7	21.6	21.0	20.4	22.7	20.1
556 500	...	AA	30/7	27.8	26.8	25.8	29.7	24.8
556 500	...	AA	26/7	22.6	21.9	21.2	24.0	20.9
556 500	...	AA	24/7	19.8	19.3	18.7	20.9	18.5
556 500	...	AA	18/1	13.7	13.5	13.4	14.3	12.9
477 000	...	AA	30/7	23.8	23.0	22.1	25.5	21.3

TABLE 3 *Continued*

Size		Class	Stranding Design Aluminum/Steel	Rated Strength (by type of steel core wire)				
cmil	AWG			ACSR/GA ACSR/MA, kips	ACSR/GB ACSR/MB, kips	ACSR/GC ACSR/MC, kips	ACSR/HS ACSR/MS, kips	ACSR/AZ, kips
477 000	...	AA	26/7	19.5	18.9	18.4	20.7	18.1
477 000	...	AA	24/7	17.2	16.7	16.2	18.1	16.0
477 000	...	AA	18/1	11.8	11.6	11.5	12.3	11.1
397 500	...	AA	30/7	20.3	19.6	18.9	21.7	18.6
397 500	...	AA	26/7	16.3	15.8	15.3	17.2	15.1
397 500	...	AA	24/7	14.6	14.3	13.9	15.4	13.9
397 500	...	AA	18/1	9.9	9.8	9.7	10.4	9.5
336 400	...	AA	30/7	17.3	16.7	16.2	18.5	15.9
336 400	...	AA	26/7	14.1	13.7	13.3	14.9	13.3
336 400	...	AA	18/1	8.7	8.5	8.4	9.0	8.3
300 000	...	AA	26/7	12.7	12.3	12.0	13.4	12.0
266 800	...	AA	26/7	11.3	11.0	10.6	11.9	10.6
266 800	...	AA	18/1	6.9	6.8	6.7	7.1	6.5
211 600	0000	AA, A	6/1	8.35	8.08	7.95	9.01	7.42
211 300	...	AA (HS)	12/7	20.7	19.8	18.9	22.6	17.9
203 200	...	AA (HS)	16/19	28.4	27.1	25.8	31.1	25.1
190 800	...	AA (HS)	12/7	18.7	17.9	17.0	20.4	16.2
176 900	...	AA (HS)	12/7	17.3	16.6	15.8	18.9	15.0
167 800	000	AA, A	6/1	6.62	6.41	6.30	7.15	5.88
159 000	...	AA (HS)	12/7	16.0	15.3	14.6	17.4	14.2
134 600	...	AA (HS)	12/7	13.6	13.0	12.4	14.8	12.1
133 100	00	AA, A	6/1	5.30	5.13	5.05	5.72	4.88
110 800	...	AA (HS)	12/7	11.3	10.8	10.3	12.2	10.1
105 600	0	AA, A	6/1	4.38	4.25	4.12	4.65	3.98
101 800	...	AA (HS)	12/7	10.4	9.91	9.46	11.2	9.24
83 690	1	AA, A	6/1	3.55	3.45	3.34	3.76	3.29
80 000	...	AA (HS)	8/1	5.20	4.99	4.89	5.73	4.47
66 360	2	AA, A	7/1	3.64	3.51	3.39	3.90	3.26
66 360	2	AA, A	6/1	2.85	2.76	2.68	3.01	2.64
41 740	4	AA, A	7/1	2.36	2.28	2.20	2.52	2.16
41 740	4	AA, A	6/1	1.86	1.81	1.76	1.97	1.76
33 090	5	A	6/1	1.49	1.45	1.41	1.57	1.41
26 240	6	AA, A	6/1	1.19	1.16	1.12	1.26	1.12

TABLE 4 **Rated Strength—Aluminum Conductor, Steel Reinforced (ACSR)**

Size, mm ²	Class	Stranding Design	Rated Strength (by type of steel core wire)				
			ACSR/GA ACSR/MA, kN	ACSR/GB ACSR/MB, kN	ACSR/GC ACSR/MC, kN	ACSR/HS ACSR/MS, kN	ACSR/AZ, kN
1250	AA	84/19	306	300	293	319	289
1250	AA	76/19	269	265	260	278	260
1250	AA	72/7	250	246	242	257	239
1120	AA	84/19	275	269	263	286	259
1120	AA	76/19	240	236	232	248	232
1120	AA	72/7	226	223	219	232	218
1000	AA	84/19	245	239	234	254	231
1000	AA	72/7	202	199	196	208	195
900	AA	84/19	226	221	217	236	217
900	AA	72/7	181	179	176	186	175
800	AA	54/19	240	233	227	252	223
800	AA	45/7	186	182	179	193	175
710	AA	54/19	213	207	201	224	198
710	AA	45/7	167	164	160	173	158
630	AA	54/19	189	184	179	199	176
630	AA	45/7	148	145	142	153	140
560	AA	54/19	173	168	164	182	164
560	AA	45/7	132	129	126	136	125
500	AA	54/7	154	150	145	163	141
500	AA	45/7	118	115	113	122	112

TABLE 4 *Continued*

Size, mm ²	Class	Stranding Design	Rated Strength (by type of steel core wire)				ACSR/AZ, kN
			ACSR/GA ACSR/MA, kN	ACSR/GB ACSR/MB, kN	ACSR/GC ACSR/MC, kN	ACSR/HS ACSR/MS, kN	
450	AA	54/7	139	135	131	147	128
450	AA	45/7	108	106	104	112	103
400	AA	30/19	170	164	158	181	155
400	AA	26/7	139	135	131	148	126
400	AA	24/7	123	120	116	130	113
355	AA	30/19	151	146	140	161	137
355	AA	26/7	123	119	115	131	112
355	AA	24/7	111	108	105	117	103
315	AA	30/19	138	133	128	147	128
315	AA	26/7	110	106	103	117	99.3
315	AA	24/7	98.7	96.0	93.2	104	91.7
315	AA	18/1	68.0	66.8	66.3	70.8	64.0
280	AA	30/7	122	118	113	131	109
280	AA	26/7	100	97.2	94.1	106	92.4
280	AA	24/7	87.5	85.1	82.6	92.0	81.2
280	AA	18/1	60.4	59.4	58.9	63.0	56.8
250	AA	30/7	109	105	101	117	97.4
250	AA	26/7	89.5	86.8	84.1	94.6	82.5
250	AA	24/7	79.4	77.2	75.0	83.4	73.8
250	AA	18/1	54.1	53.1	52.7	56.4	50.9
224	AA	30/7	97.4	93.9	90.4	104	86.9
224	AA	26/7	80.0	77.6	75.1	84.5	73.7
224	AA	24/7	72.0	70.1	68.1	74.8	68.1
224	AA	18/1	48.3	47.5	47.1	50.4	45.5
200	AA	30/7	89.7	86.6	83.4	95.5	81.6
200	AA	26/7	71.5	69.3	67.2	75.6	65.9
200	AA	24/7	64.2	62.5	60.7	67.7	60.7
200	AA	18/1	43.1	42.4	42.1	45.0	41.3
180	AA	30/7	80.7	77.9	75.0	85.9	73.4
180	AA	26/7	65.4	63.4	61.4	69.0	60.3
180	AA	24/7	57.8	56.2	54.7	60.9	54.7
180	AA	18/1	40.4	39.7	39.1	41.4	38.1
160	AA	30/7	72.9	70.4	67.9	77.6	66.4
160	AA	26/7	58.9	57.2	55.4	62.4	55.4
160	AA	24/7	52.0	50.6	49.2	54.8	49.2
160	AA	18/1	35.8	35.2	34.6	37.0	34.0
140	AA	26/7	52.2	50.7	49.2	55.3	49.2
140	AA	24/7	46.4	45.2	44.0	48.9	44.0
140	AA	18/1	31.5	30.9	30.4	32.5	29.9
125	AA	26/7	46.9	45.6	44.2	49.6	44.2
125	AA	24/7	41.5	40.4	39.3	43.6	39.3
125	AA	18/1	28.8	28.3	27.9	29.7	27.6
100	AA (HS)	16/19	123	117	111	133	106
100	AA (HS)	12/7	85.9	82.0	78.0	93.8	74.1
100	AA, A	6/1	34.6	33.5	33.0	37.3	30.8
90	AA (HS)	12/7	77.2	73.6	70.1	84.2	66.6
80	AA (HS)	12/7	70.6	67.5	64.4	76.4	62.6
80	AA, A	6/1	27.6	26.7	26.4	29.8	24.6
71	AA (HS)	12/7	62.9	60.2	57.4	68.1	55.8
63	AA (HS)	12/7	56.2	53.8	51.3	60.8	49.9
63	AA, A	6/1	22.1	21.4	21.1	23.8	20.4
56	AA (HS)	12/7	50.2	48.0	45.8	54.3	44.5
50	AA (HS)	12/7	45.4	43.5	41.5	48.2	41.5
50	AA, A	6/1	18.1	17.5	17.0	19.2	16.4
40	AA (HS)	8/1	22.5	21.5	21.1	24.7	19.3
40	AA, A	6/1	14.9	14.4	14.0	15.7	13.7
31.5	AA, A	7/1	15.1	14.6	14.0	16.2	13.5
31.5	AA, A	6/1	11.9	11.6	11.2	12.6	11.0
25	AA, A	7/1	12.3	11.9	11.5	13.1	11.2

TABLE 4 *Continued*

Size, mm ²	Class	Stranding Design	Rated Strength (by type of steel core wire)				ACSR/AZ, kN
			ACSR/GA ACSR/MA, kN	ACSR/GB ACSR/MB, kN	ACSR/GC ACSR/MC, kN	ACSR/HS ACSR/MS, kN	
25	AA, A	6/1	9.65	9.37	9.09	10.1	9.09
20	AA, A	7/1	10.0	9.69	9.34	10.7	9.15
20	AA, A	6/1	7.84	7.62	7.39	8.29	7.39
16	AA, A	6/1	6.33	6.15	5.97	6.69	5.97
12.5	AA, A	6/1	4.97	4.83	4.69	5.25	4.69

TABLE 5 Lay Factors for Aluminum Conductors, 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									Steel Wire Layers ^A						
		First (Outside)			Second			Third		Fourth (Inside)		12 Wire			6 Wire		
Min	Preferred	Max	Min	Preferred	Max	Min	Max	Min	Max	Min	Preferred	Max	Min	Preferred	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, 45/7	10	11	13	10	13	16	10	17	...	...	...	...	...	18	25	30
	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	13	14.5	...	...	...	...	...	...	...	...	...	...	...	...	...

^A See Specification B 500.

7. Joints

7.1 Electric-butt welds, cold-pressure welds, and 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 3).

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

8. Lay

8.1 The length of lay of the various layers of wires in a conductor shall conform to Table 5 (see Explanatory Note 4).

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

9. Construction

9.1 ACSR may be constructed using steel core wire with any one of nine types of protective coatings. The acceptable core wires are galvanized steel core wires, coating Classes A, B or C in accordance with Specification B 498/B 498M; high-strength galvanized steel core wire in accordance with Specification B 606; Zn-5A1-MM coated steel core wire, coating Classes A, B or C, in accordance with Specification B 802/B 802M; high-strength Zn-5A1-MM coated steel core wire in accordance with Specification B 803; aluminized steel

core wire in accordance with Specification B 341/B 341M.

9.2 The number and diameter of aluminum and steel wires and the area of cross section of aluminum wires shall conform to the requirements prescribed in Tables 1-5.

9.3 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. The nominal diameter of the compressed conductor is 3 % below the nominal diameter of noncompressed conductor and the area of cross section after compressing is in accordance with Section 13.

NOTE 2—The user's attention is called to the claim that certain compressed strand constructions may be subject to patent rights, for example Patents 3,383,704 and 3,444,684.

10. A Rated Strength of Conductor

10.1 The rated strength of a completed conductor shall be taken as the aggregate strength of the aluminum and steel components, calculated as follows. The strength contribution of the aluminum wires shall be taken as the percentage, indicated in Table 6, 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/B 230M. The strength contribution of the steel core wires shall be taken as the percentage, according to the number of layers of steel wires, indicated in Table 6, of the sum of the strengths of the steel wires, calculated from their specified nominal wire

TABLE 6 Standard Increments and Rating Factors for Mass Per Unit Length, Resistivity, and Rated Strength Determination

Stranding Design Aluminum/ Steel	Standard Increments Due to Stranding (for mass per unit length and resistivity) Increase		Rating Factors (for rated strength)	
	Aluminum (%)	Steel (%)	Aluminum (%)	Steel (%)
6/1	1.5	0	96	96
7/1	1.5	0	96	96
8/1	2.0	0	96	96
18/1	2.0	0	93	96
36/1	2.0	0	91	96
12/7	2.5	0.4	96	96
24/7	2.5	0.4	93	96
26/7	2.5	0.4	93	96
30/7	2.75	0.4	93	96
42/7	2.5	0.4	91	96
45/7	2.5	0.4	91	96
48/7	2.5	0.4	91	96
54/7	2.5	0.4	91	96
72/7	3.0	0.4	90	96
16/19	2.5	0.6	96	93
30/19	2.75	0.6	93	93
54/19	3.0	0.6	91	93
76/19	3.0	0.6	90	93
84/19	3.0	0.6	90	93

diameter and the appropriate specified minimum stress at 1 % extension given in Specification B 341/B 341M, B 498/B 498M, B 606, B 802/B 802M, or B 803, whichever is applicable.

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.

10.3 Rated strength of various constructions are given in Table 3 or Table 4.

11. Density

11.1 For the purpose of calculating mass per unit length, cross sections, etc., the density of aluminum 1350 shall be taken as 2705 kg/m³ [0.0975 lb/in.³] at 20°C (Explanatory Note 5).

11.2 For the purpose of calculating mass per unit length, cross sections, etc., the density of galvanized or aluminumized steel wire shall be taken as 7780 kg/m³ [0.281 lb/in.³] at 20°C.

12. Mass Per Unit Length and Electrical Resistance

12.1 The mass per unit length 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 6. When greater accuracy is desired, the increment based on the specific lay of the conductor may be calculated (Explanatory Note 6).

12.2 In the calculation of the electrical resistance of a conductor, the zinc-coated, Zn-5A1-MM coated, or aluminum-coated steel core wires may be included.

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 of 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 test method the increment in mass per unit length 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 per unit length increment due to stranding shall be calculated.

14. Workmanship, Finish and Appearance

14.1 The conductor shall be clean and free of 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 7).

15.2 All aluminum wires composing the conductors shall be capable of meeting the bending properties stated in Specification B 230/B 230M after stranding.

15.3 Routine production testing after stranding is not required. However, when such tests are requested by the purchaser and agreed to by the manufacturer at the time of placing the order (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 the wire before stranding. Elongation tests may be made for information purposes only and no minimum values are assigned (Explanatory Note 7). The frequency of these tests shall be agreed upon between the purchaser and the manufacturer.

15.4 Tests for demonstration of rated strength of the completed conductor are not required by this specification but may be made if agreed upon between 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 8).

15.5 Tests for all properties of zinc-coated, Zn-5A1-MM coated, or aluminum coated steel wires shall be made before stranding (Explanatory Note 7).

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 especially agreed upon between the manufacturer and the purchaser at the time of the purchase.

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

be agreed upon between the manufacturer and the purchaser at the time of placing the order. Recommended package sizes are shown in Table 7 or Table 8 (Explanatory Note 9).

17. Packaging and Package Marking

17.1 Package sizes and kind of package, reels or coils, shall

TABLE 7 Packaging Information Recommended Reel Sizes, Shipping Lengths and Net Masses

Size		Stranding Design Aluminum/ Steel	Reel Types								
			RMT			RM			NR		
cmil	AWG		Reel Size ^A	Length on Reel, ft	Net Mass, lb	Reel Size ^A	Length on Reel, ft	Net Mass, lb	Reel Size ^A	Length on Reel, ft	Net Mass, lb
2 312 000	...	76/19	96.60	7000	17 660	...	...	...	...	...	...
2 167 000	...	72/7	96.60	7000	16 100	...	...	...	...	...	...
2 156 000	...	84/19	96.60	7500	18 810	...	...	...	...	...	...
1 780 000	...	84/19	96.60	9200	19 060	...	...	...	...	...	...
1 590 000	...	54/19	90.45	5740	11 720	68.38	2870	5860	...	...	...
1 590 000	...	45/7	90.45	6000	10 740	68.38	3000	5370	60.28	2000	3580
1 510 000	...	54/19	90.45	6040	11 710	68.38	3020	5850	...	...	...
1 510 000	...	45/7	90.45	6320	10 740	68.38	3160	5370	60.28	2110	3590
1 431 000	...	54/19	90.45	6375	11 720	68.38	3190	5860	...	...	...
1 431 000	...	45/7	90.45	6665	10 730	68.38	3335	5370	60.28	2220	3580
1 351 000	...	54/19	90.45	6755	11 720	68.38	3375	5860	...	...	...
1 351 000	...	45/7	90.45	7060	10 740	68.38	3530	5370	60.28	2355	3580
1 272 000	...	54/19	90.45	7175	11 720	68.38	3585	5860	...	...	...
1 272 000	...	45/7	90.45	7500	10 740	68.38	3750	5370	60.28	2500	3580
1 272 000	...	36/1	84.45	6020	7 740	...	...	...	...	...	...
1 192 500	...	54/19	90.45	7650	11 720	68.38	3825	5860	...	...	...
1 192 500	...	45/7	90.45	8000	10 740	68.38	4000	5370	60.28	2665	3580
1 113 000	...	54/19	90.45	8200	11 730	68.38	4100	5860	...	...	...
1 113 000	...	45/7	90.45	8570	10 740	68.38	4285	5370	60.28	2855	3580
1 033 500	...	54/7	90.45	8870	11 790	68.38	4435	5890	...	...	...
1 033 500	...	45/7	90.45	9230	10 730	68.38	4615	5370	60.28	3075	3580
1 033 500	...	36/1	84.45	7420	7750	...	...	...	...	...	...
954 000	...	54/7	90.45	9600	11 780	68.38	4800	5890	...	...	...
954 000	...	45/7	90.45	10 000	10 740	68.38	5000	5370	60.28	3335	3580
954 000	...	36/1	84.45	8030	7740	...	...	...	...	...	...
900 000	...	54/7	90.45	10 180	11 790	68.38	5090	5890	...	...	...
900 000	...	45/7	90.45	10 590	10 730	68.38	5295	5360	60.28	3530	3580
795 000	...	30/19	84.45	7980	9850	66.32	3990	4920	...	...	...
795 000	...	54/7	90.45	11 520	11 780	68.38	5760	5890	...	...	...
795 000	...	45/7	90.45	12 000	10 740	68.38	6000	5370	60.28	4000	3580
795 000	...	26/7	84.36	6940	7590	...	...	...	60.28	3470	3790
795 000	...	24/7	84.36	6400	6540	...	...	...	60.28	3200	3270
795 000	...	36/1	84.45	9640	7750	...	...	...	...	...	...
715 500	...	30/19	84.45	8880	9850	66.32	4440	4930	...	...	...
715 500	...	26/7	84.36	7710	7580	...	...	...	60.28	3855	3790
715 500	...	24/7	84.36	7100	6540	...	...	...	60.28	3550	3270
666 600	...	26/7	84.36	8280	7590	...	...	...	60.28	4140	3790
666 600	...	24/7	84.36	7630	6550	...	...	...	60.28	3815	3270
636 000	...	30/19	84.45	9980	9850	66.32	4990	4930	...	...	...
636 000	...	30/7	...	...	...	66.32	5005	4980	...	...	...
636 000	...	26/7	84.36	8670	7580	...	...	...	60.28	4335	3790
636 000	...	24/7	84.36	8000	6550	...	...	...	60.28	4000	3270
636 000	...	36/1	...	...	...	66.32	6025	3870	...	...	...
636 000	...	18/1	...	...	...	66.32	6020	4150	48.28	3010	2080
...	42.28	2005	1380
605 000	...	30/19	84.45	10 490	9850	66.32	5245	4920	...	...	...
605 000	...	30/7	...	...	...	66.32	5245	4960	...	...	...
605 000	...	26/7	84.36	9110	7570	...	...	...	60.28	4555	3790
605 000	...	24/7	84.36	8410	6550	...	...	...	60.28	4205	3270
556 500	...	30/7	...	...	...	66.32	5700	4960	...	...	...
556 500	...	26/7	84.36	9910	7580	...	...	...	60.28	4955	3790
556 500	...	24/7	84.36	9140	6550	...	...	...	60.28	4570	3270
556 500	...	18/1	...	...	...	66.32	6890	4160	48.28	3445	2080
...	42.28	2295	1380
477 000	...	30/7	...	...	...	66.32	6650	4960	...	...	...
477 000	...	26/7	84.36	11 560	7580	...	...	...	60.28	5780	3790

TABLE 7 *Continued*

Size		Stranding Design Aluminum/ Steel	Reel Types								
			RMT			RM			NR		
cmil	AWG		Reel Size ^A	Length on Reel, ft	Net Mass, lb	Reel Size ^A	Length on Reel, ft	Net Mass, lb	Reel Size ^A	Length on Reel, ft	Net Mass, lb
477 000	...	24/7	84.36	10 660	6540	...	...	...	60.28	5330	3270
477 000	...	18/1	...	...	...	66.32	8030	4150	48.28	4015	2080
...	...	...	...	...	...	...	...	...	42.28	2675	1380
397 500	...	30/7	...	...	...	66.32	7980	4960	...	...	...
397 500	...	26/7	84.36	13 870	7570	...	...	...	60.28	6935	3790
397 500	...	24/7	84.36	12 790	6540	...	...	...	60.28	6395	3270
397 500	...	18/1	...	...	...	66.32	9630	4150	48.28	4815	2080
...	...	...	...	...	...	...	...	...	42.28	3210	1380
336 400	...	30/7	...	...	...	66.32	9430	4960	...	...	...
336 400	...	26/7	84.36	16 390	7570	...	...	...	60.28	8195	3790
336 400	...	18/1	...	...	...	66.32	11 390	4150	48.28	5695	2080
...	...	...	...	...	...	...	...	...	42.28	3795	1380
300 000	...	26/7	...	...	...	...	...	...	60.28	9190	3790
266 800	...	26/7	...	...	...	...	...	...	60.28	10 330	3790
266 800	...	18/1	...	...	...	66.32	14 360	4150	48.28	7180	2080
...	...	...	...	...	...	...	...	...	42.28	4785	1380
211 600	0000	6/1	...	...	...	...	...	...	42.28	6080	1770
...	...	...	...	...	...	...	...	...	36.22	3044	890
...	...	...	...	...	...	...	...	...	30.22	2025	590
211 300	...	12/7	...	...	...	...	...	...	48.28	6020	3170
203 200	...	16/19	...	...	...	66.32	7875	5310	...	...	...
190 800	...	12/7	...	...	...	...	...	...	48.28	6665	3170
176 900	...	12/7	...	...	...	...	...	...	48.28	7195	3170
167 800	000	6/1	...	...	...	...	...	...	42.28	7670	1770
...	...	...	...	...	...	...	...	...	36.22	3835	880
...	...	...	...	...	...	...	...	...	30.22	2560	590
159 000	...	12/7	...	...	...	...	...	...	48.28	8000	3170
134 600	...	12/7	...	...	...	...	...	...	48.28	9450	3170
133 100	00	6/1	...	...	...	...	...	...	42.28	9670	1770
...	...	...	...	...	...	...	...	...	36.22	4835	880
...	...	...	...	...	...	...	...	...	30.22	3220	590
110 800	...	12/7	...	...	...	...	...	...	48.28	11 480	3170
105 600	0	6/1	...	...	...	...	...	...	42.28	12 190	1770
...	...	...	...	...	...	...	...	...	36.22	6095	880
...	...	...	...	...	...	...	...	...	30.22	4060	590
101 800	...	12/7	...	...	...	...	...	...	48.28	12 500	3170
83 690	1	6/1	...	...	...	...	...	...	42.28	15 360	1770
...	...	...	...	...	...	...	...	...	36.22	7680	880
...	...	...	...	...	...	...	...	...	30.22	5120	590
80 000	...	8/1	...	...	...	...	...	...	36.22	7580	1130
66 360	2	7/1	...	...	...	...	...	...	38.22	11 250	1200
...	...	...	...	...	...	...	...	...	30.22	5625	600
66 360	2	6/1	...	...	...	...	...	...	42.28	19 390	1770
...	...	...	...	...	...	...	...	...	36.22	9695	880
...	...	...	...	...	...	...	...	...	30.22	6465	590
41 740	4	7/1	...	...	...	...	...	...	38.22	17 910	1200
...	...	...	...	...	...	...	...	...	30.22	8955	600
41 740	4	6/1	...	...	...	...	...	...	36.22	15 420	880
26 240	6	6/1	...	...	...	...	...	...	30.22	16 340	590

^A See Table 9 for dimensions of reels.

TABLE 8 Packaging Information: Recommended Reel Sizes, Shipping Lengths, and Net Masses

Size, mm ²	Class	Stranding Design	Reel Designation								
			Reel Designation RMT			Reel Designation RM			Reel Designation NR		
			Reel Size ^A	Length on Reel, m	Net Mass of Conductors, kg	Reel Size ^A	Length on Reel, m	Net Mass of Conductors, kg	Reel Size ^A	Length on Reel, m	Net Mass of Conductors, kg
1250	AA	84/19	96.60	2010	8590	...	...	...	...	...	...
1250	AA	76/19	96.60	1975	7945	...	...	...	...	...	...
1250	AA	72/7	96.60	1875	7315	...	...	...	...	...	...
1120	AA	84/19	96.60	2240	8585	...	...	...	...	...	...
1120	AA	76/19	96.60	2210	7945	...	...	...	...	...	...

TABLE 8 *Continued*

Size, mm ²	Class	Stranding Design	Reel Designation								
			Reel Designation RMT			Reel Designation RM			Reel Designation NR		
			Reel Size ^A	Length on Reel, m	Net Mass of Conductors, kg	Reel Size ^A	Length on Reel, m	Net Mass of Conductors, kg	Reel Size ^A	Length on Reel, m	Net Mass of Conductors, kg
1120	AA	72/7	96.60	2090	7310	...	...	...	...	...	...
1000	AA	84/19	96.60	2515	8590	...	...	...	...	...	...
1000	AA	72/7	96.60	2335	7310	...	...	...	...	...	...
900	AA	84/19	96.60	2795	8590	...	...	...	...	...	...
900	AA	72/7	96.60	2600	7310	...	...	...	...	...	...
800	AA	54/19	90.45	1655	4990	68.38	880	2655	...	...	...
800	AA	45/7	90.45	1840	4880	68.38	920	2440	60.28	615	1630
710	AA	54/19	90.45	1860	4980	68.38	995	2665	...	...	...
710	AA	45/7	90.45	2075	4880	68.38	1040	2445	60.28	690	1620
630	AA	54/19	90.45	2100	4985	68.38	1120	2660	...	...	...
630	AA	45/7	90.45	2340	4875	68.38	1170	2440	60.28	780	1625
560	AA	54/19	90.45	2360	4985	68.38	1260	2660	...	...	...
560	AA	45/7	90.45	2630	4875	68.38	1315	2440	60.28	875	1620
500	AA	54/19	90.45	2655	5015	68.38	1415	2670	...	...	...
500	AA	45/7	90.45	2945	4875	68.38	1475	2440	60.28	980	1625
450	AA	54/7	90.45	2940	5015	68.38	1570	2680	...	...	...
450	AA	45/7	90.45	3265	4870	68.38	1635	2440	60.28	1090	1625
400	AA	30/19	84.45	2450	4470	66.32	1225	2235	...	...	...
400	AA	26/7	84.36	2125	3445	...	...	...	60.28	1060	1720
400	AA	24/7	84.36	1960	2970	...	...	...	60.28	980	1485
355	AA	30/19	84.45	2760	4470	66.32	1380	2235	...	...	...
355	AA	26/7	84.36	2400	3445	...	...	...	60.28	1200	1720
355	AA	24/7	84.36	2210	2970	...	...	...	60.28	1105	1485
315	AA	30/19	84.45	3100	4470	66.32	1550	2235	...	...	...
315	AA	26/7	84.36	2700	3445	...	...	...	60.28	1345	1715
315	AA	24/7	84.36	2485	2970	...	...	...	60.28	1245	1485
315	AA	18/1	...	...	...	66.32	1875	1900	48.28	940	955
									42.28	625	635
280	AA	30/7	...	...	...	66.32	1745	2250	...	...	...
280	AA	26/7	84.36	3045.0	3445	...	...	...	60.28	1520	1720
280	AA	24/7	84.36	2805.0	2970	...	...	...	60.28	1405	1485
280	AA	18/1	...	...	...	66.32	2110	1900	48.28	1060	955
									42.28	705	635
250	AA	30/7	...	...	...	66.32	1955	2255	...	...	...
250	AA	26/7	84.36	3410.0	3450	...	...	...	60.28	1700	1720
250	AA	24/7	84.36	3140.0	2970	...	...	...	60.28	1570	1485
250	AA	18/1	...	...	...	66.32	2355	1900	48.28	1180	950
									42.28	790	635
224	AA	30/7	...	...	...	66.32	2190	2255	...	...	...
224	AA	26/7	84.36	3810.0	3445	...	...	...	60.28	1905	1720
224	AA	24/7	84.36	3500.0	2970	...	...	...	60.28	1750	1485
224	AA	18/1	...	...	...	66.32	2635	1900	48.28	1320	950
									42.28	880	635
200	AA	30/7	...	...	...	66.32	2455	2255	...	...	...
200	AA	26/7	84.36	4265.0	3445	...	...	...	60.28	2130	1720
200	AA	24/7	84.36	3920.0	2970	...	...	...	60.28	1960	1485
200	AA	18/1	...	...	...	66.32	2955	1900	48.28	1480	950
									42.28	985	635
180	AA	30/7	...	...	...	66.32	2730	2255	...	...	...
180	AA	26/7	84.36	4725.0	3445	...	...	...	60.28	2360	1720
180	AA	24/7	84.36	4360.0	2970	...	...	...	60.28	2180	1485
180	AA	18/1	...	...	...	66.32	3280	1900	48.28	1645	955
									42.28	1095	635
160	AA	30/7	...	...	...	66.32	3050	2255	...	...	...
160	AA	26/7	84.36	5315.0	3445	...	...	...	60.28	2655	1720
160	AA	24/7	84.36	4915.0	2970	...	...	...	60.28	2460	1485

TABLE 8 *Continued*

Size, mm ²	Class	Stranding Design	Reel Designation								
			Reel Designation RMT			Reel Designation RM			Reel Designation NR		
			Reel Size ^A	Length on Reel, m	Net Mass of Conductors, kg	Reel Size ^A	Length on Reel, m	Net Mass of Conductors, kg	Reel Size ^A	Length on Reel, m	Net Mass of Conductors, kg
160	AA	18/1	...	...	...	66.32	3705	1905	48.28	1855	955
									42.28	1240	635
140	AA	26/7	...	...	...	...	...	...	60.28	3035	1720
140	AA	24/7	...	...	...	...	...	...	60.28	2790	1485
140	AA	18/1	...	...	...	66.32	4210	1900	48.28	2110	955
									42.28	1405	635
125	AA	26/7	...	...	...	...	...	...	60.28	3415	1720
125	AA	24/7	...	...	...	...	...	...	60.28	3125	1485
125	AA	18/1	...	...	...	66.32	4735	1900	48.28	2375	955
									42.28	1585	635
100	AA (HS)	16/19	...	...	...	66.32	2480	2410	...	...	...
100	AA (HS)	12/7	...	...	...	...	...	...	...	...	...
100	AA, A	6/1	...	...	...	...	...	...	42.28	1990	805
									36.22	990	400
									30.22	665	270
90	AA (HS)	12/7	...	...	...	...	...	...	...	...	...
80	AA (HS)	12/7	...	...	...	...	...	...	...	...	...
80	AA, A	6/1	...	...	...	...	...	...	42.28	2490	805
									36.22	1235	400
									30.22	835	270
71	AA (HS)	12/7	...	...	...	...	...	...	...	...	...
63	AA (HS)	12/7	...	...	...	...	...	...	...	...	...
63	AA, A	6/1	...	...	...	...	...	...	42.28	3155	805
									36.22	1565	400
									30.22	1060	270
56	AA (HS)	12/7	...	...	...	...	...	...	...	...	...
50	AA (HS)	12/7	...	...	...	...	...	...	...	...	...
50	AA, A	6/1	...	...	...	...	...	...	42.28	3975	805
									36.22	1975	400
									30.22	1335	270
40	AA (HS)	8/1	...	...	...	...	...	...	...	...	...
40	AA, A	6/1	...	...	...	...	...	...	42.28	4990	805
									36.22	2480	400
									30.22	1675	270
31.5	AA, A	7/1	...	...	...	...	...	...	38.22	3675	545
									30.22	1820	270
31.5	AA, A	6/1	...	...	...	...	...	...	42.28	6300	805
									36.22	3130	400
									30.22	2115	270
25	AA, A	7/1	...	...	...	...	...	...	38.22	4625	545
									30.22	2290	270
25	AA, A	6/1	...	...	...	...	...	...	36.22	3970	400
20	AA, A	7/1	...	...	...	...	...	...	38.22	5750	545
									30.22	2850	270
20	AA, A	6/1	...	...	...	...	...	...	36.22	4950	400
16	AA, A	6/1	...	...	...	...	...	...	30.22	4185	270
12.5	AA, A	6/1	...	...	...	...	...	...	30.22	5335	270

^ASee Table 9 for dimensions of reels.

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.

NOTE 3—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 is to be clearly marked and the length of each portion shall be shown on the tag attached to the end of the conductor.

TABLE 9 Dimensions of Standard Reels (For Information Only)

Reel Designation ^{A,B}	Reel Capacity, in. ³ (m ³)	Nominal Reel Dimensions				
		Flange Diameter in. (m)	Drum Diameter in. (m)	Width		Arbor Hole Diameter in. (m)
				Inside in. (m)	Outside ^C in. (m)	
NR 30.22	9 950 (0.182)	30 (0.76)	18 (0.41)	22 (0.56)	25 (0.64)	3 to 3¼ (76–83)
NR 36.22	16 800 (0.275)	36 (0.91)	18 (0.46)	22 (0.56)	25 (0.64)	3 to 3¼ (76–83)
NR 38.22	18 000 (0.295)	38 (0.97)	20 (0.51)	22 (0.56)	25 (0.64)	3 to 3¼ (76–83)
NR 42.28	29 100 (0.477)	42 (1.07)	21 (0.53)	28 (0.71)	32½ (0.83)	3 to 3¼ (76–83)
NR 48.28	38 000 (0.623)	48 (1.22)	24 (0.61)	28 (0.71)	32½ (0.83)	3 to 3¼ (76–83)
NR 60.28 ^D	61 900 (1.014)	60 (1.52)	28 (0.71)	28 (0.71)	32½ (0.83)	3 to 3¼ (76–83)
RM 66.32 ^E	76 900 (1.260)	66 (1.68)	36 (0.91)	32 (0.81)	38 (0.97)	3 to 3¼ (76–83)
RM 68.38 ^E	99 300 (1.627)	68 (1.73)	36 (0.91)	38 (0.97)	44 (1.12)	3 to 3¼ (76–83)
RMT 84.36 ^F	122 100 (2.001)	78 (84) (1.98 (2.13))	42 (1.07)	36 (0.91)	43 (1.09)	5 to 5¼ (127-133)
RMT 84.45 ^F	152 700 (2.502)	78 (84) (1.98 (2.13))	42 (1.07)	45 (1.14)	52 (1.32)	5 to 5¼ (127-133)
RMT 90.45 ^F	187 000 (3.064)	84 (90) (2.13 (2.29))	42 (1.07)	45 (1.14)	52 (1.32)	5 to 5¼ (127-133)
RMT 96.60 ^F	300 000 (4.893)	90 (96) (2.29 (2.44))	42 (1.07)	60 (1.52)	67 (1.70)	5 to 5¼ (127-133)

^A Prefix "NR" denotes wooden nonreturnable reel, "RM" metal returnable reel, and "RMT" metal returnable reel with one-beam tires.

^B Reels are not designed to withstand the forces required for braking during tension stringing operations.

^C Pay-off equipment for reels NR 48.28 and smaller should be a minimum of 2 in. (50 mm) wider than the nominal outside reel width to provide for extension of bolts and for possible flange distortion. For reels NR 60.28 and larger, either wood or metal, pay-off equipment should be not less than 4 in. (100 mm) wider than the reel width.

^D Hub reinforcements will be provided for reel NR 60.28.

^E Reels RM 66.32 and RM 68.38 have flat rims.

^F Reels RMT 84.36, RMT 84.45, RMT 90.45, and RMT 96.60 have 3-in. (76 mm) I-beam tires. Reels with similar dimensions except without I-beam tires are sometimes used.

17.4 The net mass, length, size, kind of conductors, stranding, type of coating, class of zinc or Zn-5Al-MM coating (if used), 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 each package.

18. Keywords

18.1 aluminum conductor; concentric-lay-stranded aluminum conductor; electrical conductors; electrical conductors, aluminum; steel-reinforced conductors; stranded aluminum conductors

EXPLANATORY NOTES

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

NOTE 2—For definitions of terms relating to conductors, refer to Terminology B 354.

NOTE 3—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 4—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 conductors, 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 5—This density is based upon aluminum of 99.50 % purity. The inch-pound density of the aluminum wires is used for mass per unit length calculations and is based upon the standard SI density with the conversion rounded to the nearest 0.0005 lb/in.³

NOTE 6—The increment of mass or electrical resistance of a completed concentric-lay-stranded conductor (k) in percent is:

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

where m is the stranding factor, and 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 lay, 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:

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

where $n =$

$$\frac{\text{length of lay}}{\text{diameter of helical path of the wire}}$$

The derivation of the above is given in *NBS Handbook, 100 Copper Wire Tables*.

The factors k and m are to be determined separately for the zinc-coated or aluminum-coated steel (Section 8).

NOTE 7—Wires unlaid from conductors may have different physical properties from those of the wire prior to stranding because of the deformation caused by stranding and straightening for test. If tests on galvanized or aluminum-coated 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 8—To test ACSR conductors for breaking strength successfully as a unit requires special devices for gripping the ends of the aluminum and 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, split sleeves, and preformed grips, but ordinary jaws or clamping devices usually are not suitable.

NOTE 9—For the convenience of the users of this specification, Tables 7 and 8 have been prepared giving recommended shipping lengths for the standard sizes of ACSR referred to in Tables 1 and 2 respectively. Values of net mass in this table are rounded to the nearest ten pound increment.

Because of the variations in coil masses, etc., it is common practice to allow a permissible variation in length of $\pm 5\%$ for sizes larger than No. 1 AWG [40 mm²] and a tolerance of $\pm 10\%$ on sizes No. 1 AWG [40 mm²] and smaller. It is also common practice to allow an amount not exceeding 10 % of the total mass of any one order to be shipped in random lengths with no piece shorter than 50 % of the standard length ordered.

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