Designation: B856 – 13

Standard Specification for Concentric-Lay-Stranded Aluminum Conductors, Coated Steel Supported (ACSS)[1]

This standard is issued under the fixed designation B856; 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 round wire concentric-lay-stranded aluminum conductors, steel supported (ACSS) for use as overhead electrical conductors (see Explanatory Note 1).

1.2 The values stated in inch-pound or SI units are to be regarded separately as standard. Each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the specification. For conductor sizes designated by AWG or kcmil sizes, the requirements in SI units are numerically converted from the corresponding requirements in inch-pound units. For conductor sizes designation by AWG or kcmil, the requirements in SI units have been numerically converted from corresponding values stated or derived in inch-pound units. For conductor sizes designated by SI units only, the requirements are stated or derived in SI units.

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

2. Referenced Documents

2.1 The following documents of the issue in effect on date of material purchase form part of this specification to the extent referenced herein:

2.2 *ASTM Standards:*[2]

B263 Test Method for Determination of Cross-Sectional Area of Stranded Conductors

B354 Terminology Relating to Uninsulated Metallic Electrical Conductors

B498/B498M Specification for Zinc-Coated (Galvanized) Steel Core Wire for Use in Overhead Electrical Conductors

B500/B500M Specification for Metallic Coated or Aluminum Clad Stranded Steel Core for Use in Overhead Electrical Conductors

B502 Specification for Aluminum-Clad Steel Core Wire for Use in Overhead Electrical Aluminum Conductors

B549 Specification for Concentric-Lay-Stranded Aluminum Conductors, Aluminum-Clad Steel Reinforced for Use in Overhead Electrical Conductors

B606 Specification for High-Strength Zinc-Coated (Galvanized) Steel Core Wire for Aluminum and Aluminum-Alloy Conductors, Steel Reinforced

B609/B609M Specification for Aluminum 1350 Round Wire, Annealed and Intermediate Tempers, for Electrical Purposes

B802/B802M Specification for Zinc–5 % Aluminum-Mischmetal Alloy-Coated Steel Core Wire for Aluminum Conductors, Steel Reinforced (ACSR)

B803 Specification for High-Strength Zinc–5 % Aluminum-Mischmetal Alloy-Coated Steel Core Wire for Use in Overhead Electrical Conductors

B857 Specification for Shaped Wire Compact Concentric-Lay-Stranded Aluminum Conductors, Coated-Steel Supported (ACSS/TW)

B957 Specification for Extra-High-Strength and Ultra-High-Strength Zinc-Coated (Galvanized) Steel Core Wire for Overhead Electrical Conductors

B958 Specification for Extra-High-Strength and Ultra-High-Strength Class A Zinc–5% Aluminum-Mischmetal Alloy-Coated Steel Core Wire for Use in Overhead Electrical Conductors

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

E527 Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

2.3 *Other Standards:*

Aluminum Association Publication 50 Code words for Overhead Aluminum Electrical Conductors[3]

NBS *Handbook 100*—Copper Wire Tables of the National Bureau of Standards[4]

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

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from Aluminum Association, Inc., 1525 Wilson Blvd., Suite 600, Arlington, VA 22209, http://www.aluminum.org.

[4] Available from National Technical Information Service (NTIS), 5301 Shawnee Rd., Alexandria, VA 22312, http://www.ntis.gov.

3. Terminology

3.1 For definitions of terms relating to conductors refer to definitions found in Specification B354.

3.2 *Definitions:*

3.2.1 *aluminum-clad*—aluminum bonded.

3.2.2 *galvanized*—zinc coated.

3.2.3 *Zn-5A1-MM*—Zinc-5% Aluminum-Mischmetal Alloy (Zn-5A1-MM) coated.

3.3 *Abbreviations:*

3.3.1 *ACSS*—aluminum conductor, steel supported.

3.3.2 *ACSS/AW2*—supported with regular strength aluminum-clad core wire in accordance with Specification B502.

3.3.3 *ACSS/AW3*—supported with high strength aluminum-clad core wire in accordance with Specification B502.

3.3.4 *ACSS/GA2*—supported with regular strength galvanized steel core wire, coating Class A in accordance with Specification B498/B498M.

3.3.5 *ACSS/GC2*—supported with regular strength galvanized steel core wire, coating Class C in accordance with Specification B498/B498M.

3.3.6 *ACSS/GA3*—supported with high-strength galvanized steel core wire in accordance with Specification B606.

3.3.7 *ACSS/GA4*—supported with extra-high strength zinc Class A coated steel core wire in accordance with Specification B957.

3.3.8 *ACSS/GA5*—supported with ultra-high strength zinc Class A coated steel core wire in accordance with Specification B957.

3.3.9 *ACSS/MA2*—supported with regular strength Zn-5A1-MM coated steel core wire, coating Class A in accordance with Specification B802/B802M.

3.3.10 *ACSS/MA3*—supported with high-strength Zn-5A1-MM coated steel core wire in accordance with Specification B803.

3.3.11 *ACSS/MA4*—supported with extra-high strength Zinc-5% Aluminum-Mischmetal Alloy (Zn-5A1-MM) Coated steel core wire in accordance with Specification B958.

3.3.12 *ACSS/MA5*—supported with ultra-high strength Zinc-5% Aluminum-Mischmetal Alloy (Zn-5A1-MM) Coated steel core wire in accordance with Specification B958.

4. Ordering Information

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

4.1.1 Quantity of each size, stranding, and class,

4.1.2 Conductor size, circular-mil area or AWG, and diameter (see Section 9 and Table 1),

4.1.3 Number of wires, aluminum and steel,

4.1.4 Type of steel core wire and class (if applicable) of coating (see 5.2),

4.1.5 Direction of lay of outer layer of aluminum wires if other than right hand (see 7.3),

4.1.6 Special tension test, if desired (see 14.3),

4.1.7 Package size and type (see 16.1),

4.1.8 Special package markings, if required (see 16.4),

4.1.9 Heavy wood lagging, if required (see 16.3), and

4.1.10 Place of inspection (see Section 15).

5. Requirement for Wires

5.1 After stranding, the round aluminum wires shall conform to the requirements of Specification B609/B609M for 1350-0 temper, except for elongation requirements. The elongation shall not be less than 20 % after stranding.

5.2 Before stranding, the steel core wire shall meet the requirements of Specification B498/B498M, B606, B802/B802M, B803, B957, or B958, whichever is applicable.

5.3 The stranded steel core shall meet the requirements of Specification B500/B500M as applicable.

6. Joints

6.1 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 (see Explanatory Note 2).

6.2 There shall be no joints of any kind made in the finished coated steel wires.

7. Lay

7.1 The length of lay of the various layers of aluminum wires in a conductor shall conform to Table 2 (see Explanatory Note 3).

7.2 The length of lay of the various layers of steel wires in a conductor shall conform to Specification B500/B500M.

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

8. Construction

8.1 The number and diameter of the aluminum and steel wires and the area of cross section of the aluminum wires for standard constructions are shown in Table 1.

8.2 ACSS may be constructed using steel core wire with a number of different types. The acceptable core wires are, but not limited to:

8.2.1 Regular strength Galvanized steel core wires, with coating Classes A or C (designated GA2 and GC2) in accordance with Specification B498/B498M (see Explanatory Note 9);

8.2.2 High-strength galvanized steel core wire, coating Class A (designated GA3) in accordance with Specification B606 (see Explanatory Note 9);

8.2.3 Regular strength Zn-5A1-MM coated steel core wire, coating Class A (designated MA2) in accordance with Specification B802/B802M;

8.2.4 High-strength Zn-5A1-MM coated steel core wire, coating Class A (designated MA3) in accordance with Specification B803;

TABLE 1 Construction Requirements of Aluminum Conductors, Steel Supported (ACSS)

ACSS Conductor				Aluminum Wire			Steel Wires			Nominal Mass GA(X) or MA(X) (lb/1000 ft)	Rated Strength (by type and coating of steel wires)					
Size (kcmil)	Stranding	Codeword[A]	Class	Number	Diameter (in.)	Layers	Number	Diameter (in.)	Layers		GA2 or MA2 (kips)	GA3 or MA3 (kips)	GA4 or MA4 (iips)	GA5 or MA5 (kips)	AW2 (kips)	AW3 (kips)
266.8	26/7	Partridge/ACSS	AA	26	0.1013	2	7	0.0788	1	366.8	8.88	9.73	10.8	11.4	8.37	8.88
266.8	30/7	Junco/ACSS	AA	30	0.0943	2	7	0.0943	1	417.4	11.7	13.0	14.4	15.2	11.2	11.7
300.0	26/7	Ostrich/ACSS	AA	26	0.1074	2	7	0.0835	1	412.4	10.0	10.9	12.1	12.8	9.40	10.0
336.4	26/7	Linnet/ACSS	AA	26	0.1137	2	7	0.0885	1	462.5	11.2	12.3	13.6	14.4	10.5	11.2
336.4	30/7	Oriole/ACSS	AA	30	0.1059	2	7	0.1059	1	526.3	14.8	16.3	18.2	19.1	14.2	14.8
397.5	24/7	Brant/ACSS	AA	24	0.1287	2	7	0.0858	1	511.4	11.0	12.1	13.3	14.1	10.4	11.0
397.5	26/7	Ibis/ACSS	AA	26	0.1236	2	7	0.0962	1	546.5	13.0	14.2	15.8	16.5	12.4	13.0
397.5	30/7	Lark/ACSS	AA	30	0.1151	2	7	0.1151	1	621.9	17.5	19.3	21.5	22.6	16.7	17.5
477.0	24/7	Flicker/ACSS	AA	24	0.1410	2	7	0.0940	1	613.6	13.0	14.2	15.7	16.4	12.5	13.0
477.0	26/7	Hawk/ACSS	AA	26	0.1354	2	7	0.1053	1	655.8	15.6	17.1	18.9	19.8	14.9	15.6
477.0	30/7	Hen/ACSS	AA	30	0.1261	2	7	0.1261	1	746.3	21.0	22.7	25.3	26.7	20.1	20.5
556.5	24/7	Parakeet/ACSS	AA	24	0.1523	2	7	0.1015	1	716.1	15.2	16.6	18.3	19.1	14.6	15.2
556.5	26/7	Dove/ACSS	AA	26	0.1463	2	7	0.1138	1	765.1	18.2	19.9	22.1	23.1	17.5	18.2
556.5	30/7	Eagle/ACSS	AA	30	0.1362	2	7	0.1362	1	870.6	24.5	26.5	29.6	31.1	22.9	24.0
605.0	24/7	Peacock/ACSS	AA	24	0.1588	2	7	0.1058	1	778.3	16.5	18.0	19.9	20.8	15.9	16.5
605.0	26/7	Squab/ACSS	AA	26	0.1525	2	7	0.1186	1	831.8	19.7	21.7	24.0	25.1	19.0	19.7
605.0	30/7	Wood Duck/ACSS	AA	30	0.1420	2	7	0.1420	1	946.5	26.0	28.3	31.6	33.3	24.4	25.5
605.0	30/19	Teal/ACSS	AA	30	0.1420	2	19	0.0852	2	938.6	26.6	29.3	32.6	34.7	25.0	26.6
636.0	24/7	Rook/ACSS	AA	24	0.1628	2	7	0.1085	1	818.2	17.3	19.0	20.9	21.9	16.7	17.3
636.0	26/7	Grosbeak/ACSS	AA	26	0.1564	2	7	0.1216	1	874.4	20.7	22.4	24.8	26.0	19.9	20.3
636.0	30/7	Scoter/ACSS	AA	30	0.1456	2	7	0.1456	1	995.0	27.4	29.7	33.2	35.0	25.1	26.8
636.0	30/19	Egret/ACSS	AA	30	0.1456	2	19	0.0874	2	986.8	28.0	30.9	34.3	36.6	26.3	28.0
666.6	24/7	Flamingo/ACSS	AA	24	0.1667	2	7	0.1111	1	857.6	18.2	19.9	21.9	22.9	17.5	18.2
666.6	26/7	Gannet/ACSS	AA	26	0.1601	2	7	0.1245	1	916.4	21.7	23.4	26.0	27.3	20.9	21.3
715.5	24/7	Stilt/ACSS	AA	24	0.1727	2	7	0.1151	1	920.5	19.5	21.3	23.5	24.6	18.8	19.5
715.5	26/7	Starling/ACSS	AA	26	0.1659	2	7	0.1290	1	983.7	23.3	25.2	27.9	29.3	22.0	22.9
715.5	30/19	Redwing/ACSS	AA	30	0.1544	2	19	0.0927	2	1,110	30.9	34.1	37.9	39.8	29.5	30.9
795.0	24/7	Cuckoo/ACSS	AA	24	0.1820	2	7	0.1213	1	1,023	21.7	23.3	25.7	26.9	20.9	21.3
795.0	26/7	Drake/ACSS	AA	26	0.1749	2	7	0.1360	1	1,093	25.9	28.0	31.0	32.6	24.4	25.4
795.0	42/7	Macaw/ACSS	AA	42	0.1376	3	7	0.0764	1	857.5	11.8	12.6	13.6	14.2	11.4	11.8
795.0	45/7	Tern/ACSS	AA	45	0.1329	3	7	0.0886	1	894.9	14.2	15.2	16.5	17.4	13.5	14.2
795.0	54/7	Condor/ACSS	AA	54	0.1213	3	7	0.1213	1	1,023	21.7	23.3	25.7	26.9	20.9	21.3
795.0	30/19	Mallard/ACSS	AA	30	0.1628	2	19	0.0977	2	1,233	34.3	37.9	42.1	44.3	32.9	34.3
900.0	45/7	Ruddy/ACSS	AA	45	0.1414	3	7	0.0943	1	1,013	15.8	17.0	18.5	19.2	15.3	15.8
900.0	54/7	Canary/ACSS	AA	54	0.1291	3	7	0.1291	1	1,158	24.6	26.4	29.1	30.5	23.2	24.1
954.0	24/7	Redbird/ACSS	AA	24	0.1994	2	7	0.1329	1	1,227	26.0	28.0	30.9	32.3	24.6	25.5
954.0	45/7	Rail/ACSS	AA	45	0.1456	3	7	0.0971	1	1,074	16.7	18.0	19.6	20.4	16.2	16.7
954.0	48/7	Towhee/ACSS	AA	48	0.1410	3	7	0.1097	1	1,122	19.7	21.3	23.3	24.3	19.0	19.7
954.0	54/7	Cardinal/ACSS	AA	54	0.1329	3	7	0.1329	1	1,227	26.0	28.0	30.9	32.3	24.6	25.5
954.0	30/19	Canvasback/ACSS	AA	30	0.1783	2	19	0.1070	2	1,480	41.1	45.4	50.5	53.1	39.4	41.1
1033.5	42/7	Snowbird/ACSS	AA	42	0.1569	3	7	0.0871	1	1,115	15.4	16.4	17.7	18.5	14.8	15.4
1033.5	45/7	Ortolan/ACSS	AA	45	0.1515	3	7	0.1010	1	1,163	18.1	19.5	21.2	22.0	17.6	18.1
1033.5	54/7	Curlew/ACSS	AA	54	0.1383	3	7	0.1383	1	1,330	28.2	30.3	33.4	35.0	26.1	27.7
1113.0	45/7	Bluejay/ACSS	AA	45	0.1573	3	7	0.1048	1	1,253	19.5	21.0	22.8	23.8	18.9	19.5
1113.0	54/19	Finch/ACSS	AA	54	0.1436	3	19	0.0861	2	1,429	30.4	33.2	36.5	38.7	28.7	30.4
1192.5	45/7	Bunting/ACSS	AA	45	0.1628	3	7	0.1085	1	1,342	20.9	22.5	24.5	25.4	20.3	20.9
1192.5	54/19	Grackle/ACSS	AA	54	0.1486	3	19	0.0892	2	1,531	32.6	35.5	39.1	41.5	30.8	32.6
1272.0	45/7	Bittern/ACSS	AA	45	0.1681	3	7	0.1121	1	1,432	22.3	24.0	26.1	27.1	21.6	22.3
1272.0	54/19	Pheasant/ACSS	AA	54	0.1535	3	19	0.0921	2	1,633	34.1	37.3	41.1	43.0	32.8	34.1
1351.0	45/7	Dipper/ACSS	AA	45	0.1733	3	7	0.1155	1	1,521	23.7	25.5	27.7	28.8	23.0	23.7
1351.0	54/19	Martin/ACSS	AA	54	0.1582	3	19	0.0949	2	1,735	36.2	39.6	43.6	45.6	34.9	36.2

TABLE 1 *Continued*

ACSS Conductor			Aluminum Wire				Steel Wires			Nominal Mass GA(X) or MA(X) (lb/1000 ft)	Rated Strength (by type and coating of steel wires)					
Size (kcmil)	Stranding	Codeword[A]	Class	Number	Diameter (in.)	Layers	Number	Diameter (in.)	Layers		GA2 or MA2 (kips)	GA3 or MA3 (kips)	GA4 or MA4 (iips)	GA5 or MA5 (kips)	AW2 (kips)	AW3 (kips)
1431.0	45/7	Bobolink/ACSS	AA	45	0.1783	3	7	0.1189	1	1,611	25.1	27.0	29.4	30.5	24.3	25.1
1431.0	54/19	Plover/ACSS	AA	54	0.1628	3	19	0.0977	2	1,837	38.4	41.9	46.2	48.3	36.9	38.4
1510.0	45/7	Nuthatch/ACSS	AA	45	0.1832	3	7	0.1221	1	1,700	26.5	28.1	30.6	31.8	25.7	26.1
1510.0	54/19	Parrot/ACSS	AA	54	0.1672	3	19	0.1003	2	1,939	40.4	44.2	48.7	51.0	38.9	40.4
1590.0	42/7	Ratite/ACSS	AA	42	0.1946	3	7	0.1081	1	1,715	23.4	25.0	26.9	27.9	22.7	23.4
1590.0	45/7	Lapwing/ACSS	AA	45	0.1880	3	7	0.1253	1	1,790	27.9	29.6	32.2	33.5	27.0	27.5
1590.0	54/19	Falcon/ACSS	AA	54	0.1716	3	19	0.1030	2	2,041	42.6	46.6	51.4	53.7	41.1	42.6
1780.0	84/19	Chukar/ACSS	AA	84	0.1456	3	19	0.0873	2	2,071	35.3	38.2	41.6	43.9	33.6	35.3
2034.5	72/7	Mockingbird/ACSS	AA	72	0.1681	3	7	0.1121	1	2,159	27.2	28.9	31.0	32.0	26.5	27.2
2057.0	76/19	Roadrunner/ACSS	AA	76	0.1645	3	19	0.0768	2	2,245	31.7	33.9	36.5	38.3	30.3	31.7
2156.0	84/19	Bluebird/ACSS	AA	84	0.1602	3	19	0.0961	2	2,508	42.1	45.5	49.6	51.7	40.7	42.1
2167.0	72/7	Kiwi/ACSS	AA	72	0.1735	3	7	0.1157	1	2,300	29.0	30.8	33.0	34.1	28.2	29.0
2312.0	76/19	Thrasher/ACSS	AA	76	0.1744	3	19	0.0814	2	2,524	35.6	38.1	41.0	43.0	34.1	35.6
2515.0	76/19	Joree/ACSS	AA	76	0.1819	3	19	0.0849	2	2,745	38.7	41.4	44.6	46.8	37.1	38.7
101.8	12/7	Petrel/ACSS	AA(HS)	12	0.0921	1	7	0.0921	1	253.8	10.2	11.4	12.8	13.5	9.7	10.2
110.8	12/7	Minorca/ACSS	AA(HS)	12	0.0961	1	7	0.0961	1	276.3	11.1	12.4	13.9	14.7	10.6	11.1
134.6	12/7	Leghorn/ACSS	AA(HS)	12	0.1059	1	7	0.1059	1	335.5	13.5	15.0	16.9	17.8	12.9	13.5
159.0	12/7	Guinea/ACSS	AA(HS)	12	0.1151	1	7	0.1151	1	396.3	15.9	17.8	20.0	21.0	15.2	15.9
176.9	12/7	Dotterel/ACSS	AA(HS)	12	0.1214	1	7	0.1214	1	440.9	17.7	19.4	21.8	23.0	16.9	17.3
190.8	12/7	Dorking/ACSS	AA(HS)	12	0.1261	1	7	0.1261	1	475.7	19.1	20.9	23.5	24.8	18.3	18.7
203.2	16/19	Brahma/ACSS	AA(HS)	16	0.1127	2	19	0.0977	2	674.6	30.5	34.1	38.3	40.5	29.1	30.5
211.3	12/7	Cochin/ACSS	AA(HS)	12	0.1327	1	7	0.1327	1	526.8	21.2	23.1	26.0	27.5	19.7	20.7

[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 for information only.

Conversion factors – inch-pound to SI:

1 kcmil = 0.5067 mm^2

1 inch = 2.5400 mm

1 lb/1000 ft = 1.488 kg/km

1 kip (1000 lbf) = 4.448 kN

TABLE 2 Lay Factors for Aluminum Conductors, Steel-Supported (ACSS), Concentric-Lay-Stranded[A]

Stranding Class	Stranding	Ratio of Length of Lay of a Layer to Nominal Outside Diameter of That Layer									
		Aluminum Wire Layers									
		First (Outside)			Second			Third		Fourth (Inside)	
		min	pref[B]	max	min	pref	max	min	max	min	max
AA	76/19, 84/19	10	11	13	10	13	16	10	17	10	17
	72/7	10	11	13	10	13	16	10	17	10	17
	54/19	10	11	13	10	13	16	10	17	. . .	. . .
	54/7, 45/7	10	11	13	10	13	16	10	17	. . .	. . .
	30/19	10	11	13	10	13	16	. . .	. . .	. . .	. . .
	30/7, 26/7, 24/7	10	11	13	10	13	16	. . .	. . .	. . .	. . .
	16/19	10	12.5	14.5	. . .	. . .	. . .	. . .	. . .	. . .	. . .
	12/7	10	12.5	14.5	. . .	. . .	. . .	. . .	. . .	. . .	. . .

[A] See Specification B500/B500M for lay factors of the steel core wires.
[B] Preferred (pref).

8.2.5 Extra-high-strength galvanized steel core wire coating Class A (designated GA4) in accordance with Specification B957 (see Explanatory Note 9);

8.2.6 Extra-high-strength Zn-5Al-MM coated steel core wire, coating Class A (designated MA4) in accordance with Specification B958;

8.2.7 Ultra-high-strength galvanized steel core wire coating Class A (designated GA5) in accordance with Specification B957 (see Explanatory Note 9);

8.2.8 Ultra-high-strength Zn-5Al-MM coated steel core wire, coating Class A (designated MA5) in accordance with Specification B958;

8.2.9 Regular strength Aluminum Clad steel (designated AW2 in accordance with B502;

8.2.10 High-strength Aluminum Clad steel (designated AW3 in accordance with B502.

9. Rated Strength of Conductor

9.1 The rated strength of the completed ACSS conductor shall be taken as the aggregate strengths of the aluminum and steel components, calculated as follows. The strength contribution of the aluminum wires shall be taken as that percentage, indicated in Table 3, of the sum of the strengths of the 1350-0 wires calculated from their minimum average tensile strengths specified in Specification B609/B609M. The strength contribution of the steel core wires shall be taken as that percentage, indicated in Table 3, of the sum of the strengths of the steel wires, calculated from their specified nominal wire diameter and the appropriate minimum ultimate tensile strengths given in Specification B498/B498M, B502, B549, B606, B802/B802M, B803, B957, or B958, whichever is applicable.

TABLE 3 Standard Increments and Rating Factors for Mass, Resistivity, and Rated Strength Determination

Stranding Design Aluminum/Steel	Standard Increments Due to Stranding (for Mass and Resistivity) Increase		Rating Factors (for Rated Strength)	
	Aluminum, %	Steel, %	Aluminum, %	Steel, %
12/7	2.5	0.4	96	100
24/7	2.5	0.4	96	100
26/7	2.5	0.4	96	100
30/7	2.75	0.4	96	100
42/7	2.5	0.4	96	100
45/7	2.5	0.4	96	100
48/7	2.5	0.4	96	100
54/7	2.5	0.4	96	100
72/7	3.0	0.4	96	100
16/19	2.5	0.6	96	100
30/19	2.75	0.6	96	100
54/19	3.0	0.6	96	100
76/19	3.0	0.6	96	100
84/19	3.0	0.6	96	100

9.2 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 E29.

9.3 Rated strength of typical constructions are given in Table 1.

10. Density

10.1 For the purpose of calculating mass, cross sections, and so forth, the density of aluminum 1350 shall be taken as 0.0975 lb/in.^{3} (2705 kg/m^3) at 20°C (see Explanatory Note 4).

10.2 For the purpose of calculating mass, cross sections, and so forth, the density of galvanized or Zn-5A1-MM alloy coated steel wire shall be taken as 0.281 lb/in.^{3} (7780 kg/m^3) at 20°C.

10.3 For the purposes of calculating mass, cross sections, and so forth, the density of aluminum-clad steel wire shall be taken as 0.2381 lb/in.^{3} (6590 kg/m^3) at 20°C.

11. Mass and Electrical Resistance

11.1 The mass and electrical resistance of a unit length of stranded conductor are a function of the length of lay. The approximate weight and electrical resistance may be determined using the standard increments shown in Table 3. When greater accuracy is desired, the increment based on the specific lay of the conductor may be calculated (see Explanatory Note 5).

11.2 In the calculation of the electrical resistance of a conductor, the zinc-coated, Zn-5A1-MM-coated, steel core wires shall be taken as 0.19157 Ω·mm^2/m at 20°C and the resistivity of aluminum-clad steel core wires shall be taken as 0.0848 Ω·mm^2/m at 20°C. These are typical values and are not guaranteed. The electrical resistance of the aluminum wires shall be taken as 0.0279 Ω·mm^2/m at 20°C.

12. Workmanship, Finish, and Appearance

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

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 a 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 B263. In applying that method the increment in linear density resulting from stranding may be the applicable value specified in 13.1 or may be calculated from the measured component dimensions of the sample under test. In case of a question regarding area compliance, the actual linear density increment due to stranding shall be calculated.

14. Mechanical and Electrical Tests

14.1 Tests for mechanical and electrical properties of aluminum wires shall be made after stranding (see Explanatory Note 6).

14.2 The electrical resistivity shall meet the minimum resistivity specified for the wire after stranding. The frequency of these tests shall be agreed upon between the purchaser and the manufacturer.

14.3 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 (see Explanatory Note 7).

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

15. Inspection

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

15.2 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.

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

16. Packaging and Package Marking

16.1 Package sizes and kind of package, reels or coils, shall be agreed upon between the manufacturer and the purchaser. Recommended package sizes are shown in Table 4 (see Explanatory Note 8).

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

16.3 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.

16.4 The net linear density, length, size, kind of conductors, stranding, type of coating, class 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.

17. Keywords

17.1 ACSS; aluminum conductors; concentric-lay stranded aluminum conductors; electrical conductors; electrical conductors; aluminum; steel-reinforced conductors; steel-supported aluminum conductors; stranded aluminum conductors

TABLE 4 Packaging Information—Recommended Reel Sizes, Shipping Lengths, and Net Masses

Size		Stranding Design Aluminum/ Steel	Reel Types								
			RMT			RM			NR		
cmil	AWG		Reel Size	Length on Reel (feet)	Net Mass (lb)	Reel Size	Length on Reel (feet)	Net Mass (lb)	Reel Size	Length on Reel (feet)	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
1 510 500	. . .	54/19	90.45	6040	11 710	68.38	3020	5850	. . .	. . .	. . .
1 510 500	. . .	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
1 192 500	. . .	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
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
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
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
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
477 000	. . .	30/7	. . .	. . .	. . .	66.32	6650	4960	. . .	. . .	. . .
477 000	. . .	26/7	84.36	11 560	7580	. . .	. . .	. . .	60.28	5780	3790
477 000	. . .	24/7	84.36	10 660	6540	. . .	. . .	. . .	60.28	5330	3270
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
336 400	. . .	30/7	. . .	. . .	. . .	66.32	9430	4960	. . .	. . .	
336 400	. . .	26/7	84.36	16 390	7570	. . .	. . .	. . .	60.28	8195	3790
300 000	. . .	26/7	. . .	. . .	. . .	. . .	. . .	. . .	60.28	9190	3790
266 800	. . .	26/7	. . .	. . .	. . .	. . .	. . .	. . .	60.28	10 330	3790
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
159 000	. . .	12/7	. . .	. . .	. . .	. . .	. . .	. . .	48.28	8000	3170
134 600	. . .	12/7	. . .	. . .	. . .	. . .	. . .	. . .	48.28	9450	3170
110 800	. . .	12/7	. . .	. . .	. . .	. . .	. . .	. . .	48.28	11 480	3170
101 800	. . .	12/7	. . .	. . .	. . .	. . .	. . .	. . .	48.28	12 500	3170

EXPLANATORY NOTES

NOTE 1—In this specification only, concentric-lay-stranded aluminum conductors, steel supported, are specifically designated. Conductor constructions not included in this specification should be agreed upon between the manufacturer and the purchaser when placing the order. Requirements of shaped wire compact concentric-lay-stranded aluminum conductors, steel supported may be found in specification B857.

NOTE 2—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 3—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 layers, and larger for conductors of smaller diameter than for those of larger diameter.

NOTE 4—The density is based upon aluminum of 99.50 % purity. The inch-pound density of the aluminum wires is used for linear density calculations and is based upon the standard SI density with the conversion rounded to the nearest 0.0005 lb/in.[3]

NOTE 5—The increment of weight or electrical resistance of a completed concentric-lay-stranded conductor (k) in percent is as follows:

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

where m is the stranding factor, and also the ratio of the weight 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, this 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 =

$$\frac{\text{length of lay}}{\text{diameter of helical path of wires}} \tag{3}$$

The derivation of the above is given in *NBS Handbook 100*.[4] The factors k and m are to be determined separately for the zinc-coated or aluminum-coated steel (see Section 7).

NOTE 6—Wires unlaid from conductors may have different physical properties from those of the wire when prepared for cabling, on account of the deformation caused by laying and again 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 7—To test ACSS 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 and split sleeves, but ordinary jaws or clamping devices usually are not suitable.

NOTE 8—For the convenience of the user of this specification, Table 4 has been prepared giving recommended shipping lengths for the standard sizes of ACSS referred to in Table 1. Because of the variation in coil weights, and so forth, it is common practice to allow a permissible tolerance in length of ±5 % for sizes larger than No. 1 AWG and a tolerance of ±10 % on sizes No. 1 AWG and smaller. 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 9—Industry practice has limited the use of ACSS conductors built with zinc galvanized steel core material to an operational conductor temperature limit of 200°C.