



Designation: B 856 – 01a

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

This standard is issued under the fixed designation B 856; 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:

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

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

B 502 Specification for Aluminum-Clad Steel Core Wire for Aluminum Conductors, Aluminum-Clad Steel Reinforced²

B 549 Specification for Concentric-Lay-Stranded Aluminum Conductors, Aluminum-Clad Steel Reinforced ACSR/AW²

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

B 609/B 609M Specification for Aluminum 1350 Round Wire, Annealed and Intermediate Tempers, for Electrical Purposes²

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

B 857 Specification for Shaped Wire Compact Concentric-Lay-Stranded Aluminum Conductors, Coated-Steel Supported (ACSS/TW)²

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications³

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

2.3 Other Standards:

Aluminum Association Publication 50 Code words for Overhead Aluminum Electrical Conductors⁵

NBS *Handbook 100*—Copper Wire Tables of the National Bureau of Standards⁶

3. Terminology

3.1 For definitions of terms relating to conductors refer to definitions found in Specification B 354.

3.2 Definitions:

3.2.1 *aluminized*—aluminum coated.

3.2.2 *aluminum-clad*—aluminum bonded.

3.2.3 *galvanized*—zinc coated.

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 Oct. 10, 2001. Published November 2001. Originally published as B 856-95¹. Last previous edition B 856-01.

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

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

⁴ *Annual Book of ASTM Standards*, Vol 01.01.

⁵ Available from the Aluminum Association, Inc., 900 19th Street, NW, Suite 300, Washington, DC 20006.

⁶ Available from National Technical Information Services, 5285 Port Royal Road, Springfield, VA 22161.

3.3 Abbreviations:

- 3.3.1 *ACSS*—aluminum conductor, steel supported.
- 3.3.2 *ACSS/GA*—supported with galvanized steel core wire, coating Class A in accordance with Specification B 498.
- 3.3.3 *ACSS/GB*—supported with galvanized steel core wire, coating Class B in accordance with Specification B 498.
- 3.3.4 *ACSS/GC*—supported with galvanized steel core wire, coating Class C in accordance with Specification B 498.
- 3.3.5 *ACSS/HS*—supported with high-strength galvanized steel core wire in accordance with Specification B 606.
- 3.3.6 *ACSS/MA*—supported with Zn-5A1-MM coated steel core wire, coating Class A in accordance with Specification B 802.
- 3.3.7 *ACSS/MB*—supported with Zn-5A1-MM coated steel core wire, coating Class B in accordance with Specification B 802.
- 3.3.8 *ACSS/MC*—supported with Zn-5A1-MM coated steel core wire, coating Class C in accordance with Specification B 802.
- 3.3.9 *ACSS/MS*—supported with high-strength Zn-5A1-MM coated steel core wire in accordance with Specification B 803.
- 3.3.10 *Zn-5A1-MM*—zinc-5 % aluminum-mischmetal alloy.
- 3.3.11 *ACSS/AZ*—supported with aluminum steel core wire in accordance with Specification B 341.
- 3.3.12 *ACSS/AW supported with aluminum*—clad core wire in accordance with Specification B 502.

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 7.2),
 - 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 B 609 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 B 341, B 498, B 502, B 606, B 802, or B 803, whichever is applicable.
- 5.3 The stranded steel core shall meet the requirements of Specification B 500 or B 549, 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 wires in a conductor shall conform to Table 2 (see Explanatory Note 3).
- 7.2 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 ACSS may be constructed using steel core wire with any one of ten 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; 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; 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; aluminum-clad core wire in accordance with Specification B 502.
- 8.2 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.

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 B 609. 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 Specifications B 341, B 498, B 502, B 606, B 802, or B 803, whichever is applicable.
- 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 E 29.
- 9.3 Rated strength of typical constructions are given in Table 4.

10. Density

- 10.1 For the purpose of calculating mass, cross sections, etc. the density of aluminum 1350 shall be taken as 0.0975 lb/in.³ (2705 kg/m³) at 20°C (see Explanatory Note 4).
- 10.2 For the purpose of calculating mass, cross sections, etc., the density of galvanized, aluminized, or Zn-5A1-MM alloy coated steel wire shall be taken as 0.281 lb/in.³ (7780 kg/m³) at 20°C.



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

Conductor Information			Class	Stranding Design Aluminum/ Steel	Stranding						Nominal Outside Diameter in.	Mass, ^A lb/1000 ft
Size cmil ^B	Size mm ^{2C}	Code Word ^D			Number	Diameter, in. ^B	Layers	Number	Diameter, in. ^B	Layers		
2 312 000	1171	Thrasher/ACSS	AA	76/19	76	0.1744	4	19	0.0814	2	1.802	2523
2 167 000	1098	Kiwi/ACSS	AA	72/7	72	0.1735	4	7	0.1157	1	1.735	2310
2 156 000	1092	Bluebird/ACSS	AA	84/19	84	0.1602	4	19	0.0961	2	1.762	2508
1 780 000	901.9	Chukar/ACSS	AA	84/19	84	0.1456	4	19	0.0874	2	1.602	2072
1 590 000	805.7	Falcon/ACSS	AA	54/19	54	0.1716	3	19	0.1030	2	1.545	2040
1 590 000	805.7	Lapwing/ACSS	AA	45/7	45	0.1881	3	7	0.1253	1	1.504	1790
1 510 500	765.4	Parrot/ACSS	AA	54/19	54	0.1672	3	19	0.1003	2	1.505	1938
1 510 500	765.4	Nuthatch/ACSS	AA	45/7	45	0.1832	3	7	0.1221	1	1.466	1700
1 431 000	725.1	Plover/ACSS	AA	54/19	54	0.1628	3	19	0.0977	2	1.465	1838
1 431 000	725.1	Bobolink/ACSS	AA	45/7	45	0.1783	3	7	0.1189	1	1.427	1611
1 351 000	684.8	Martin/ACSS	AA	54/19	54	0.1582	3	19	0.0949	2	1.424	1735
1 351 000	684.8	Dipper/ACSS	AA	45/7	45	0.1733	3	7	0.1155	1	1.386	1521
1 272 000	644.5	Pheasant/ACSS	AA	54/19	54	0.1535	3	19	0.0921	2	1.382	1634
1 272 000	644.5	Bittern/ACSS	AA	45/7	45	0.1681	3	7	0.1121	1	1.345	1432
1 191 500	603.7	Skylark/ACSS	AA	54/19	54	0.1486	3	19	0.0892	2	1.338	1531
1 192 500	604.2	Bunting/ACSS	AA	45/7	45	0.1628	3	7	0.1085	1	1.302	1345
1 113 000	564.0	Finch/ACSS	AA	54/19	54	0.1436	3	19	0.0862	2	1.293	1430
1 113 000	564.0	Bluejay/ACSS	AA	45/7	45	0.1573	3	7	0.1049	1	1.259	1254
1 033 500	523.7	Curlew/ACSS	AA	54/7	54	0.1383	3	7	0.1383	1	1.245	1329
1 033 500	523.7	Ortolan/ACSS	AA	45/7	45	0.1515	3	7	0.1010	1	1.212	1163
954 000	483.4	Cardinal/ACSS	AA	54/7	54	0.1329	3	7	0.1329	1	1.196	1227.1
954 000	483.4	Rail/ACSS	AA	45/7	45	0.1456	3	7	0.0971	1	1.165	1074
900 000	456.0	Canary/ACSS	AA	54/7	54	0.1291	3	7	0.1291	1	1.162	1158
900 000	456.0	Ruddy/ACSS	AA	45/7	45	0.1414	3	7	0.0943	1	1.131	1013
795 000	402.8	Mallard/ACSS	AA	30/19	30	0.1628	2	19	0.0977	2	1.140	1233.9
795 000	402.8	Condor/ACSS	AA	54/7	54	0.1213	3	7	0.1213	1	1.092	1022
795 000	402.8	Tern/ACSS	AA	45/7	45	0.1329	3	7	0.0886	1	1.063	895
795 000	402.8	Drake/ACSS	AA	26/7	26	0.1749	2	7	0.1360	1	1.108	1093
795 000	402.8	Cuckoo/ACSS	AA	24/7	24	0.1820	2	7	0.1213	1	1.092	1023
715 500	362.6	Redwing/ACSS	AA	30/19	30	0.1544	2	19	0.0926	2	1.081	1109.3
715 500	362.6	Starling/ACSS	AA	26/7	26	0.1659	2	7	0.1290	1	1.051	983.7
715 500	362.6	Stilt/ACSS	AA	24/7	24	0.1727	2	7	0.1151	1	1.036	921
666 600	337.8	Gannet/ACSS	AA	26/7	26	0.1601	2	7	0.1245	1	1.014	916.2
666 600	337.8	Flamingo/ACSS	AA	24/7	24	0.1667	2	7	0.1111	1	1.000	857.9
636 000	322.3	Egret/ACSS	AA	30/19	30	0.1456	2	19	0.0897	2	1.019	987.2
636 000	322.3	Scoter/ACSS	AA	30/7	30	0.1456	2	7	0.1456	1	1.019	995.1
636 000	322.3	Grosbeak/ACSS	AA	26/7	26	0.1564	2	7	0.1216	1	0.990	874.2
636 000	322.3	Rook/ACSS	AA	24/7	24	0.1628	2	7	0.1085	1	0.977	818.2
605 000	306.6	Teal/ACSS	AA	30/19	30	0.1420	2	19	0.0852	2	0.994	938.6
605 000	306.6	Wood Duck/ACSS	AA	30/7	30	0.1420	2	7	0.1420	1	0.994	946.5
605 000	306.6	Squab/ACSS	AA	26/7	26	0.1525	2	7	0.1186	1	0.966	831.3
605 000	306.6	Peacock/ACSS	AA	24/7	24	0.1588	2	7	0.1059	1	0.953	778.8
556 500	282.0	Eagle/ACSS	AA	30/7	30	0.1362	2	7	0.1362	1	0.953	870.7
556 500	282.0	Dove/ACSS	AA	26/7	26	0.1463	2	7	0.1138	1	0.927	765.2
556 500	282.0	Parakeet/ACSS	AA	24/7	24	0.1523	2	7	0.1015	1	0.914	716.1
477 000	241.7	Hen/ACSS	AA	30/7	30	0.1261	2	7	0.1261	1	0.883	764.4
477 000	241.7	Hawk/ACSS	AA	26/7	26	0.1354	2	7	0.1053	1	0.858	655.3
477 000	241.7	Flicker/ACSS	AA	24/7	24	0.1410	2	7	0.0940	1	0.846	613.9
397 500	201.4	Lark/ACSS	AA	30/7	30	0.1151	2	7	0.1151	1	0.806	621.8
397 500	201.4	Ibis/ACSS	AA	26/7	26	0.1236	2	7	0.0961	1	0.783	546.0
397 500	201.4	Brant/ACSS	AA	24/7	24	0.1287	2	7	0.0858	1	0.772	511.4
336 400	170.5	Oriole/ACSS	AA	30/7	30	0.1059	2	7	0.1059	1	0.741	526.4
336 400	170.5	Linnet/ACSS	AA	26/7	26	0.1137	2	7	0.0884	1	0.720	462.0
300 000	152.0	Ostrich/ACSS	AA	26/7	26	0.1074	2	7	0.0835	1	0.680	412.2
266 800	135.2	Partridge/ACSS	AA	26/7	26	0.1013	2	7	0.0788	1	0.642	366.9
211 300	107.1	Cochin/ACSS	AA (HS)	12/7	12	0.1327	1	7	0.1327	1	0.664	526.8
203 200	103.0	Brahma/ACSS	AA (HS)	16/19	16	0.1127	1	19	0.0977	2	0.714	674.6
190 800	96.7	Dorking/ACSS	AA (HS)	12/7	12	0.1261	1	7	0.1261	1	0.631	475.7
176 900	89.6	Dotterel/ACSS	AA (HS)	12/7	12	0.1214	1	7	0.1214	1	0.607	440.9
159 000	80.6	Guinea/ACSS	AA (HS)	12/7	12	0.1151	1	7	0.1151	1	0.576	396.3
134 600	68.2	Leghorn/ACSS	AA (HS)	12/7	12	0.1059	1	7	0.1059	1	0.530	335.5
110 800	56.1	Minorca/ACSS	AA (HS)	12/7	12	0.0961	1	7	0.0961	1	0.481	276.3
101 800	51.6	Petrel/ACSS	AA (HS)	12/7	12	0.0921	1	7	0.0921	1	0.461	253.8

^A Mass based on H.S. Class A zinc-coated steel core.

^B Conversion factors:

- 1 cmil = 5.067E-04 mm²(0.0005067 mm²)
- 1 in. = 2.54E+01 mm (25.4 mm)
- 1 lb/1000ft = 1.488 kg/km
- 1 ft = 3.048E-01 m (0.3048 m)
- 1 lb = 4.536E-01 kg (0.4536 kg)
- 1 lbf = 4.448E-03 kN (0.004448 kN)

^C mm² sizes are a numeric conversion of the kcmil size and are provided for information only.

^D 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.



TABLE 2 Lay Factors for Aluminum Conductors, Steel-Supported (ACSS), 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	pref ^B	max	min	pref	max	min	max	min	max	min	max	min	pref	max	min	pref	max
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
	16/19	10	12.5	14.5	...	...	...	...	...	...	...	16	20	24	18	25	30
	12/7	10	12.5	14.5	...	...	...	...	...	...	...	...	...	...	18	25	30

^A See Specification B 500.
^B Preferred (pref).

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

10.3 For the purposes of calculating mass, cross sections, and the like, the density of aluminum-clad steel wire shall be taken as 0.2381 lb/in.³ (6590 kg/m³) 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, or aluminum-coated steel core wires shall be taken as 0.19157 Ω·mm²/m at 20°C and the resistivity of aluminum-clad steel core wires shall be taken as 0.0848 Ω·mm²/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·mm²/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 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 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 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-coated steel wires shall be made before stranding (see Explanatory Note 5).