Designation: B502/B502M – 23

Standard Specification for Aluminum-Clad Steel Core Wire for Use in Overhead Electrical Aluminum Conductors[1]

This standard is issued under the fixed designation B502/B502M; 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, aluminum-clad steel core wire with two designations of tensile strengths, AW2 (Normal Strength) and AW3 (High Strength).

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

1.2.1 For conductor sizes designated by AWG, 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.

1.3 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

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

2.2 *ASTM Standards:*[2]

B193 Test Method for Resistivity of Electrical Conductor Materials

E8/E8M Test Methods for Tension Testing of Metallic Materials

3. Ordering Information

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

3.1.1 Quantity of each size,

3.1.2 Wire size: diameter in inches (see 6.1),

3.1.3 Core Wire Strength, AW2 (Normal Strength) or AW3 (High Strength) (see Table 1 and Table 2),

3.1.4 Package size: (see 17.1),

3.1.5 Special packaging and package marking if required (see 16.1), and

3.1.6 Place of inspection if other than place of manufacture (see 14.1).

4. Materials and Manufacture

4.1 The base metal shall be steel produced by the open-hearth, electric-furnace, or basic-oxygen process and shall be of such composition that the finished clad wire shall have the properties and characteristics prescribed in this specification.

4.2 The aluminum used for cladding shall have a purity and quantity sufficient to meet thickness and resistance requirements of this specification (see 7.1 and 9.1).

5. Tensile Properties

5.1 *Requirements*—The aluminum-clad steel core wire shall conform to the tensile requirements prescribed in Table 1 and Table 2. In computing the stress at 1 % extension and computing the ultimate tensile strength, the actual diameter of the finished wire shall be used. Purchasers of core intended for use in conductor constructions with annealed aluminum wires, such as ACSS may request the stranded steel core be compliant only with ultimate tensile strength and may waive compliance with the 1 % extension tensile requirement. This use of the ultimate tensile requirement as an alternate to the 1 % extension requirement shall be by agreement between the purchaser and producer and shall be noted on product compliance documentation. For the ACSS conductor, the individual wires shall also meet a minimum actual breaking strength requirement as calculated based on the minimum ultimate tensile strength and the nominal wire diameter.

5.2 *Elongation Test*—The elongation shall be determined by an extensometer suitable for measuring elongation in 10.0 in. [250 mm] and equipped with a vernier or other instrument

[1] This specification is under the jurisdiction of ASTM Committee B01 on Electrical Conductors and is the direct responsibility of Subcommittee B01.06 on Bi-Metallic Conductors.

Current edition approved Oct. 1, 2023. Published October 2023. Originally approved in 1970. Last previous edition approved in 2019 as B502/B502M – 19. DOI: 10.1520/B0502_B0502M-23.

[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.

TABLE 1 Tensile Requirements for Normal Strength (AW2) For ACSR/AW2, ACSR/TW/AW2 and ACSS/AW2, ACSR/TW/AW2 Type Conductors

Nominal Diameter, in. [mm]	Stress at 1.0 % Extension min, psi (MPa)	Ultimate Tensile Strength, min, psi (MPa)	Elongation, min, %, 10 in. [250 mm]
0.0770 to 0.1289 [1.956 to 3.274], incl	175 000 (1206)	195 000 (1344)	1.5
0.1290 to 0.1369 [3.275 to 3.477], incl	170 000 (1172)	190 000 (1310)	1.5
0.1370 to 0.1443 [3.478 to 3.665], incl	165 000 (1137)	185 000 (1275)	1.5
0.1444 to 0.1549 [3.666 to 3.934], incl	160 000 (1103)	180 000 (1241)	1.5
0.1550 to 0.1620 [3.935 to 4.115], incl	160 000 (1103)	175 000 (1206)	1.5
0.1621 to 0.1729 [4.116 to 4.392], incl	155 000 (1068)	170 000 (1172)	1.5
0.1730 to 0.1819 [4.393 to 4.620], incl	150 000 (1034)	165 000 (1137)	1.5
0.1820 to 0.1880 [4.621 to 4.775], incl	145 000 (1000)	160 000 (1103)	1.5

TABLE 2 Tensile Requirements for High Strength (AW3) For ACSS/AW3 and ACSS/TW/AW3 Type Conductors

Nominal Diameter, in. [mm]	Stress at 1.0 % Extension min, psi (MPa)	Ultimate Tensile Strength, min, psi (MPa)	Elongation, min, %, 10 in. [250 mm]
0.0770 to 0.0899 [1.956 to 2.283], incl	190 000 (1310)	210 000 (1450)	1.5
0.0900 to 0.1199 [2.284 to 3.045], incl	185 000 (1280)	205 000 (1410)	1.5
0.1200 to 0.1399 [3.046 to 3.553], incl	180 000 (1240)	200 000 (1380)	1.5
0.1400 to 0.1880 [3.554 to 4.775], incl	170 000 (1170)	195 000 (1340)	1.5

reading to 0.001 in. [0.025 mm]. It shall be attached to the test specimen at a load equal to the initial tensile stress shown in Table 3 and Table 4. At this load the extensometer shall be adjusted to the initial setting shown in Table 3 and Table 4. Upon application of further load, the tension shall be read at an extensometer reading of 1.0 % to determine conformance with the requirement in Table 1 and Table 2. Further elongation shall be observed while applying a tension load to the specimen. The elongation thus determined shall be not less than 1.5 % in 10.0 in. [250 mm]. A test in which the extensometer reading is less than 1.5 % shall be disregarded if the fracture occurs less than 1.0 in. [25 mm] from either attachment. In this case, another specimen from the same reel or coil shall be tested.

TABLE 3 Initial Settings for Determining at 1 % Extension for Normal Strength (AW2)

Nominal Diameter, in. [mm]	Initial Stress, psi (MPa)	Initial Setting of Extensometer, % in./in. [cm/cm]
0.0770 to 0.0999 [1.956 to 2.537], incl	11 800 (81)	0.0005 (0.05 % extension)
0.1000 to 0.1299 [2.538 to 3.299], incl	23 500 (162)	0.0010 (0.10 % extension)
0.1300 to 0.1880 [3.300 to 4.775], incl	35 300 (243)	0.0015 (0.15 % extension)

TABLE 4 Initial Settings for Determining at 1 % Extension for High Strength (AW3)

Nominal Diameter, in. [mm]	Initial Stress, psi (MPa)	Initial Setting of Extensometer, % in./in. [cm/cm]
0.0770 to 0.0899 [1.96 to 2.283], incl	14 000 (100)	0.0005 (0.05 % extension)
0.0900 to 0.1199 [2.284 to 3.045], incl	28 000 (190)	0.0010 (0.10 % extension)
0.1200 to 0.1880 [3.046 to 4.775], incl	42 000 (290)	0.0015 (0.15 % extension)

5.3 The tension tests shall be made in accordance with Test Methods E8/E8M. The method for determining elongation is described in the Procedures Section of Test Methods E8/E8M.

6. Dimensions and Permissible Variations

6.1 The size shall be expressed by the wire diameter in decimals of an inch to the nearest 0.0001 in. [0.003 mm].

6.2 Within the range of diameters included in Table 5 the wire shall not vary from the nominal diameter by more than the amounts shown in this table. In computing permissible variations, diameters shall be rounded to the nearest 0.0001 in. [0.003 mm].

6.3 If accessible, one measurement shall be taken near each end and one near the middle of the coil or reel. In the case of reels, the center and one end may not be accessible and the prescribed measurement shall be taken along the length of the accessible material. If any of the selected coils or reels fail to conform to the requirements as prescribed in 6.2, all coils or reels shall be measured in the manner specified.

7. Thickness of Aluminum

7.1 The aluminum thickness at any point shall be not less than 10 % of the nominal wire radius. Measurements shall be read to the nearest 0.001 in. [0.03 mm]. In determining the required or measured thickness, fractions of 0.0005 in. [0.013 mm] or less shall be dropped and for fractions of greater than 0.0005 in. [0.013 mm], the next larger 0.001 in. [0.003 mm] shall be used.

7.2 Measurements shall be made by using suitable electrical indicating instruments operating on the permeameter principle, or by direct measurement. For referee purposes, direct measurement shall be used to determine aluminum thickness on specimens taken from the ends of the coils.

8. Density

8.1 For the purpose of calculating mass, cross sections, etc., the density of the wire shall be taken as 0.2381 lb/in.^{3} [6.590 g/cm^3] at 20 °C.

TABLE 5 Wire Diameter Variations

Nominal Diameter, in. [mm]	Permissible Variations in Nominal Diameter
0.0770 to 0.0999 [1.956 to 2.537], incl	0.0015 in. [0.038 mm]
0.1000 to 0.1880 [2.538 to 4.775], incl	1.5 %