INTERNATIONAL

Designation: ~~B415 – 98 (Reapproved 2013)~~ B415 – 16

Standard Specification for Hard-Drawn Aluminum-Clad Steel Wire[1]

This standard is issued under the fixed designation B415; 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 U.S. Department of Defense.

1. Scope

1.1 This specification covers four conductivities of bare, hard-drawn, round, aluminum-clad steel wire for general use for electrical purposes in sizes 0.2043 to 0.0808 in. incl (4 to 12 AWG) (Note 1). This specification does not apply to wires used as reinforcement in ACSR conductors. (See Specification B502.)

NOTE 1—Wire ordered to this specification is not intended for redrawing. If wire is desired for this purpose, the manufacturer shall be consulted.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

2. Referenced Documents

2.1 The following documents of the issue in effect on the 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

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

3. Ordering Information

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

3.1.1 Quantity and conductivity of each size,

3.1.2 Wire size: diameter in inches (see 7.1 and Table 1),

3.1.3 Method of measuring elongation if other than 5.3 (optional),

3.1.4 Special package marking if required (Section 16), and

3.1.5 Package size (see 17.1), and

3.1.6 Place of inspection if other than place of manufacture (Section 14).

4. Material

4.1 The wire shall be composed of a steel core with a substantially uniform and continuous aluminum covering thoroughly bonded to it. The drawn wire shall have the properties and characteristics prescribed in this specification.

5. Tensile Properties

5.1 The wire shall conform to the tensile requirements prescribed in Table 1 (Note 2). In computing tensile strength, the actual diameter of the finished wire shall be used.

NOTE 2—The approximate properties of standard AWG sizes of hard-drawn aluminum-clad steel wire are shown in Table 2 for the information of the user of this specification.

5.2 Wire of a nominal diameter that exceeds a size listed in Table 1 shall conform to the tensile requirements of the next larger diameter.

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[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.

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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.

TABLE 1 Tensile Requirements

Nominal Diameter, in.	Size, AWG	20 %		27 %		30 %		40 %	
		psi	MPa	psi	MPa	psi	MPa	psi	MPa
0.2043	4	155 000	1070	125 000	862	102 000	703	80 000	552
0.1880		160 000	1100	129 000	889	106 000	731	84 000	579
0.1819	5	165 000	1140	133 000	917	110 000	758	88 000	607
0.1729		170 000	1170	137 000	945	114 000	786	92 000	634
0.1620	6	175 000	1210	141 000	972	114 000	786	96 000	662
0.1549		180 000	1240	145 000	1000	118 000	814	96 000	662
0.1443	7	185 000	1280	150 000	1034	122 000	841	98 000	676
0.1369		190 000	1310	154 000	1062	126 000	869	98 000	676
0.1285	8	195 000	1340	156 000	1076	128 000	883	99 500	686
0.1144	9	195 000	1340	156 000	1076	128 000	883	99 500	686
0.1019	10	195 000	1340	156 000	1076	128 000	883	99 500	686
0.0907	11	195 000	1340	156 000	1076	128 000	883	99 500	686
0.0808	12	195 000	1340	156 000	1076	128 000	883	99 500	686

TABLE 2 Physical Constants

% Conductivity	Density at 20°C	Modulus of Elasticity psi	Coef. of Linear Exp.	Temperature Coef. of Resistance
~~20.3~~	~~0.2381 lb/in³ (6.590 g/cm³)~~	~~23.5 × 10⁶ (162 GPa)~~	~~0.0000072/°F (0.0000126/°C)~~	~~0.0020/°F (0.0036/°C)~~
~~27~~	~~0.2135 lb/in³ (5.91 g/cm³)~~	~~20.3 × 10⁶ (140 GPa)~~	~~0.0000077/°F (0.0000134/°C)~~	~~0.0020/°F (0.0036/°C)~~
~~30~~	~~0.2027 lb/in³ (5.61 g/cm³)~~	~~19.1 × 10⁶ (132 GPa)~~	~~0.0000079/°F (0.0000138/°C)~~	~~0.0021/°F (0.0038/°C)~~
~~40~~	~~0.1676 lb/in³ (4.64 g/cm³)~~	~~15.8 × 10⁶ (109 GPa)~~	~~0.0000089/°F (0.0000155/°C)~~	~~0.0022/°F (0.0040/°C)~~

TABLE 2 Physical Constants

% Conductivity	Density at 20°C	Modulus of Elasticity psi	Coef. of Linear Exp.	Temperature Coef. of Resistance
20.3	$0.2381\ lb/in^3$ ($6.590\ g/cm^3$)	23.5×10^6 (162 GPa)	0.0000072/°F (0.0000130/°C)	0.0020/°F (0.0036/°C)
27	$0.2135\ lb/in^3$ ($5.91\ g/cm^3$)	20.3×10^6 (140 GPa)	0.0000077/°F (0.0000139/°C)	0.0020/°F (0.0036/°C)
30	$0.2027\ lb/in^3$ ($5.61\ g/cm^3$)	19.1×10^6 (132 GPa)	0.0000079/°F (0.000142/°C)	0.0021/°F (0.0038/°C)
40	$0.1676\ lb/in^3$ ($4.64\ g/cm^3$)	15.8×10^6 (109 GPa)	0.0000089/°F (0.0000160/°C)	0.0022/°F (0.0040/°C)

5.3 Elongation shall be determined by an extensometer suitable for measuring elongation in 10 in. (250 mm) and equipped with a vernier reading to 0.01 in. (0.25 mm). It shall be attached to the test specimen at a tensile load of 10 % of the rated strength. The elongation shall be observed while applying a tension load to the specimen. The reading at the time of fracture shall be taken as the elongation of the specimen. The elongation thus determined shall be not less than 1.5 % in 10 in. Tests shall be disregarded in which the extensometer reading is less than 1.5 % and in which the fracture does not occur between the extensometer attachments and at least 1 in. (25.0 mm) from the two attachments. In this case another sample from the same reel or coil shall be tested.

5.4 When agreed upon by the manufacturer and the purchaser, the elongation may be determined by measurements made between the jaws of the testing machine. The zero length shall be the distance between the jaws when a load equal to 10 % of the specified tensile strength shall have been applied and the final length shall be the distance between the jaws at the time of rupture. The zero length shall be as near 60 in. (1.52 m) as practicable. The elongation thus determined shall be not less than 1.4 %. Tests in which the elongation is less than 1.4 % and in which the fracture occurs at or within 1 in. (25.4 mm) of the jaws shall be disregarded. In this case another sample from the same reel or coil shall be tested.

6. Resistance

6.1 The electrical resistance of the wire (Note 2 and Note 3) shall be determined by resistance measurements and maximum resistance shall be based on the nominal diameter of the wire and the resistivity value of:

51.01 Ω·cmil/ft at 20°C for 20.3 % Conductivity
38.41Ω·cmil/ft at 20°C for 27 % Conductivity
34.57 Ω·cmil/ft at 20°C for 30 % Conductivity
25.93 Ω·cmil/ft at 20°C for 40 % Conductivity

NOTE 3—Electrical resistance is calculated by the following equation: