



Designation: B227 – 15

Standard Specification for Hard-Drawn Copper-Clad Steel Wire¹

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1. Scope

1.1 This specification covers bare hard-drawn round copper-clad steel wire for electrical purposes (Note 1).

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

1.2 Four grades of wire are specified, designated as follows (Note 2): Grade 40 HS, Grade 40 EHS, Grade 30 HS, and Grade 30 EHS.

NOTE 2—The grades covered by this specification correspond to the following commercial designations:

- Grade 40 HS, High Strength, 40 % Conductivity.
- Grade 40 EHS, Extra High Strength, 40 % Conductivity
- Grade 30 HS, High Strength, 30 % Conductivity.
- Grade 30 EHS, Extra High Strength, 30 % Conductivity.

1.3 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 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**
- B258 Specification for Nominal Diameters and Cross-Sectional Areas of AWG Sizes of Solid Round Wires Used as Electrical Conductors**

2.3 *National Institute of Standards and Technology*:
NBS Handbook 100—Copper Wire Tables³

¹ This specification is under the jurisdiction of the 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.

³ Available from National Institute of Standards and Technology (NIST), 100 Bureau Dr., Stop 1070, Gaithersburg, MD 20899-1070, http://www.nist.gov.

3. Ordering Information

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

- 3.1.1 Quantity of each size and grade,
- 3.1.2 Wire size: diameter in inches (see 5.1 and Table 1),
- 3.1.3 Grade (see 1.2 and Table 1),
- 3.1.4 Method of measuring elongation (see 7.3 and 7.4),
- 3.1.5 Package size (see 14.1),
- 3.1.6 Special package marking, if required (Section 13), and
- 3.1.7 Place of inspection (Section 15).

4. Material

4.1 The wire shall be composed of a steel core with a substantially uniform and continuous copper cladding thoroughly bonded to it throughout.

4.2 The finished copper-clad steel wire shall conform to the requirements prescribed in this specification.

5. Dimensions and Permissible Variations

5.1 The size shall be expressed as the diameter of the wire in decimal fractions of an inch using four places of decimals, that is, in tenths of mils (Note 3).

NOTE 3—The values of wire diameters in Table 1 are given to the nearest 0.0001 in. and correspond to the standard sizes given in Specification B258. In specifying diameters of wire or in inspecting wire, express the diameter to the fourth decimal place. The diameters preceded by asterisks are not in the American Wire Gage series and are also given to four places of decimals. They correspond to certain numbers of the Birmingham Wire Gage of the British Standard Wire Gage and are used for communication lines. The use of gage numbers in specifying wire sizes is not recognized in these specifications because of the possibility of confusion. An excellent discussion of wire gages and related subjects is contained in *NBS Handbook 100* of the National Institute of Standards and Technology.³

5.2 Within the range of diameters included in Table 1, the wire shall not vary from the specified diameter by more than the following amounts rounded off to the nearest 0.1 mil (0.0001 in.):

Specified Diameter, in. (mm)	Permissible Variations in Specified Diameter
0.2043 (5.189) to 0.1000 (2.540), incl	±1.5 %
0.0999 (2.537) and under	±1.0 %

5.3 Ten percent, but not less than five coils or spools (or all if the lot is less than five) from any lot of wire, shall be gaged

TABLE 1 Tensile Requirements

Nominal Diameter in. (mm)	Area at 20°C		Tensile Strength, min, psi (MPa) ^A			
	cmil	in. ² (mm ²) ^A	Grade 40 HS	Grade 40 EHS	Grade 30 HS	Grade 30 EHS
0.2043 (5.189)	41 740	0.03278 (21.15)	108 000 (745)	...	120 000 (828)	142 500 (983)
0.1819 (4.620)	33 090	0.02599 (16.77)	113 000 (780)	...	125 000 (863)	150 500 (1038)
0.1650 (4.191) ^B	27 230	0.02138 (13.79)	118 000 (814)	...	130 000 (897)	157 500 (1087)
0.1620 (4.115)	26 240	0.02061 (13.30)	118 000 (814)	...	130 000 (897)	157 500 (1087)
0.1443 (3.665)	20 820	0.01635 (10.55)	123 000 (849)	...	135 000 (932)	164 000 (1132)
0.1285 (3.264)	16 510	0.01297 (8.368)	128 000 (883)	...	140 000 (966)	170 000 (1173)
0.1280 (3.251) ^B	16 380	0.01287 (8.303)	128 000 (883)	...	140 000 (966)	170 000 (1173)
0.1144 (2.906)	13 090	0.01028 (6.632)	133 000 (918)	...	145 000 (1001)	174 100 (1201)
0.1040 (2.642) ^B	10 820	0.008495 (5.481)	138 600 (956)	156 000 (1076)	151 000 (1042)	175 000 (1208)
0.1019 (2.588)	10 380	0.008155 (5.261)	138 600 (956)	...	151 000 (1042)	179 000 (1235)
0.0808 (2.052)	6 530	0.005129 (3.309)	115 000 (794)	...	120 000 (828)	179 000 (1235)
0.0800 (2.032) ^B	6 400	0.005027 (3.243)	115 000 (794)	...	120 000 (828)	179 000 (1235)
0.0640 (1.626) ^B	4 096	0.003217 (2.076)	125 000 (863)	...	130 000 (897)	179 000 (1235)
0.0403 (1.024)	1 624	0.001276 (0.8232)	130 000 (897)	...	135 000 (932)	179 000 (1235)
0.0390 (0.9906) ^B	1 521	0.001195 (0.7710)	130 000 (897)	...	135 000 (932)	179 000 (1235)
0.0320 (0.8128)	1 024	0.000804 (0.5187)	135 000 (932)	161 000 (1111)	145 000 (1001)	179 000 (1235)

^A Metric equivalents: 1 in. = 25.4 mm (round to four significant figures); 1 in.² = 645.16 mm² (round to four significant figures); 1 psi = 6.9 kPa (round to significant figure of U.S. customary units).

^B These diameters are often employed by purchasers for communication lines but are not in the American Wire Gage (B & S Wire Gage) series, as are the other diameters listed (Note 3).

TABLE 2 Approximate Properties of Hard-Drawn Copper-Clad Steel Wire
(For Information Only)

Nominal Diameter in. (mm)	Breaking Strength, min lbf (N) ^A				Mass/Unit Length		
	Grade 40 HS	Grade 40 EHS	Grade 30 HS	Grade 30 EHS	lb/1000 ft	lb/mile	kg/km ^A
0.2043 (5.189)	3435 (15280)	...	3817 (16979)	4532 (20159)	115.8	611.6	172.3
0.1819 (4.620)	2849 (12673)	...	3152 (14021)	3795 (16881)	91.86	485.0	136.7
0.1650 (4.191)	2448 (10889)	...	2697 (11997)	3267 (14532)	75.55	398.9	112.4
0.1620 (4.115)	2360 (10498)	...	2600 (11565)	3150 (14012)	72.85	384.6	108.4
0.1443 (3.665)	1952 (8683)	...	2142 (9528)	2602 (11574)	57.77	305.0	85.97
0.1285 (3.264)	1611 (7166)	...	1762 (7838)	2139 (9515)	45.81	241.9	68.17
0.1280 (3.251)	1598 (7108)	...	1748 (7775)	2122 (9439)	45.47	240.1	67.67
0.1144 (2.906)	1326 (5898)	...	1446 (6432)	1736 (7722)	36.33	191.8	54.06
0.1040 (2.642)	1142 (5080)	1286 (5720)	1245 (5538)	1442 (6414)	30.01	158.5	44.66
0.1019 (2.588)	1097 (4880)	...	1195 (5316)	1416 (6299)	28.81	152.1	42.87
0.0808 (2.052)	578 (2571)	...	603 (2682)	900 (4003)	18.12	95.68	26.97
0.0800 (2.032)	567 (2522)	...	591 (2629)	882 (3923)	17.76	93.77	26.43
0.0640 (1.626)	394 (1753)	...	410 (1824)	564 (2509)	11.37	60.03	16.92
0.0403 (1.024)	163 (725)	...	169 (752)	224 (996)	4.507	23.80	6.707
0.0390 (0.9906)	152 (676)	...	158 (703)	210 (934)	4.221	22.29	6.282
0.0320 (0.8126)	106 (472)	127 (565)	114 (507)	141 (627)	2.842	15.00	4.229

^A Metric equivalents: 1 lbf = 4.4482 N (round to significant figure of customary units); 1 lb/1000 ft = 1.48816 kg/km (round to four significant figures).

at three places. If accessible, one gaging shall be taken near each end and one near the middle. If any of the selected coils or spools fail to conform to the requirements for diameter as prescribed in 5.2, all coils or spools shall be gaged in the manner specified.

6. Workmanship, Finish, and Appearance

6.1 The surface of the wire shall be smooth and free from imperfections not consistent with good commercial practice.

7. Tensile Properties

7.1 The wire shall conform to the tensile requirements prescribed in Table 1 (Note 4).

NOTE 4—The approximate properties of hard-drawn copper-clad steel wire are shown in Table 2 for the information of the user of this specification.

7.2 Wire whose nominal diameter is more than 0.001 in. (1 mil) (0.03 mm) greater than a size listed in Table 1 shall conform to the tensile requirements of the next larger size.

7.3 Tension tests shall be made on representative samples. Unless otherwise agreed upon between the manufacturer and the purchaser, the elongation shall 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