Designation: B227 – 10

StandardSpecification for Hard-Drawn Copper-Clad Steel Wire[1]

This standard is issued under the fixed designation B227; 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 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 Tables*[3]

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

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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.

TABLE 1 Tensile Requirements

Nominal Diameter, in.	Area at 20°C		Tensile Strength, min, psi[A]			
	cmil	in.^{2,A}	Grade 40 HS	Grade 40 EHS	Grade 30 HS	Grade 30 EHS
0.2043	41 740	0.03278	108 000	. . .	120 000	142 500
0.1819	33 090	0.02599	113 000	. . .	125 000	150 500
0.1650[B]	27 230	0.02138	118 000	. . .	130 000	157 500
0.1620	26 240	0.02061	118 000	. . .	130 000	157 500
0.1443	20 820	0.01635	123 000	. . .	135 000	164 000
0.1285	16 510	0.01297	128 000	. . .	140 000	170 000
0.1280[B]	16 380	0.01287	128 000	. . .	140 000	170 000
0.1144	13 090	0.01028	133 000	. . .	145 000	174 100
0.1040[B]	10 820	0.008495	138 600	156 000	151 000	175 000
0.1019	10 380	0.008155	138 600	. . .	151 000	179 000
0.0808	6 530	0.005129	115 000	. . .	120 000	179 000
0.0800[B]	6 400	0.005027	115 000	. . .	120 000	179 000
0.0640[B]	4 096	0.003217	125 000	. . .	130 000	179 000
0.0403	1 624	0.001276	130 000	. . .	135 000	179 000
0.0390[B]	1 521	0.001195	130 000	. . .	135 000	179 000
0.0320	1 024	0.000804	135 000	161 000	145 000	179 000

[A] Metric equivalents: 1 in. = 25.4 mm (round to four significant figures); 1 in.^{2} = 645.16 mm^2 (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).

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 applied, and the final length shall be the distance between the

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

Nominal Diameter, in.	Breaking Strength, min lb				Mass/Unit Length, lb	
	Grade 40 HS	Grade 40 EHS	Grade 30 HS	Grade 30 EHS	per 1000 ft	per mile
0.2043	3435	. . .	3817	4532	115.8	611.6
0.1819	2849	. . .	3152	3795	91.86	485.0
0.1650	2448	. . .	2697	3267	75.55	398.9
0.1620	2360	. . .	2600	3150	72.85	384.6
0.1443	1952	. . .	2142	2602	57.77	305.0
0.1285	1611	. . .	1762	2139	45.81	241.9
0.1280	1598	. . .	1748	2122	45.47	240.1
0.1144	1326	. . .	1446	1736	36.33	191.8
0.1040	1142	1286	1245	1442	30.01	158.5
0.1019	1097	. . .	1195	1416	28.81	152.1
0.0808	578	. . .	603	900	18.12	95.68
0.0800	567	. . .	591	882	17.76	93.77
0.0640	394	. . .	410	564	11.37	60.03
0.0403	163	. . .	169	224	4.507	23.80
0.0390	152	. . .	158	210	4.221	22.29
0.0320	106	127	114	141	2.842	15.00