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

This standard is issued under the fixed designation B 227; 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 Department of Defense.

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 the standard. The values given in parentheses are in SI units.

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:*

B 193 Test Method for Resistivity of Electrical Conductor Materials[2]

B 258 Specification for Standard Nominal Diameters and Cross-Sectional Areas of AWG Sizes of Solid Round Wires Used as Electrical Conductors[2]

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 B 258. 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) to 0.0800 (2.032), incl	±0.0015 in. (1.5 mils) (0.038 mm)
0.799 (2.029) to 0.0600 (1.524), incl	+0.0010 in. (1.0 mils) (0.025 mm) –0.0015 in. (1.5 mils) (0.038 mm)
0.0599 (1.521) and under	±0.0010 in. (1.0 mils) (0.025 mm)

[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 Composite Conductors.

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

[3] Available from National Institute of Standards and Technology, (NIST), Gaithersburg, MD 20899.

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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).

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 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 jaws at the time of rupture. The zero length shall be as near 10 in. (250 mm) as possible. The fracture shall be 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[B]	
	Grade 40 HS	Grade 40 EHS	Grade 30 HS	Grade 30 EHS	per 1000 ft	per mile
0.2043	3541	. . .	3934	4672	115.8	611.6
0.1819	2938	. . .	3250	3913	91.86	485.0
0.1650	2523	. . .	2780	3368	75.55	398.9
0.1620	2433	. . .	2680	3247	72.85	384.6
0.1443	2011	. . .	2207	2681	57.77	305.0
0.1285	1660	. . .	1815	2204	45.81	241.9
0.1280	1647	. . .	1802	2188	45.47	240.1
0.1144	1368	. . .	1491	1790	36.33	191.8
0.1040	1177	1325	1283	1487	30.01	158.5
0.1019	1130	. . .	1231	1460	28.81	152.1
0.0808	602	. . .	628	918	18.12	95.68
0.0800	590	. . .	615	900	17.76	93.77
0.0640	410	. . .	427	576	11.37	60.03
0.0403	169	. . .	176	228	4.507	23.80
0.0390	158	. . .	165	214	4.221	22.29
0.0320	158	132	119	144	2.842	15.00

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