Designation: ~~B1 – 12~~ B1 – 13

Standard Specification for Hard-Drawn Copper Wire[1]

This standard is issued under the fixed designation B1; 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 hard-drawn round copper wire for electrical purposes.

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.

1.2.1 *Exception*—For density, resistivity and temperature, the values stated in SI units are to be regarded as standard.

2. Referenced Documents

2.1 The following documents of the issue in effect at the time of reference form a part of this specification to the extent referenced herein:

2.2 *ASTM Standards:*[2]

B49 Specification for Copper Rod Drawing Stock for Electrical Purposes

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:*~~*Other Documents:*

NBS Handbook 100 ~~—Copper~~ — 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,

3.1.2 Wire size: diameter in inches (~~5.4~~5.3 and Table 1),

3.1.3 Type of copper, if special (Section 4),

~~3.1.4 Whether certification of resistivity of rod stock is acceptable instead of resistivity tests on the finished wire (6.2),~~

3.1.4 Package size (~~8.1~~10.1),

3.1.5 Special package marking, if required, and

3.1.6 Place of inspection (7.1).

4. Materials ~~and Manufacture~~

4.1 The material shall be copper of such quality and purity that the finished product shall have the properties and characteristics prescribed in this specification.

NOTE 1—Specification B49 defines the materials suitable for use.

[1] This specification is under the jurisdiction of ASTM Committee B01 on Electrical Conductors and is the direct responsibility of Subcommittee B01.04 on Conductors of Copper and Copper Alloys.

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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 ~~the~~ National Technical Information ~~Service, 5285 Port Royal Road, Springfield, VA 22161.~~Service (NTIS), 5301 Shawnee Rd., Alexandria, VA 22312, http://www.ntis.gov.

TABLE 1 Tensile Properties

Diameter[A]			Area at 20°C		Nominal Tensile Strength[B] (see Explanatory Note 2)		Nominal Elongation,%[B]
in.	mm	cmil	in.^{2}	mm^2	psi	MPa	in 10 in. (250 mm)
0.4600	11.684	211 600	0.1662	107.0	49 000	340	3.8
0.4096	10.464	167 800	0.1318	85.0	51 000	350	3.3
0.3648	9.266	133 100	0.1045	67.4	52 800	365	2.8
0.3249	8.252	105 600	0.08291	53.5	54 500	375	2.4
0.2893	7.348	83 690	0.06573	42.4	56 100	385	2.2
0.2576	6.543	66 360	0.05213	33.6	57 600	395	2.0
0.2294	5.827	52 620	0.04133	26.7	59 000	405	1.8
0.2043	5.189	41 740	0.03278	21.2	60 100	415	1.7
0.1819	4.620	33 090	0.02599	16.8	61 200	420	1.6
0.1650*	4.191	27 220	0.02138	13.8	62 000	425	1.5
0.1620	4.115	26 240	0.02061	13.3	62 100	430	1.4
0.1443	3.665	20 820	0.01635	10.5	63 000	435	1.3
0.1340*	3.404	17 960	0.01410	9.10	63 400	435	1.3
0.1285	3.264	16 510	0.01297	8.37	63 700	440	1.3
0.1144	2.906	13 090	0.01028	6.63	64 300	445	1.2
0.1040*	2.642	10 820	0.008495	5.48	64 800	445	1.2
0.1019	2.588	10 380	0.008155	5.26	64 900	445	1.2
0.0920*	2.387	8 460	0.00665	4.29	65 400	450	1.1
0.0907	2.304	8 230	0.00646	4.17	65 400	450	1.1
0.0808	2.052	6 530	0.00513	3.31	65 700	455	1.1
0.0800*	2.032	6 400	0.00503	3.24	65 700	455	1.1
0.0720	1.829	5 180	0.00407	2.63	65 900	455	1.1
0.0650*	1.651	4 220	0.00332	2.14	66 200	455	1.0
0.0641	1.628	4 110	0.00323	2.08	66 200	455	1.0
0.0571	1.450	3 260	0.00256	1.65	66 400	460	1.0
0.0508	1.290	2 580	0.00203	1.31	66 600	460	1.0
0.0453	1.151	2 050	0.00161	1.04	66 800	460	1.0
0.0403	1.024	1 620	0.00128	0.823	67 000	460	1.0

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0.0453	1.151	2 050	0.00161	1.04	66 800	460	1.0
0.0403	1.024	1 620	0.00128	0.823	67 000	460	1.0

[A] The diameters marked by asterisks (*) 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 (see Explanatory Note 4).

[B] These values are subject to the requirements of conformance criteria in Section 88 in determining acceptability of wire under this specification. They are intended to be used as the "minimum values" in design and in all dependent specifications.

5. General Requirements (see Section 8)

5.1 *Tensile Strength and Elongation —Elongation*—The wire shall conform to the requirements as to tensile strength and elongation prescribed in Table 1 (see Explanatory Note 1 and Note 2). For wire whose nominal diameter is more than 0.001 in. (0.025 mm) greater than a size listed in Table 1 and less than that of the next larger size, the requirements of the next larger size shall apply.

5.1.1 Tests on a specimen containing a joint shall show at least 95 % of the tensile strength give in Table 1. Elongation tests shall not be made on a specimen containing a joint.

5.2 *Joints*—No joints shall be made in the completed wire (see Explanatory Note 3). Joints in the wire and rods made prior to final drawing shall be in accordance with the best commercial practice. Tests on a specimen containing a joint shall show at least 95% of the tensile strength given in Table 1. Elongation tests shall not be made on a specimen containing a joint.

5.2 *Resistivity*—The electrical resistivity at 20°C shall not exceed the following values:

Nominal Diameter, in.	Resistivity at 20°C, Ω·lb/mile^2
0.460 to 0.325, incl	900.77
Under 0.325 to 0.0403, incl	910.15

Nominal Diameter, in.	Resistivity at 20°C, Ω·g/m^2
11.68 to 8.25, incl	0.15775
Under 8.25 to 1.02, incl	0.15940

Nominal Diameter, in.	Resistivity at 20°C, Ω·lb/mile^2	Resistivity at 20°C, Ω·g/m^2
0.460 to 0.325 (11.684 to 8.255 mm), incl	900.77	0.15775
Under 0.325 to 0.0403 (8.255 to 1.024 mm), incl	910.15	0.15940

5.3 *Dimensions and Permissible Variations*—The wire sizes shall be expressed as the diameter of the wire in decimal fractions of an inch to the nearest 0.0001 in. (or 0.001 mm) (see Explanatory Note 4). Within the range of diameters given in Table 1, the wire shall not vary from the specified diameter by more than plus and minus 1 %, expressed to the nearest 0.0001 in. (or 0.001 mm).mm) (see Explanatory Note 4).

5.4 *Joints*—No joints shall be made in the completed wire (Explanatory Note 3). Joints in the wire and rods made prior to final drawing shall be in accordance with the best commercial practice and shall conform to the requirements prescribed in 5.1.

5.5 *Finish*—The wire shall be free of all imperfections not consistent with the best commercial practice.

6. Test Methods

6.1 *Tensile Strength and Elongation : Elongation:*

6.1.1 Obtain the tensile strength, expressed in pounds per square inch, by dividing the maximum load carried by the specimen during the tension test, by the original cross-sectional area of the specimen. Tensile strength and elongation may be determined simultaneously on the same specimen.

6.1.2 Determine the elongation of the wire as the permanent increase in length due to the breaking of the wire in tension, measured between gage marks placed originally 10 in. (250 mm) apart upon the test specimen (see Explanatory Note 5).

6.1.3 If any part of the fracture takes place outside the gage marks or in the jaws of the testing machine, or if an examination of the specimen indicates a flaw, the value obtained may not be representative of the material. In such cases the test may be discarded and a new test made.

6.2 *Resistivity*—Determine the electrical resistivity of the material in accordance with Test Method B193 (see Explanatory Note 6). The purchaser may accept certification that the wire was drawn from rod stock meeting the International Standard for Annealed Copper instead of resistivity tests on the finished wire.

6.3 *Dimensional Measurements*—Dimensional measurements shall be made with equipment capable of measuring to a graduation of 0.0001 in. (or 0.001 mm). Take measurements on at least three places on each unit selected for this test. If accessible, take one measurement on each end and one near the middle. The average of the three measurements shall determine compliance with the requirements.

6.4 *Surface Finish*—Make a surface-finish inspection with the unaided eye (normal spectacles accepted).

7. Inspection

7.1 *General (see* Explanatory Note 7*)*—Unless otherwise specified in the contract or purchaser order, the manufacturer shall be responsible for the performance of all inspection and test requirements specified.

7.1.1 All inspections and tests shall be made at the place of manufacture unless otherwise specifically agreed to between the manufacturer and the purchaser at the time of the purchase.