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Standard Specification for Medium-Hard-Drawn Copper Wire[1]

This standard is issued under the fixed designation B 2; 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.

~~ε[1] NOTE—Reference to military approval (DoD) was removed in March 2005.~~

1. Scope

1.1 This specification covers medium-hard-drawn round copper wire for electrical purposes (see Explanatory Note 1).

1.2 The SI values of density and resistivity are to be regarded as standard. For all other properties the inch-pound values are to be regarded as standard, and the SI units may be approximate.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

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]

B 5 Specification for High~~-~~ Conductivity Tough-Pitch Copper Refinery Shapes

B 49 Specification for Copper Rod Drawing Stock for Electrical Purposes

B 170 Specification for Oxygen-Free Electrolytic Copper~~—~~Refinery Shapes

B 193 Test Method for Resistivity of Electrical Conductor Materials

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

2.3 *Other Documents:*

NBS Handbook 100 Copper Wire Tables of the National Bureau of Standards[3]

3. Ordering Information

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

3.1.1 Quantity of each size;

3.1.2 Wire size: diameter in inches (see 5.1 and Table 1);

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

3.1.4 Package size (see ~~10.1~~11.1);

3.1.5 Special package marking, if required; and

3.1.6 Place of inspection (Section 10).

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—Specifications B 5, B 49, and B 170 define the materials suitable for use.

4.2 Copper bars of special qualities, forms, or types, as may be agreed upon between the manufacturer and the purchaser, and which will conform to the requirements prescribed in this specification, may also be used.

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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 B01.04 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 National Technical Information Service (NTIS), ~~U.S. Department of Commerce,~~ 5285 Port Royal Rd., Springfield, VA 22161, http://www.ntis.gov.

TABLE 1 Tensile Requirements

Diameter, in.	Diameter, mm	Area at 20°C, cmil	Area at 20°C, in.²	Area at 20°C, mm²	Tensile Strength, psi, Min	Tensile Strength, psi, Max	Tensile Strength, MPa, Min	Tensile Strength, MPa, Max	Elongation, min, %in 10-in. (250 mm)
0.4600	11.684	211 600	0.1662	107.0	42 000	49 000	290	340	3.8
0.4096	10.404	167 800	0.1318	85.0	43 000	50 000	295	345	3.6
0.3648	9.266	133 100	0.1045	67.4	44 000	51 000	305	350	3.2
0.3249	8.252	105 600	0.08291	53.5	45 000	52 000	310	360	3.0
0.2893	7.348	83 690	0.06573	42.4	46 000	53 000	315	365	2.8
0.2576	6.543	66 360	0.05212	33.6	47 000	54 000	325	370	2.5
0.2294	5.827	52 620	0.04133	26.7	48 000	55 000	330	380	2.2
0.2043	5.189	41 740	0.03278	21.2	48 330	55 330	335	380	1.9
0.1819	4.620	33 090	0.02599	16.8	48 660	55 660	335	385	1.7
0.1620	4.115	26 240	0.02061	13.3	49 000	56 000	340	385	1.5
0.1443	3.665	20 820	0.01635	10.5	49 330	56 330	340	390	1.4
0.1285	3.264	16 510	0.01297	8.37	49 660	56 660	340	390	1.3
0.1144	2.906	13 090	0.01028	6.63	50 000	57 000	345	395	1.3
~~0.1019~~	~~2.588~~	~~10 380~~	~~0.008155~~	~~5.26~~	~~50 330~~	~~57 330~~	~~345~~	~~395~~	~~1.2~~
0.1019	2.588	10 380	0.00816	5.26	50 330	57 330	345	395	1.2
0.0907	2.304	8 230	0.00646	4.17	50 660	57 600	350	400	1.2
0.0808	2.052	6 530	0.00513	3.31	51 000	58 000	350	400	1.1
0.0720	1.829	5 180	0.00407	2.63	51 330	58 330	355	400	1.1
0.0641	1.628	4 110	0.00323	2.08	51 660	58 660	355	405	1.0
0.0571	1.450	3 260	0.00256	1.65	52 000	59 000	360	405	1.0
0.0508	1.290	2 580	0.00203	1.31	52 330	59 330	360	410	1.0
0.0453	1.151	2 050	0.00161	1.04	52 660	59 660	365	410	1.0
0.0403	1.024	1 620	0.00128	0.823	53 000	60 000	365	415	1.0

5. Dimensions and Permissible Variations

5.1 The wire sizes shall be expressed as the diameter of the wire in decimal fractions of an inch to the nearest 0.0001 in. (0.1 mil) or in millimetres to the nearest 0.001 mm (Explanatory Note 2).

5.2 Within the range of diameters included in Table 1 the wire shall not vary from the specified diameter by more than ±1 %, expressed to the nearest 0.0001 in. (0.1 mil) 0.001 mm.

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 fails to conform to the requirements prescribed in 5.2, all coils or spools shall be gaged in the manner specified.

6. Workmanship, Finish, and Appearance

6.1 The wire shall be free from all imperfections not consistent with the best commercial practice.

7. Tensile Properties

7.1 The wire shall conform to the requirements as to tensile properties prescribed in Table 1 ~~(Explanatory Note 2 and~~ (Explanatory Note 3 and Note 4).

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

7.3 For wire the nominal diameter of which is more than 0.001 in. (1 mil) (0.025 mm) greater than a size listed in Table 1, but which is less than that of the next larger size, the requirements of the next larger size shall apply.

7.4 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. (254 mm) apart upon the test specimen (Explanatory Note 4).

7.5 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.

7.6 *Retests*—If, upon testing a sample from any coil or spool of wire, the results do not conform to the requirements prescribed in Table 1, two additional samples shall be tested and the average of the three tests shall determine the acceptance or rejection of the coil or spool.

8. Resistivity

8.1 Electrical resistivity shall be determined on representative samples by resistance measurements (Explanatory Note 5 and Note 6). At a temperature of 20°C the resistivity shall not exceed the following values:

Nominal Diameter, in.	Resistivity at 20°C, Ω·lb/mile²	Resistivity at 20°C, Ω·g/m²
0.460 to 0.325 (11.684 to 8.255 mm), incl	896.15	0.15695
Under 0.325 to 0.0403 (8.255 to 1.024 mm), incl	905.44	0.15858