



Standard Specification for Soft or Annealed Copper Wire¹

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This standard has been approved for use by agencies of the Department of Defense. Consult the DoD Index of Specifications and Standards for the specific year of issue which has been adopted by the Department of Defense.

1. Scope

1.1 This specification covers drawn and annealed or soft round bare copper wire for electrical purposes (Explanatory Note 1).

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

1.3 The hazard statement applies only to Section 6, Test Methods, of this specification. *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 at the time of reference form a part of this specification to the extent referenced herein:

2.2 ASTM Standards:

B 49 Specification for Copper Redraw Rod for Electrical Purposes²

B 193 Test Method for Resistivity of Electrical Conductor Materials³

B 258 Specification for Standard Nominal Diameters and Cross-Sectional Areas of AWG Sizes of Solid Round Wires Used as Electrical Conductors³

2.3 *National Institute of Standards and Technology:*
NBS Handbook 100— *Copper Wire Tables*⁴

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 (see 5.4 and Table 1),

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

3.1.4 Package size (see 10.1),

3.1.5 Special package marking, if required, and

3.1.6 Place of inspection (see 9.1).

3.2 In addition, Supplementary Requirements shall apply only when specified by the purchaser in the inquiry, contract, or purchase order for direct procurement by agencies of the U.S. Government (S1, S2, and S3).

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—The following standards define the materials suitable for use: Specification B 49.

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.

5. General Requirements (see Section 7)

5.1 *Tensile Strength and Elongation*—The wire shall conform to the requirements for elongation prescribed in Table 1 (Explanatory Note 2). No requirements for tensile strength are specified. For wire whose nominal diameter is more than 0.001 in. (1 mil) (0.025 mm) greater than a size listed in Table 1, but less than that of the next larger size, the requirements of the next larger size shall apply.

5.2 *Joints*—Necessary joints in the completed wire and in the wire and rods prior to final drawing shall be made in accordance with the best commercial practice.

5.3 *Resistivity*—The electrical resistivity 20°C shall not exceed 875.20 Ω·lb/mile².

5.4 *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 0.1 mil (0.0001 in.) (0.0025 mm) (Explanatory Note 3). For diameters under 0.0100 in. (0.2540 mm), the wire shall not vary from the specified diameter by more than plus and minus 0.1 mil (0.0001 in.), and for diameters of 0.0100 in. and over the wire shall not vary from the specified diameter by more than plus and minus 1 %, expressed to the nearest 0.1 mil (0.0001 in.).

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

¹ This specification is under the jurisdiction of ASTM Committee B-1 on Wires for Electrical Conductors and is the direct responsibility of Subcommittee B01.04 on Conductors of Copper and Copper Alloys.

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² *Annual Book of ASTM Standards*, Vol 02.01.

³ *Annual Book of ASTM Standards*, Vol 02.03.

⁴ Available from the National Technical Information Service, 5285 Port Royal Rd, Springfield, VA 22161.

TABLE 1 Tensile Requirements

Diameter			Area at 20°C		Elongation in 10 in. (254 mm), % min
in.	mm	cmils	in. ²	mm ²	
0.4600	11.684	211 600	0.1662	107.0	35
0.4096	10.404	167 800	0.1318	85.0	35
0.3648	9.266	133 100	0.1045	67.4	35
0.3249	8.252	105 600	0.08291	53.5	35
0.2893	7.348	83 690	0.06573	42.4	30
0.2576	6.543	66 360	0.05212	33.6	30
0.2294	5.827	52 620	0.04133	26.7	30
0.2043	5.189	41 740	0.03278	21.2	30
0.1819	4.620	33 090	0.02599	16.8	30
0.1620	4.115	26 240	0.02061	13.3	30
0.1443	3.665	20 820	0.01635	10.5	30
0.1285	3.264	16 510	0.01297	8.37	30
0.1144	2.906	13 090	0.01028	6.63	30
0.1019	2.588	10 380	0.008155	5.26	25
0.0907	2.304	8 230	0.00646	4.17	25
0.0808	2.052	6 530	0.00513	3.31	25
0.0720	1.829	5 180	0.00407	2.63	25
0.0641	1.628	4 110	0.00323	2.08	25
0.0571	1.450	3 260	0.00256	1.65	25
0.0508	1.290	2 580	0.00203	1.31	25
0.0453	1.151	2 050	0.00161	1.04	25
0.0403	1.024	1 620	0.00128	0.823	25
0.0359	0.912	1 290	0.00101	0.654	25
0.0320	0.813	1 020	0.000804	0.517	25
0.0285	0.724	812	0.000638	0.411	25
0.0253	0.643	640	0.000503	0.324	25
0.0226	0.574	511	0.000401	0.259	25
0.0201	0.511	404	0.000317	0.205	20
0.0179	0.455	320	0.000252	0.162	20
0.0159	0.404	253	0.000199	0.128	20
0.0142	0.361	202	0.000158	0.102	20
0.0126	0.320	159	0.000125	0.081	20
0.0113	0.287	128	0.000100	0.065	20
0.0100	0.254	100	0.0000785	0.051	15
0.0089	0.226	79.2	0.0000622	0.040	15
0.0080	0.203	64.0	0.0000503	0.032	15
0.0071	0.180	50.4	0.0000396	0.026	15
0.0063	0.160	39.7	0.0000312	0.020	15
0.0056	0.142	31.4	0.0000246	0.016	15
0.0050	0.127	25.0	0.0000196	0.013	15
0.0045	0.114	20.2	0.0000159	0.010	15
0.0040	0.102	16.0	0.0000126	0.0081	15
0.0035	0.089	12.2	0.00000962	0.0062	15
0.0031	0.079	9.61	0.00000755	0.0049	15

6. Test Methods

6.1 *Tensile Strength and Elongation*—No test for tensile strength shall be required.

6.1.1 Determine the elongation of wire whose nominal diameter is larger than 0.0808 in. (2.052 mm) in diameter as the permanent increase in length, expressed in percent of the original 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). The elongation of wire whose nominal diameter is 0.0808 in. and under may be determined as described above or by measurements made between the jaws of the testing machine. When the latter method is used, the zero length shall be the distance between the jaws at the start of the tension test and be as near 10 in. as practicable, and the final length shall be the distance between the jaws at the time of rupture. The fracture shall be between gage marks in the case of specimens so marked or between the jaws of the testing machine and not closer than 1 in. (25.4 mm) to either gage mark or either jaw.

6.2 *Resistivity*—Determine the electrical resistivity of the

material in accordance with Test Method B 193 (Explanatory Note 5). The purchaser may accept certification that the wire was drawn from stock meeting the international standard for annealed copper instead of resistivity tests on the finished wire.

6.3 *Dimensional Measurements*—Make dimensional measurements with a micrometer caliper equipped with a vernier graduated in 0.0001 in. (0.0025 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 excepted).

7. Conformance Criteria (Explanatory Note 6)

7.1 Any lot of wire, the samples of which comply with the conformance criteria of this section, shall be considered as complying with the requirements of Section 5. Individual production units that fail to meet one or more of the requirements shall be rejected. Failure of a sample group from a lot to