



Designation: B3 – 12

Standard Specification for Soft or Annealed Copper Wire¹

This standard is issued under the fixed designation B3; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

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

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*:
NBS Handbook 100—Copper Wire Tables³

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).

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 B49.

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 (see Explanatory Note 2). No requirements for tensile strength are specified. For wire whose nominal diameter is more than 0.001 in. (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 at 20°C shall not exceed 875.20 Ω ·lb/mile² (0.15328 Ω ·g/m²).

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 0.0001 in. (or 0.001 mm) (see Explanatory Note 3). For diameters under 0.0100 in. (0.254 mm), the wire shall not vary from the specified diameter by more than plus and minus 0.0001 in. (0.0025 mm), and for diameters of 0.0100 in. (0.254 mm) and over 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).

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 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 Rd, Springfield, VA 22161.

TABLE 1 Tensile Requirements

in.	Diameter		Area at 20°C			Elongation in 10 in. (254 mm), % min
	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	0.000 0159	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 The elongation of wire with a nominal diameter greater than 0.0808 in. (2.052 mm) shall be determined as the permanent increase in length due to the breaking of the wire in tension (see Explanatory Note 4). The elongation shall be measured between gage marks placed originally 10 in. (242 mm) apart upon the test specimen and expressed in percent of the original length.

6.1.2 The elongation of wire with a nominal diameter equal to or less than 0.0808 in. (2.053 mm) may be determined as described above or by measurements made between the jaws of the testing machine. When measurements are made between the jaws, the zero length shall be the distance between the jaws at the start of the tension test and be as near 10 in. (254 mm) as practicable. The final length shall be the distance between

the jaws at the time of rupture. The fracture shall be between gage marks or jaws of the testing machine, depending on method used, and not closer than 1 in. (25.4 mm) to either gage mark or jaw.

6.2 *Resistivity*—Determine the electrical resistivity of the material in accordance with Test Method B193 (see 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. (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