



Designation: B2 – 13

Standard Specification for Medium-Hard-Drawn Copper Wire¹

This standard is issued under the fixed designation B2; 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 medium-hard-drawn round 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.

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 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 *Other Documents*:

NBS Handbook 100 Copper Wire Tables of the National Bureau of Standards³

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.

Current edition approved Oct. 1, 2013. Published October 2013. Originally approved in 1912. Last previous edition approved in 2012 as B2 – 12^{ε1}. DOI: 10.1520/B0002-13.

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 Institute of Standards and Technology (NIST), 100 Bureau Dr., Stop 1070, Gaithersburg, MD 20899-1070, http://www.nist.gov.

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 5.3 and Table 1);

3.1.3 Type of copper, if special (see 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 (Section 7).

4. Materials

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 copper 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.

5. General Requirements (see Section 8)

5.1 *Tensile Strength and Elongation*—The wire shall conform to the requirements as to tensile properties prescribed in Table 1 (Explanatory Note 3 and Note 4). For wire whose nominal diameter is more than 0.001 in. (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.

5.1.1 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.

5.2 *Resistivity*—Electrical resistivity at 20°C shall not exceed the following values (see Explanatory Note 5):

Nominal Diameter, in.	Resistivity at 20°C,	
	$\Omega \cdot \text{lb}/\text{mile}^2$	$\Omega \cdot \text{g}/\text{m}^2$
0.460 to 0.325 (11.684 to 8.255 mm), incl	896.15	0.15694
Under 0.325 to 0.0403 (8.255 to 1.024 mm), incl	905.44	0.15857

5.3 *Dimensions and Permissible Variations*—Within the range of diameters included in Table 1 the wire shall not vary

TABLE 1 Tensile Requirements

Diameter		Area at 20°C			Tensile Strength				Elongation, min, % in 10-in. (250 mm)
in.	mm	cmil	in. ²	mm ²	psi		MPa		
					Min	Max	Min	Max	
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	0.00816	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

from the specified diameter by more than $\pm 1\%$, expressed to the nearest 0.0001 in. (0.001 mm) (see Explanatory Note 2).

5.4 *Joints*—No joints shall be made in the completed wire (Explanatory Note 7). Joints in wire and rods, prior to final drawing, shall be made 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:

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 (see Explanatory Note 4).

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.

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 5). 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 a micrometer caliper equipped with a vernier graduated in 0.0001 in. (0.0025 mm). Measurements shall be made on at least three places on each unit selected for this test. If accessible, one measurement shall be taken 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 (Explanatory Note 8 and Note 9)*—Unless otherwise specified in the contract or purchase 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 especially agreed upon between the manufacturer and the purchaser at the time of purchase.

7.1.2 The manufacturer shall afford the inspector representing the purchaser all reasonable manufacturer's facilities to satisfy him that the material is being furnished in accordance with this specification.

7.1.3 Unless otherwise agreed upon between the purchaser and the manufacturer, conformance of the wire to the various requirements listed in Section 5 shall be determined on samples taken from each lot of wire presented for acceptance.

7.1.4 The manufacturer shall, if requested prior to inspection, certify that all wire in the lot was made under such conditions that the product as a whole conforms to the requirements of this specification as determined by regularly made and recorded tests.

7.2 Definitions Applicable to Inspection: