



## Designation: B47 – 95a (Reapproved 2017)

# Standard Specification for Copper Trolley Wire<sup>1</sup>

This standard is issued under the fixed designation B47; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This specification covers round and grooved hard-drawn copper and silver-bearing copper trolley wire.

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.

1.3 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

2.1 *ASTM Standards:*<sup>2</sup>

**B49** Specification for Copper Rod for Electrical Purposes

**B193** Test Method for Resistivity of Electrical Conductor Materials

## 3. Ordering Information

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

3.1.1 Quantity of each size and section,

3.1.2 Wire size: diameter in inches (see **6.1** and **Table 1**) or area in circular mils (see **10.1** and **Fig. 1**),

3.1.3 Shape of section (Section **1**),

3.1.4 Type of copper, if the addition of silver of 25 troy oz./short ton minimum, is required (see Section **4** and Explanatory **Note 1**),

3.1.5 Package size (see **18.3**),

3.1.6 Lagging, if required (see **18.1**),

3.1.7 Relation between vertical axis of grooved wire and axis of reel (see **18.1**),

3.1.8 Size of arbor hole, if special (see **18.2**),

3.1.9 Special package marking, if required (see **18.4**), and

3.1.10 Place of inspection (Section **16**).

## 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.

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

4.3 Either oxygen-free or tough pitch copper may be supplied. Tests for oxygen content of the copper are not a requirement of this specification.

## ROUND WIRE

## 5. Tensile Properties

5.1 Round wire shall conform to the requirements as to tensile properties specified in **Table 1**.

5.2 Tests on a specimen of round wire containing a joint shall show at least 95 % of the tensile strength specified in **Table 1**. Elongation tests shall not be made on specimens containing joints.

5.3 Tension tests shall be made on representative samples. The elongation shall be determined as the permanent increase in length, due to the breaking of the wire in tension, measured between gage marks placed originally 10 in. apart upon the test specimen (Explanatory **Note 2**). The fracture shall be between the gage marks and not closer than 1 in. to either gage mark.

## 6. Dimensions and Permissible Variations

6.1 The size of round trolley wire shall be expressed as the diameter of the wire in decimal fractions of an inch, to the nearest 0.1 mil (0.0001 in.).

6.2 Wire shall be truly cylindrical in form. The diameter shall not vary more than plus and minus 1 % from that specified.

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee **B01** on Electrical Conductors and is the direct responsibility of **B01.04** on Conductors of Copper and Copper Alloys.

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<sup>2</sup> 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.

**TABLE 1 Tensile Requirements (See Explanatory Note 2)**

Diameter, in.	Area, cmils	Tensile Strength, min. psi		Elongation in 10 in., min. %
		No silver added	25 troy oz. min./short ton added	
0.5477	300 000	46 400	48 500	4.50
0.4600	211 600	49 000	51 500	3.75
0.4096	167 800	51 000	53 000	3.25
0.3648	133 100	52 800	54 000	2.80
0.3249	105 600	54 500	55 000	2.40

## 7. Twist Test

7.1 For the purpose of determining and developing defects which may be prejudicial to the life of trolley wire, owing to its peculiar service as compared to that of wire for other purposes, round wire shall be subjected to the twist test described in 7.2. Round wire that does not withstand at least 9 twists without breaking shall not be considered satisfactory.

7.2 Three twist tests shall be made on specimens 10 in. (254 mm) in length between the holders of the testing machine. The twisting machine shall be so constructed that there is a linear motion of the tail stock with respect to the head. The twist shall be applied not faster than 10 turns/min. All three specimens shall be twisted to destruction and shall not reveal under test any seams, pits, slivers, or surface imperfections of sufficient magnitude to indicate inherent defects or imperfections in the wire. At the time of fracture, the wire shall twist with reasonable uniformity.

## GROOVED WIRE

### 8. Tensile Properties

8.1 Grooved wire shall conform to the requirements as to tensile properties specified in Table 2.

8.2 Tests on a specimen of grooved wire containing a joint shall show at least 95 % of the tensile strength specified in Table 2. Elongation tests shall not be made on specimens containing joints.

8.3 The tension and elongation tests for grooved wire shall be made in the same manner as those on round wire as described in 5.3.

### 9. Sections

9.1 Standard sections of grooved trolley wire shall be those known as the “American Standard Grooved Trolley Wire Sections” (the Standard Design of the American Transit Engineering Association) shown in Fig. 1.

### 10. Dimensions and Permissible Variations

10.1 The size of grooved trolley wire shall be expressed as the nominal area of cross section in circular mils, the standard sizes being as specified in Fig. 1.

10.2 The weight in pounds per mile of grooved trolley wire calculated from the weight of a specimen not less than 18 in. in length shall not vary more than plus and minus 4 % from that specified in Fig. 1.

10.3 Conformance of the trolley wire to the specified dimensions shall be determined by taking the measurements shown in Fig. 1 under the heading, “Dimensions for Inspection, in.” The shape of the groove shall be checked with the appropriate “go” and “no-go” slip gages described in Fig. 2. The gages shall be applied to the ends of the samples taken from each reel. Samples shall be clean and ends free from burrs. The groove shall be considered as conforming to these specifications if the “go” gage can be pushed on the straightened wire by hand and the “no-go” gage cannot be pushed on the wire.

### 11. Twist Test

11.1 The twist test shall be omitted.

## ROUND AND GROOVED WIRE

### 12. Resistivity

12.1 Electrical resistivity shall be determined on representative samples by resistance measurements (Explanatory Note 4). At a temperature of 20°C the resistivity shall not exceed 900.77Ω·lb/mile<sup>2</sup>.

12.2 Electrical resistivity shall be determined in accordance with Test Method B193.

### 13. Density

13.1 For the purpose of calculating weights, cross sections, etc., the density of the copper shall be taken as 8.89 g/cm<sup>3</sup> (0.32117 lb/in.<sup>3</sup>) at 20°C (Explanatory Note 5).

### 14. Joints

14.1 No joints shall be made in the completed wire. Joints in the wire and rods made prior to final drawings shall be in accordance with the best commercial practice, and shall be capable of meeting the tensile strength requirements in 5.2 or 8.2.

### 15. Workmanship, Finish, and Appearance

15.1 The wire shall be of uniform size, shape, and quality throughout, and shall be free from all scale, flaws, splits and scratches not consistent with the best commercial practice.

### 16. Inspection

16.1 All tests governing the acceptance or rejection of the wire, unless otherwise specified, shall be made at the place of manufacture with apparatus furnished by the manufacturer and in the presence of the purchaser or his representative, who shall be furnished a copy of the tests. The manufacturer shall afford the inspector representing the purchaser all reasonable facilities, without charge, to satisfy him as to the reliability of the results before the wire is delivered. If the purchaser waives inspection, and if he so elects at that time, he shall be furnished with a certified copy of tests made by the manufacturer.

### 17. Rejection

17.1 Any reel of wire that fails to conform to the requirements prescribed in this specification may be rejected. Failure