Designation: B973 – 10

Standard Specification for Tin-Coated Braid and Ribbon Flat Copper Wire intended for use in Electronic Application[1]

This standard is issued under the fixed designation B973; 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.

1. Scope

1.1 This specification covers tin-coated hard-drawn copper braid and ribbon flat wire intended for electronic application (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 *Exceptions*—The SI values for density, resistivity, and volume 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 *ASTM Standards:*[2]

B1 Specification for Hard-Drawn Copper Wire

B3 Specification for Soft or Annealed Copper Wire

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

2.2 *Other Standards:*[3]

NBS Handbook 100 Copper Wire Tables

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-thickness and width in inches (see 5.3),

3.1.3 Type of copper, if special (see 4.2),

3.1.4 Package size (see 10.1),

3.1.5 Special packaging marking, if required, and

3.1.6 Place of inspection (see 7.1).

4. Material

4.1 *Tin for Coating*—The tin shall be electroplated for the coating and shall be commercially pure (Explanatory Note 1). For purposes of this specification, the tin shall be considered commercially pure if the total of other elements, exclusive of copper, does not exceed 1%. Not withstanding the previous sentence, chemical analysis of the tin coating or of the tin used for coating shall not be required under this specification.

4.2 *Copper-Base Metal*—The base metal shall be copper of such quality and purity that the finished product shall have properties and characteristics prescribed in this specification.

NOTE 1—Specifications B1, B3, or B49 defines copper suitable for use.

5. General Requirements (See Section 8)

5.1 *Tensile and Elongation*—The tin-coated copper flat wire in the hard drawn condition shall conform to elongation requirements of 1% minimum to 5% maximum. The tensile strength shall be 55 000 psi (379 MPa) minimum.

5.2 *Resistivity* (Explanatory Note 3)—The electrical resistivity of the coated wire at a temperature of 20°C shall not exceed the values prescribed in Table 1.

5.3 *Dimensions and Permissible Variations*—The flat wire sizes shall be expressed as the thickness and width of the wire in decimal fractions of an inch to the nearest 0.0001 in. (0.0025 mm). The tin-coated flat wire shall not vary from the specified thickness and width by more than the amounts specified in Table 2 and Table 3, respectively.

5.4 *Continuity of Coating*—The tin coating shall be continuous. The continuity of coating on the flat wire shall be determined on representative samples taken before braiding applications or insulating. The continuity of coating shall be determined by the hydrochloric acid-sodium polysulfide test in accordance with 6.4.

[1] This test method 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), 5285 Port Royal Rd., Springfield, VA 22161, http://www.ntis.gov.

TABLE 1 Electrical Resistivity Requirements

Thickness Range, Inch (mm)	Resistivity at 20°C Ω·lb/mile2
0.0008 to 0.0012 (0.020 to 0.031), incl	1006.0
0.0013 to 0.0016 (0.033 to 0.041), incl	972.45
0.0017 to 0.0024 (0.043 to 0.061), incl	961.76
0.0025 to 0.0048 (0.064 to 0.122), incl	951.31
0.0049 to 0.0100 (0.125 to 0.254), incl	941.08

TABLE 2 Permissible Variations in Thickness

Nominal Thickness Range, Inch (mm)	Tolerance, Inch (mm)
0.0010 to 0.0014 (0.025 to 0.036)	+/- 0.0002 (0.005)
0.0015 to 0.0019 (0.038 to 0.048)	+/- 0.0003 (0.008)
0.0020 to 0.0049 (0.051 to 0.124)	+/- 0.0004 (0.010)
0.0050 to 0.0100 (0.127 to 0.254)	+/- 0.0005 (0.013)

TABLE 3 Permissible Variations in Width

Nominal Width Range, Inch (mm)	Tolerance, Inch (mm)
0.0100 to 0.0499 (0.254 to 1.27)	+/- 0.0013 (0.033)
0.0500 to 0.0699 (1.27 to 1.78)	+/- 0.0015 (0.038)
0.0700 to 0.0999 (1.78 to 2.54)	+/- 0.0020 (0.051)
0.1000 to 0.1249 (2.54 to 3.17)	+/- 0.0030 (0.076)
0.1250 to 0.1500 (3.18 to 3.81)	+/- 0.0040 (0.102)

5.5 *Joints*—Necessary joints in the wire and rods prior to final coating and drawing shall be made in accordance with the best commercial practice. There shall be no uncoated joints in the final product.

5.6 *Finish*—The coating shall consist of a smooth continuous layer, firmly adherent to the surface of the copper. The wire shall be free of all imperfections not consistent with the best commercial practice.

6. Test Methods

6.1 *Tensile Strength and Elongation* (Explanatory Note 4):

6.1.1 The tensile strength, expressed in pounds per square inch, shall be obtained 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.

6.1.2 The elongation of the flat wire may be determined by measurements made between the jaws of the tensile testing machine. 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 the jaws of the testing machine and not closer than 1 in. (25.4 mm) to the jaw.

6.2 *Resistivity* (Explanatory Note 3)—The electrical resistivity of the material shall be determined in accordance with Test Method B193. 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 for width and thickness 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. Any measurement taken exceeding the dimensions and permissible variation requirements in 5.4 shall constitute failure to meet the dimensional conformance criterion.

6.4 *Continuity of Coating:*

6.4.1 *Specimens:*

6.4.1.1 *Length of Specimens*—Test specimens shall have a length of about 6 in. (152 mm). They shall be tagged or marked to correspond with the coil, spool, or reel from which they were cut.

6.4.1.2 *Treatment of Specimens*—The specimens shall be thoroughly cleaned by immersion in a suitable organic solvent for at least 3 min; then removed and wiped dry with a clean, soft cloth (Caution-see Explanatory Note 5). The specimens thus cleaned shall be kept wrapped in a clean, dry cloth until tested. That part of the specimen to be immersed in the test solution shall not be handled. Care shall be taken to avoid abrasion by the cut ends.

6.4.2 *Special Solutions Required:*

6.4.2.1 *Hydrochloric Acid Solution (HCl) (sp gr 1.088)*—Commercial HCl (sp gr 1.12) shall be diluted with distilled water to a specific gravity of 1.088 measured at 15.6°C (60°F). A portion of HCl solution having a volume of 180 mL shall be considered to be exhausted when the number of test specimens prescribed in Table 4 of a size as indicated in 6.4.3 have been immersed in it for two cycles.

6.4.2.2 *Sodium Polysulfide Solution (sp gr 1.142)* (Explanatory Note 6)—A concentrated solution shall be made by dissolving sodium sulfide crystals (cp) in distilled water until the solution is saturated at about 21°C (70°F), and adding sufficient flowers of sulfur (in excess of 250 g/L of solution) to provide complete saturation, as shown by the presence in the solution of an excess of sulfur after the solution has been allowed to stand for at least 24 h. The test solution shall be made by diluting a portion of the concentrated solution with distilled water to a specific gravity of 1.135 to 1.145 at 15.6°C (60°F). The sodium polysulfide test solution should have sufficient strength to blacken thoroughly a piece of clean untinned copper wire in 5 s. The test solution used for testing

TABLE 4 Limiting Number of Test Specimens for Coating Test[A]

Equivalent Round Nominal Diameter		Maximum Number of Specimens to be Tested for 2 Cycles in 180 mL of Acid Solution
in.	mm	
Under 0.0851 to 0.0501, incl	Under 2.2 to 1.3, incl	6
Under 0.0501 to 0.0381, incl	Under 1.3 to 0.97, incl	10
Under 0.0381 to 0.0301, incl	Under 0.97 to 0.76, incl	12
Under 0.0301 to 0.0030, incl	Under 0.76 to 0.076, incl	14

[A]See Explanatory Note 2 for equivalent round calculation.