Designation: B 286 – 02

Standard Specification for Copper Conductors for Use in Hookup Wire for Electronic Equipment[1]

This standard is issued under the fixed designation B 286; 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.

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

1. Scope

1.1 This specification covers uninsulated metallic-coated copper conductors for use in hookup wire for electronic equipment.

1.2 The SI values for density are to be regarded as standard. For all other properties, the inch-pound values are to be regarded as the standard.

2. Referenced Documents

2.1 The following documents of the issue in effect on date of material purchase form a part of this specification to the extent referenced herein:

2.2 *ASTM Standards:*

B 33 Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes[2]

B 189 Specification for Lead-Coated and Lead-Alloy-Coated Soft Copper Wire for Electrical Purposes[2]

B 193 Test Method for Resistivity of Electrical Conductor Materials[2]

B 258 Specification for Standard Nominal Diameters and Cross-Sectional Areas of AWG Sizes of Solid Round Wires Used as Electrical Conductors[2]

B 298 Specification for Silver-Coated Soft or Annealed Copper Wire[2]

B 355 Specification for Nickel-Coated Soft or Annealed Copper Wire[2]

3. Ordering Information

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

3.1.1 Quantity of each size, designation (Table 1) and type,

3.1.2 Conductor size, designation, construction, and type (Table 1).

3.1.3 Whether tin, lead alloy, silver-coated, or nickel-coated (see 4.1).

3.1.4 For silver-coated conductors and nickel-coated conductors, class of coating (see 4.1), and when required, unannealed (see 4.2),

3.1.5 Desired constructions where alternates are given (Table 1, Type II and, 5.1, 6.1, and 6.2),

3.1.6 Package size (Section 12).

3.1.7 Special package marking if required (Section 11), and

3.1.8 Place of inspection (Section 10).

4. General Requirements

4.1 *Coating of Wires*— The coating of the solid conductors and the wires composing stranded conductors (before stranding) shall conform to the coating requirements of ASTM Specifications B 33, B 189, B 298, and B 355, as indicated on the purchase order.

4.2 *Temper*—Unless otherwise specified, all coated conductors shall be furnished in the annealed temper. When so specified, silver-coated conductors or nickel-coated conductors shall be furnished unannealed (Explanatory Note 1).

NOTE 1—The term unannealed as used in this specification means cold-worked conductor as produced on commercial wire-drawing machines.

4.3 *Elongation*—The elongation of annealed Type I conductors shall be as specified in Specifications B 33, B 189, B 298, and B 355 as applicable. The elongation of annealed individual wires removed from stranded conductors shall be permitted to vary from the requirements of the applicable specifications, Specifications B 33, B 189, B 298, and B 355 by the following amounts:

4.3.1 *Average of Results Obtained on All Wires Tested*—The minimum elongation required shall be reduced in numerical value 5 (for example: from 15 % to 10 %) from the numerical requirements for the wire before stranding.

4.3.2 *Results Obtained on Individual Wires*—The elongation of individual wires shall be reduced in numerical value 10 from the minimum requirements before stranding (that is: 5 in

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[2] *Annual Book of ASTM Standards*, Vol 02.03.

addition to the 5 allowed in 4.3.1), but in no case shall the elongation of any individual wire be less than 5 %.

4.4 *D-C Resistance*— The d-c resistance in ohms per 1000 ft of annealed solid and stranded conductor shall not exceed, before insulating, the appropriate values prescribed in Table 1 (Explanatory Note 1).

5. Conductor Construction

5.1 Solid conductors shall conform to the requirements for Type I conductors prescribed in Table 1.

5.2 Stranded conductors shall conform to the requirements for Type II conductors prescribed in Table 1. The method of stranding for conductor size designations 32-7 through 10-104 inclusive shall be at the option of the manufacturer unless otherwise specified. Stranded conductors size designation 10-105 and larger shall normally be furnished in a rope-lay-stranded construction consisting of either 7 or 19 bunch-stranded members.

6. Lay of Stranded Conductors

6.1 The direction of lay of the outside layer of stranded conductors shall be left-hand. The direction of lay of the bunch-stranded members composing rope-lay-stranded conductors shall be at the option of the manufacturer unless otherwise specified.

6.2 The direction of lay of the outer layer of rope-lay-stranded conductors shall be lefthand. The direction of lay of the other layers shall be reversed in successive layers, unless otherwise specified.

6.3 The length of lay of the outside layer of stranded conductors in size designation 32-7 through 10-104, inclusive, shall conform to the values in Table 1 (Explanatory Note 2). For strand constructions containing more than one distinct layer the length of lay of the inner layer shall not exceed the maximum value shown in Table 1 for the conductor in question. For rope-lay-stranded conductors size designation 10-105 and larger, and size 49/0.0142, the length of lay of the wires composing the bunch-stranded members shall be not more than 30 times the diameter of the member, and the length of lay of the outer layer of rope-lay-stranded conductors shall be not less than 8 nor more than 16 times the outside diameter of the completed conductor.

7. Joints

7.1 Necessary joints in the individual wires of conductors size designation 32-7 through size designation 10-104, inclusive, may be silver soldered, brazed, or butt welded. (Explanatory Note 3). Bunch-stranded members composing ropelay-stranded conductors may be joined as a unit by brazing and these joints shall be at least two lay lengths apart and be finished off so that the conductor diameter is not increased at the joint. Disposition of joints throughout the conductor shall be such that the diameter, configuration, conductor resistance, flexibility, and mechanical strength are not substantially affected.

8. Physical and Electrical Tests

8.1 Tests to determine conformance of the coating to the requirements of Specifications B 33, B 189, B 298, or B 355 shall be performed on Type I conductors before insulating and on the individual wires of Type II conductors before stranding.

8.2 Tests to determine conformance to the elongation requirements prescribed in 4.3 shall be made before insulating and, in the case of stranded conductors, on component wires removed from the conductors.

8.3 Tests to determine conformance to the electrical resistance requirements prescribed in Table 1 shall be made on the uninsulated conductor in accordance with Test Method B 193 (Explanatory Note 1).

8.4 *Examination for workmanship of finished uninsulated stranded conductor*—A visual inspection with the unaided eye shall be performed on the outer layer of the conductor on the supplied package. Use a white card (as a background) to ascertain if any base metal is exposed through a break in the coating. Detection of any base metal constitutes rejection.

8.5 *Examination for workmanship of finished uninsulated stranded conductor*—AB visual inspection with 10X magnification and with a white background shall be performed on a conductor sample taken from the top of the supplied spool. The sample shall be a minimum of 12 in. (30 cm) in length. The outer surface of all stranded constructions shall be examined.

Detection of excessive exposed base metal due to the stranding process, such as indications along one side of the sample due to excessive localized abrasion during stranding, constitutes rejection. Continuous lines or patterns of exposed base metals constitute rejection. Small random point failures shall not be cause for rejection.

9. Density

9.1 For the purpose of calculating mass, cross-sectional area, etc., the density of the coated copper shall be taken as 8.89 g/cm ^{3}(0.32117 lb/in.^{3}) at 20°C (Explanatory Note 4).

10. Inspection

10.1 All tests and inspection shall be made at the place of manufacture unless otherwise especially agreed upon by the manufacturer and the purchaser at the time of purchase. The manufacturer shall afford the inspector representing the purchaser all reasonable facilities, without charge, to satisfy him that the material is being furnished in accordance with this specification.

11. Product Marking

11.1 The net mass, length (or lengths, and number of lengths, if more than one length is included in the package), size designation, type of conductor, purchase order number, and any other marks required by the purchase order shall be marked on a tag attached to the end of the conductor inside of the package. The same information, together with the manufacturer's serial number (if any) and all shipping marks required by the purchaser, shall appear on the outside of each package.

12. Packing and Package Marking

12.1 Package sizes for conductors shall be agreed upon by the manufacturer and the purchaser in the placing of individual orders.