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Standard Specification for Fine-Wire Bunch-Stranded and Rope-Lay Bunch-Stranded Copper Conductors for Use as Electrical Conductors[1]

This standard is issued under the fixed designation B738; 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 bare bunch-stranded and rope-lay bunch-stranded conductors made from round copper wires finer than No. 40 AWG with diameters less than 0.0031 in. (.078 mm), either coated or uncoated with tin or silver, for use as electrical conductors. (Explanatory Note 1).

1.2 The values ~~(SI units) for density and temperature are regarded as the standard. For all other properties the inch-pound values~~stated in inch-pound units are to be regarded as ~~standard, and the SI units may be approximate.~~ 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 and temperature are to be regarded as standard.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

B33 Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes
B49 Specification for Copper Rod Drawing Stock for Electrical Purposes
B172 Specification for Rope-Lay-Stranded Copper Conductors Having Bunch-Stranded Members, for Electrical Conductors
B174 Specification for Bunch-Stranded Copper Conductors for Electrical Conductors
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
B298 Specification for Silver-Coated Soft or Annealed Copper Wire
B354 Terminology Relating to Uninsulated Metallic Electrical Conductors

3. Classification

3.1 For the purposes of this specification, the following classifications have been assigned (Explanatory Note 2):

3.1.1 *Type:*

3.1.1.1 *Type B*—Bunch-stranded conductors.

3.1.1.2 *Type R*—Rope-lay bunch-stranded conductors.

3.1.2 *Class:*

3.1.2.1 *Class R*—Stranded conductors using wire 42 AWG (0.0025).

3.1.2.2 *Class S*—Stranded conductors using wire 44 AWG (0.0020).

3.1.2.3 *Class T*—Stranded conductors using wire 46 AWG (0.00157).

3.1.2.4 *Class U*—Stranded conductors using wire 48 AWG (0.00124).

3.1.2.5 *Class V*—Stranded conductors using wire 50 AWG (0.00099).

3.2 Detailed information on Type B Conductors is found in Table 1 and Table 2. Detailed information on Type R Conductors is found in Table 3 and Table 2.

[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.

TABLE 1 Classification of Type B Bunch-Stranded Conductors

Class	Wire Diameter, in.[A]	Conductor Sizes, AWG
R	0.0025 (No. 42 AWG)	24,26,28,30,32,34
S	0.0020 (No. 44 AWG)	26,28,30,32,34,36
T	0.00157 (No. 46 AWG)	28,30,32,34,36,38
U	0.00124 (No. 48 AWG)	30,32,34,36,38,40
V	0.00099 (No. 50 AWG)	32,34,36,38,40

[A] Sufficient quantities of wires of these diameters shall be used to form conductors having cross-sectional areas approximately equal to the AWG conductor sizes listed.

4. Ordering Information

4.1 Orders for materials under this specification shall include the following information:

4.1.1 Quantity of each size, class, and type,

4.1.2 *Conductor size*—circular-mil area, dc resistance (7.1) or AWG (5.2.1),

4.1.3 Class and type (Section 3),

4.1.4 Whether coated or uncoated; if coated, designate type of coating (6.1); if silver coated, the minimum thickness of silver (6.1.2), and whether tarnish protection is desired (11.3),

4.1.5 Maximum length of lay (5.2.4), if required,

4.1.6 Temper (6.2),

4.1.7 Separators, if required (5.2.2),

4.1.8 Package size (11.1),

4.1.9 Special package marking, if required (Section 10), and

4.1.10 Place of inspection (Section 9).

4.2 In addition, Supplementary Requirements shall apply only when specified by the purchaser in the inquiry, contract, or purchase order for direct procurement by agencies of the U.S. Government.

5. Materials and Manufacture

5.1 The material shall be copper of such quality and purity that the finished product shall have the properties and characteristics described in this specification. Material meeting the requirements of Specification B49 is such a material.

5.2 *Construction:*

5.2.1 *Cross-Sectional Area*—The cross-sectional area, number, and diameter of wires for a variety of strand constructions in general use are shown in Table 2.

5.2.2 *Separators*—If a separator is required to be furnished with the conductor, it shall be specified by the purchaser at the time of the order as to the requirements for the kind and thickness of material and its application details.

5.2.3 *Joints:*

5.2.3.1 Necessary joints in wires shall be made in accordance with accepted commercial practice.

5.2.3.2 Joints shall be so constructed and so disposed throughout the conductor that the diameter or configuration of the completed conductor is not substantially affected, and that the flexibility of the completed conductor is not adversely affected.

5.2.4 *Lay:*

5.2.4.1 Conductors of the same size and description furnished on one order shall have the same lay.

5.2.4.2 The direction of the lay of bunch-stranded conductors shall be at the option of the manufacturer unless otherwise specified by the purchaser.

5.2.4.3 Unless otherwise specified by the purchaser, the length of the lay of bare or coated bunch-stranded conductors shall conform to the requirements of Table 4.

5.2.4.4 The direction of the lay of the outer layer of rope-lay stranded conductors shall be lefthand, unless otherwise specified by the purchaser.

5.2.4.5 The length of the lay of the outer layer of rope-lay stranded conductors shall be not less than 8 or more than 16 times the outside diameter of the completed conductor. The length of the lay of the wires composing the bunch-stranded members shall be not more than 30 times the diameter of the member.

6. Physical Properties

6.1 *Wire Coating*—When coated, the coating of the wires of the stranded conductor, before stranding, shall conform to the requirements of 6.1.1 or 6.1.2.

6.1.1 Tin coating shall conform to the coating requirements of Specification B33.

6.1.2 Silver coating shall conform to the minimum thickness requirements of the purchase document. Minimum thickness shall be determined using the method for determining plating thickness described in Specification B298.

TABLE 2 Construction Requirements of Bunch-Stranded and Rope-Lay Bunch-Stranded Conductors[A]

Nominal Area, cmil	Size, AWG	CLASS R		CLASS S		CLASS T		CLASS U		CLASS V	
		Minimum Number of Wires 0.0025 in. in Diameter (No. 42 AWG)		Minimum Number of Wires 0.0020 in. in Diameter (No. 44 AWG)		Minimum Number of Wires 0.00157 in. in Diameter (No. 46 AWG)		Minimum Number of Wires 0.00124 in. in Diameter (No. 48 AWG)		Minimum Number of Wires 0.00099 in. in Diameter (No. 50 AWG)	
		Type[B] B	Type[C] R	Type B	Type R	Type B	Type R	Type B	Type R	Type B	Type R
2580	16	...	...	...	665	...	...	...	...	...	...
1620	18	...	...	...	413	...	...	...	...	...	...
1020	20	...	168	...	259	...	...	...	...	...	...
640	22	...	105	...	168	...	...	...	...	...	...
404	24	65	...	...	105	...	168	...	...	...	...
253	26	41	...	65	...	...	105	...	168	...	...
159	28	26	...	40	...	65	...	...	105	...	168
100	30	16	...	25	...	40	...	65	...	...	105
64	32	10	...	16	...	25	...	40	...	65	...
40	34	7	...	10	...	16	...	25	...	40	...
25	36	...	...	7	...	10	...	16	...	25	...
16	38	...	...	...	...	7	...	10	...	16	...
10	40	...	...	...	...	...	...	7	...	10	...

[A] ~~This~~ This table shows a variety of strand constructions useful and generally adequate to meet the needs encountered. It is not intended that the constructions listed in this table be exclusive of other constructions that may appear durable in certain applications employing the same number of wires. The constructions shown in this table provide for a finished, noncovered, stranded conductor approximately of the area indicated. When specified by the purchaser, usually to provide additional area to compensate for draw-down during subsequent processing, the number or size of wires composing the uncovered conductor may be increased as required.
[B] Type B Bunch-Stranded Conductors.
[C] Type R Rope-Lay Bunch-Stranded Conductors.

TABLE 3 Classification of Type R Rope-Lay Bunch-Stranded Conductors[A]

Class	Wire Diameter, in.[B]	Conductor Sizes, AWG
R	0.0025 (No. 42 AWG)	20,22
S	0.0020 (No. 44 AWG)	16,18,20,22,24
T	0.00157 (No. 46 AWG)	24,26
U	0.00124 (No. 48 AWG)	26,28
V	0.00099 (No. 50 AWG)	28,30

[A] Rope-lay bunch-stranded conductors 7 by bunch-stranded members.
[B] Sufficient quantities of wires of these diameters shall be used to form conductors having cross-sectional areas approximately equal to the AWG conductor sizes listed.

6.1.3 The finished diameter and mass of the coated wires used shall be substantially equal to those of the uncoated wires of the same class.

6.2 *Temper*—Unless otherwise specified, all coated conductors shall be furnished in the annealed temper. Uncoated conductors may be furnished either annealed or unannealed as ordered (see 4.1.6).

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

6.3 *Tensile Strength and Elongation*—The stranded conductor, in its finished form, shall conform to the following:

Finished State	Tensile Strength, min. psi	Tensile Strength, min. MPa	Elongation, min, 10 in. %
~~Unannealed~~	~~40 000~~	~~275~~	~~...~~
~~Annealed~~	~~...~~	~~...~~	~~10~~
Unannealed	40 000	275	...
Annealed	...	...	10

7. Electrical Properties

7.1 *DC Resistance*—The dc resistance in Ω/1000 ft of the bunch-stranded conductor shall not exceed the appropriate values specified in Table 5. The dc resistance in Ω/1000 ft of the rope-lay bunch-stranded conductor shall not exceed the appropriate values specified in Table 6 (Explanatory Note 3 and Note 4).

8. Test Methods

8.1 *Coating*—Tests to determine conformance of the coating to the requirements of Specification B33 or Specification B298 shall be performed on the individual wires before stranding (see 6.1.1 to 6.1.3).

8.2 *Tensile Strength and Elongation:*