



# Standard Specification for Bunch-Stranded Copper Conductors for Electrical Conductors<sup>1</sup>

This standard is issued under the fixed designation B 174; 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.

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

## 1. Scope

1.1 This specification covers bare bunch-stranded conductors made from round copper wires, either uncoated or coated with tin, lead, or lead-alloy for use as electrical conductors (Explanatory Note 1 and Explanatory Note 2).

1.2 Coated wires shall include only those wires with finished diameters and densities substantially equal to the respective diameters and densities of uncoated wires.

1.3 The SI values for density and resistivity are to be regarded as the standard. For all other properties the inch-pound values are to be regarded as the standard and the SI units may be approximate.

## 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:*

B 3 Specification for Soft or Annealed Copper Wire<sup>2</sup>

B 33 Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes<sup>2</sup>

B 172 Specification for Rope-Lay-Stranded Copper Conductors Having Bunch-Stranded Members, for Electrical Conductors<sup>2</sup>

B 189 Specification for Lead-Coated and Lead-Alloy-Coated Soft Copper Wire for Electrical Purposes<sup>2</sup>

B 263 Test Method for Determination of Cross-Sectional Area of Stranded Conductors<sup>2</sup>

B 354 Terminology Relating to Uninsulated Metallic Electrical Conductors<sup>2</sup>

2.3 *American National Standard:*

ANSI C42.35 Definitions of Electrical Terms<sup>3</sup>

## 3. Classification

3.1 For the purpose of this specification bunch-stranded

conductors are classified as shown in Table 1.

## 4. Ordering Information

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

4.1.1 Quantity of each size and class,

4.1.2 Conductor size: circular-mil area or AWG (see 7.1),

4.1.3 Class (Section 3 and Table 2),

4.1.4 Whether coated or uncoated; if coated, designate type of coating (see 11.1),

4.1.5 Maximum length of lay (see 6.3 and Table 3),

4.1.6 Whether separator is required (see 7.2),

4.1.7 Package size (see section 15.1),

4.1.8 Special package marking, if required (Section 14), and

4.1.9 Place of inspection (Section 13).

4.1.10 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 (see S1, S2, and S3).

## 5. Joints

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

5.2 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 so that the flexibility of the completed conductor is not adversely affected.

## 6. Lay

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

6.2 The direction of lay shall be at the option of the manufacturer unless otherwise specified.

6.3 Unless otherwise specified by the purchaser, the length of lay of bare or coated bunch-stranded conductors shall conform to the requirements of Column B of Table 2.

6.4 When specified, for constructions other than those listed in Footnote A of Table 2, the length of lay shall conform to the requirements of Column A of Table 2.

6.5 Conductors of an intermediate nominal area in circular mils shall conform to the requirements for length of lay of the next smaller conductor.

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

Current edition approved July 15, 1995. Published September 1995. Originally published as B 158 – 41 T. Last previous edition B 174 – 90.

<sup>2</sup> *Annual Book of ASTM Standards*, Vol 02.03.

<sup>3</sup> Available from American National Standards Institute, 11 West 42nd St., 13th Floor, New York, NY 10036.

**TABLE 1 Classification and Construction Requirements of Bunch-Stranded Conductors<sup>A</sup>**

Area of Cross Section		Size, AWG	Notes	Classification, Size, and Minimum Number of Wires							
				Class I	Class J	Class K	Class L	Class M	Class O	Class P	Class Q
cmil	mm			Wire Diameter 0.0201 in. (0.511 mm) No. 24 AWG	Wire Diameter 0.0126 in. (0.320 mm) No. 28 AWG	Wire Diameter 0.0100 in. (0.254 mm) No. 30 AWG	Wire Diameter 0.0080 in. (0.203 mm) No. 32 AWG	Wire Diameter 0.0063 in. (0.160 mm) No. 34 AWG	Wire Diameter 0.0050 in. (0.127 mm) No. 36 AWG	Wire Diameter 0.0040 in. (0.102 mm) No. 38 AWG	Wire Diameter 0.0031 in. (0.079 mm) No. 40 AWG
20 820	10.5	7		52	...	...	...	...	...	...	...
16 510	8.37	8		41	...	...	...	...	...	...	...
13 090	6.63	9		33	...	...	...	...	...	...	...
10 380	5.26	10		26	65	104	165	...	...	...	...
6 530	3.31	12		...	41	65	104	...	...	...	...
4 110	2.08	14		...	26	41	65	104	...	...	...
2 580	1.31	16		...	16	26	41	65	104	165	...
1 620	0.821	18		...	10	16	26	41	65	104	165
1 020	0.517	20	B,C	...	7	10 <sup>B</sup>	16	26	41	65	104
640	0.324	22	D	...	...	7	...	19	...	...	...
404	0.205	24	D	...	...	...	7	...	19	...	...
253	0.128	26	D	...	...	...	...	7	...	...	...
159	0.0806	28	D	...	...	...	...	...	...	...	...

<sup>A</sup>The constructions shown in this table are typical of those used in the industry. It is not intended that this table preclude other constructions which may be desirable for specific applications. The constructions shown provide for a finished, non-covered, stranded conductor approximately of the area indicated. When specified by the purchaser, the number or size of wires may be increased to provide additional area to compensate for draw-down during subsequent processing.

<sup>B</sup>As an alternate to the construction shown for No. 20 AWG, Class K; for hook-up wire construction may consist of 8 wires 0.0100 in. (0.254 mm) diameter around 1 wire of 0.0142 in. (0.361 mm) diameter.

<sup>C</sup>No. 20 AWG conductor is restricted in the schedule of requirements by Underwriters' Laboratories, Inc. (UL), to usages such as types FX, FXT, X, and XT, and does not meet UL requirements for fixture wires unless such usage has been approved for specific applications.

<sup>D</sup>The constructions of No. 22 through No. 28 AWG conductors are listed in UL requirements for appliance wire.

**TABLE 2 Maximum Length of Lay for Bunch-Stranded Conductors**

Area of Cross Section		Size, AWG	Maximum Length of Lay					
			Nominal Diameter		Column A		Column B <sup>A</sup>	
cmil	mm		in.	mm	in.	mm	in.	mm
20 820	10.5	7	0.167	4.24	3.00	76.20	3.00	76.20
16 510	8.37	8	0.149	3.78	2.75	69.85	2.75	69.85
13 090	6.63	9	0.133	3.38	2.50	63.50	2.50	63.50
10 380	5.26	10	0.118	3.00	2.50	63.50	2.50	63.50
6 530	3.31	12	0.093	2.36	2.00	50.80	2.00	50.80
4 110	2.08	14	0.074	1.88	2.00	50.80	1.62	41.15
2 580	1.31	16	0.059	1.50	2.00	50.80	1.25	31.75
1 620	0.821	18	0.047	1.19	2.00	50.80	1.00	25.40
1 020	0.517	20	0.037	0.94	2.00	50.80	1.00	25.40
640	0.324	22	0.030	0.76	1.30	33.02 <sup>B</sup>	0.80	20.32 <sup>C</sup>
404	0.205	24	0.024	0.61	1.20	30.48 <sup>B</sup>	0.70	17.78 <sup>C</sup>
253	0.128	26	0.019	0.48	1.00	25.40 <sup>B</sup>	0.60	15.24 <sup>C</sup>
159	0.0806	28	0.015	0.38	1.00	25.40 <sup>B</sup>	0.50	12.70 <sup>C</sup>

<sup>A</sup>The lengths of lay of Column B meet the requirements of the following types of flexible cords and fixture wires as defined by Underwriters' Laboratories, Inc.: Types S, SJ, SO, SJO, SJT, ST, SV, SVT, SF, SFF, SP, SPT, and HPN for sizes 10 AWG through 18 AWG and for Types FX, FXT, X, and XT for size 20 only.

<sup>B</sup>The lengths of lay of sizes 22 AWG through 28 of Column A meet the requirements of appliance wires (insulated using a separator) as defined by Underwriters' Laboratories, Inc.

<sup>C</sup>The lengths of lay of Sizes 22 AWG through 28 AWG of Column B meet the requirements of appliance wires (insulated without a separator) as defined by Underwriters' Laboratories, Inc.

6.6 Underwriters' Laboratories, Inc., requirements state that uncoated conductors which are to be rubber or neoprene insulated, and all conductors having lengths of lay longer than those specified by Column B of Table 2, shall be provided with a separator between the conductor and the insulation.

**7. Construction**

7.1 The area of cross section, and the number and diameter

of wires for a variety of strand constructions in general use are shown in Table 1.

7.2 If a separator is required to be furnished with the conductor, it shall be specified by the purchaser as to requirements for the kind and thickness of material and its application details.

**8. Physical and Electrical Tests**

8.1 Tests for the electrical properties of wires composing conductors made from soft or annealed copper wire, bare or coated, shall be made before stranding.

8.2 Tests for the physical properties of soft or annealed copper wire, bare or coated, may be made upon the wires before stranding or upon wires removed from the completed stranded conductors, but need not be made upon both. Care shall be taken to avoid mechanical injury and stretching when removing wires from the conductor for the purpose of testing.

8.3 The physical properties of wire when tested before stranding shall conform to the applicable requirements of 11.1.

8.4 The physical properties of wires removed from the completed stranded conductor shall be permitted to vary from the applicable requirements of 11.1 by the following amounts (Explanatory Note 3):

8.4.1 *Average of Results Obtained on All Wires Tested*—The percent minimum elongation may be reduced by the value of 5 % from the values required for unstranded wires as specified by Specifications B 3, B 33, or B 189, as applicable. For example, where the unstranded wire specification requires minimum elongation of 30 %, wire of that material removed from Specification B 174 stranded conductor shall meet a minimum elongation value of 25 %, a value 5 % reduction.

8.4.2 *Results Obtained on Individual Wires*—The percent minimum elongation may be reduced by the value of 15 %