



Designation: B496 – 04

Standard Specification for Compact Round Concentric-Lay-Stranded Copper Conductors¹

This standard is issued under the fixed designation B496; 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 compact round concentric-lay-stranded conductors made from uncoated round copper wires for general use for electrical purposes. These conductors shall be constructed with a central core surrounded by one or more layers of helically laid compacted wires (Explanatory **Note 1** and **Note 2**).

1.2 The values stated in inch-pound or SI units are to be regarded separately as standard. The values in each system are not exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

1.2.1 For density, resistivity, and temperature, the values stated in SI units are to be regarded as 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*:²

B3 Specification for Soft or Annealed Copper Wire

B263 Test Method for Determination of Cross-Sectional Area of Stranded Conductors

B354 Terminology Relating to Uninsulated Metallic Electrical Conductors

3. Ordering Information

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

3.1.1 Quantity of each size (**Table 1**),

3.1.2 Conductor size; circular-mil area or AWG, (Section 6 and **Table 1**),

3.1.3 Packaging (Section 14), if required,

3.1.4 Special package marking, and

3.1.5 Place of inspection (Section 16).

4. Joints

4.1 Welds and brazes may be made in rods or in wires prior to final drawing.

4.2 Welds and brazes may be made in the individual round drawn wires for compact conductors, but shall not be closer together than 1 ft (300 mm) for conductor of 19 wires or less or closer than 1 ft (300 mm) in a layer for conductor of more than 19 wires.

4.3 No joint nor splice shall be made in a compact-stranded conductor as a whole.

5. Lay

5.1 The length of lay shall be not less than 8 nor more than 16 times the outside diameter of the completed conductor.

5.2 The direction of lay of the outer layer shall be left-hand, and it shall be reversed in successive layers, unidirectional, or unilay.

6. Construction

6.1 The construction of the compact round concentric-lay-stranded conductors shall be as shown in **Table 1**.

6.2 The starting round copper wires used in the fabrication of the compact round conductor shall be of such diameter as to produce a finished conductor having a nominal cross-sectional area and diameter as prescribed in **Table 1**.

7. Density

7.1 For the purpose of calculating linear densities, cross sections, and so forth, the density of the copper shall be taken as 8.89 g/cm³ (0.32117 lb/in.³) at 20°C.

8. Mass and Resistance

8.1 The mass per unit length and dc electrical resistance of a compact round conductor are greater than the total of these characteristics of the compressed wires composing the finished conductor, depending upon the lay. The standard increment of mass per unit length and electrical resistance shall be taken as

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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 Construction Requirements of Compact Round Concentric-Lay-Stranded Copper Conductors

Conductor Size			Number of Wires	Compact Conductor Diameter		Mass, lb/1000 ft	Mass, kg/km	DC Resistance at 20°C	
cmil	AWG	mm ²		in.	mm			Ω/1000 ft	Ω/km
1 000 000	...	507	61 ^A	1.060	26.9	3086	4590	0.0106	0.0347
900 000	...	456	61 ^A	0.999	25.4	2780	4140	0.0118	0.0386
800 000	...	405	61 ^A	0.938	23.8	2469	3680	0.0132	0.0433
750 000	...	380	61 ^A	0.908	23.0	2316	3450	0.0141	0.0462
700 000	...	355	61 ^A	0.877	22.3	2160	3220	0.0151	0.0495
650 000	...	329	61 ^A	0.845	21.4	2006	2990	0.0163	0.0535
600 000	...	304	61 ^A	0.813	20.6	1850	2760	0.0176	0.0577
550 000	...	279	61 ^A	0.775	19.7	1700	2530	0.0192	0.0630
500 000	...	253	37 ^B	0.736	18.7	1542	2300	0.0212	0.0695
450 000	...	228	37 ^B	0.700	17.8	1390	2070	0.0235	0.0770
400 000	...	203	37 ^B	0.659	16.7	1236	1840	0.0264	0.0865
350 000	...	177	37 ^B	0.616	15.7	1080	1610	0.0302	0.0990
300 000	...	152	37 ^B	0.570	14.5	925	1380	0.0353	0.116
250 000	...	127	37 ^B	0.520	13.2	772	1150	0.0423	0.139
211 600	4/0	107	19 ^C	0.475	12.1	653	972	0.0500	0.164
167 800	3/0	85.0	19 ^C	0.423	10.8	518	771	0.0630	0.206
133 100	2/0	67.4	19 ^C	0.376	9.57	411	611	0.0795	0.261
105 600	1/0	53.5	19 ^C	0.336	8.55	326	485	0.100	0.328
83 690	1	42.4	19 ^C	0.299	7.60	259	385	0.126	0.413
66 360	2	33.6	7	0.268	6.81	205	305	0.159	0.521
41 740	4	21.2	7	0.213	5.41	129	192	0.253	0.830
26 240	6	13.3	7	0.169	4.29	80.9	121	0.403	1.32
16 510	8	8.37	7	0.134	3.40	51.0	75.9	0.641	2.10

^A 58 wires minimum.

^B 35 wires minimum.

^C 18 wires minimum.

2 %. The nominal mass per unit length and dc resistance are shown in **Table 1**. When the dc resistance is measured at other than 20°C, it shall be corrected by using the multiplying factors given in **Table 2**.

8.2 In cases where the lay is definitely known, the increment may be calculated if desired (Explanatory **Note 3**).

8.3 For conductors to be used in covered or insulated wires or cables, direct current (DC) resistance measurement may be used instead of the method outlined in Section 9, to determine compliance with this specification.

9. Variation in Area

9.1 The cross-sectional area of the compact round conductor shall be not less than 98 % of the cross-sectional area as specified in Column 1 of **Table 1**.

TABLE 2 Temperature Correction Factors for Conductor Resistance

Temperature, °C	Multiplying Factor for Conversion to 20°C
0	1.085
5	1.063
10	1.041
15	1.020
20	1.000
25	0.981
30	0.962
35	0.944
40	0.927
45	0.911
50	0.895
55	0.879
60	0.864
65	0.850
70	0.836
75	0.822
80	0.809
85	0.797
90	0.784

9.2 The manufacturer shall determine the cross-sectional area by Test Method **B263**. In applying this method, the increment in mass per unit length resulting from stranding may be the applicable value specified in 9.1 or may be calculated from the measured dimensions of the sample under test. In case of question regarding area compliance, the actual mass per unit length increment due to stranding shall be calculated.

10. Variation in Diameter

10.1 The average diameter of the compact-round conductor shall not vary by more than +1 % and –2 % from the diameter specified in **Table 1**.

11. Finish

11.1 The conductor surface shall be smooth and free of imperfections not consistent with the best commercial practice.

12. Physical and Electrical Tests

12.1 Tests for the physical and electrical properties of wires composing the conductors shall be made before stranding in accordance with Specification **B3** (Explanatory **Note 4** and **Note 5**).

13. Requirements for Wires

13.1 Before stranding and compacting the copper wire shall meet all of the requirements of Specification **B3**.

13.2 Wire shaped before stranding shall meet the requirements of Specification **B3**, except for diameter tolerance. The elongation requirement shall be the same as round wires of equal nominal area. The area tolerance for shaped wires shall be such that the finished conductor conforms to Section 10 of this specification.

14. Inspection

14.1 All tests and inspection shall be made at the place of manufacture unless otherwise especially agreed upon between