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# Standard Specification for Compact Round Modified Concentric-Lay-Stranded Copper Conductors for Use in Insulated Electrical Cables<sup>1</sup>

This standard is issued under the fixed designation B 785; 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.

## 1. Scope

1.1 This specification covers bare compact round modified concentric-lay-stranded conductors made from uncoated round copper wires for use in insulated electrical cables. These conductors shall be constructed with a central core consisting of not more than seven wires, surrounded by one or more layers of helically laid compacted wires (Explanatory Note 1).

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

NOTE 1—The significant differences in this specification from Specification B 496 are as follows: (1) the central core is permitted to contain up to seven wires drawn into the assembly with an infinite length of lay while Specification B 8 permits only one, and (2) the construction is only applicable to stranded assemblies of 19 or more wires.

## 2. Referenced Documents

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

### 2.1.1 ASTM Standards:

- B 3 Specification for Soft or Annealed Copper Wire<sup>2</sup>
- B 8 Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft<sup>2</sup>
- B 263 Test Method for Determination of Cross-Sectional Area of Stranded Conductors<sup>2</sup>
- B 354 Definitions of Terms Relating to Uninsulated Metallic Electrical Conductors<sup>2</sup>
- B 496 Specification for Compact Round Concentric-Lay-Stranded Copper Conductors<sup>2</sup>

### 2.1.2 Other Standard:

NBS Handbook 100<sup>3</sup>

## 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 American Wire Gage, AWG, (Section 7 and Table 1),

- 3.1.3 Packaging (Section 16),
- 3.1.4 Special package marking (Section 15),
- 3.1.5 Place of inspection (Section 14), and
- 3.1.6 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 (S1, S2, and S3), (Explanatory Note 2).

## 4. Requirements for Wires

4.1 Before stranding and compacting the copper wire shall meet all of the requirements of Specification B 3.

4.2 Wire shaped before stranding shall meet the requirements of Specification B 3, 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 11.

## 5. Joints

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

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

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

## 6. Lay

6.1 Except for the central core, the length of lay shall be not less than eight nor more than sixteen times the outside diameter of the completed conductor.

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

## 7. Construction

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

7.2 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.

## 8. Physical and Electrical Tests

8.1 Tests for the physical and electrical properties of wires composing the conductors shall be made before stranding in

<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.

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

<sup>3</sup> Available from the National Institute of Standards and Technology (NIST), Gaithersburg, MD 20899.



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TABLE 1 Construction Requirements of Compact Round Modified Concentric Lay Stranded Copper Conductors

Conductor Size			Number of Wires	Modified Compact Conductor Diameter		Mass		d-c Resistance at 20°C	
cmil	AWG	mm <sup>2</sup>		in.	mm	lb/1000 ft	kg/km	Ω/1000 ft	Ω/km
1 000 000		507	61 <sup>A</sup>	1.060	26.9	3086	4590	0.0106	0.0347
900 000		456	61 <sup>A</sup>	0.999	25.4	2780	4140	0.0118	0.0386
800 000		405	61 <sup>A</sup>	0.938	23.8	2469	3680	0.0132	0.0433
750 000		380	61 <sup>A</sup>	0.908	23.0	2316	3450	0.0141	0.0462
700 000		355	61 <sup>A</sup>	0.877	22.3	2160	3220	0.0151	0.0495
650 000		329	61 <sup>A</sup>	0.845	21.4	2006	2990	0.0163	0.0535
600 000		304	61 <sup>A</sup>	0.813	20.6	1850	2760	0.0176	0.0577
550 000		279	61 <sup>A</sup>	0.775	19.7	1700	2530	0.0192	0.0630
500 000		253	37 <sup>B</sup>	0.736	18.7	1542	2300	0.0212	0.0695
450 000		228	37 <sup>B</sup>	0.700	17.8	1390	2070	0.0235	0.0770
400 000		203	37 <sup>B</sup>	0.659	16.7	1236	1840	0.0264	0.0865
350 000		177	37 <sup>B</sup>	0.616	15.7	1080	1610	0.0302	0.0990
300 000		152	37 <sup>B</sup>	0.570	14.5	925	1380	0.0353	0.1160
250 000		127	37 <sup>B</sup>	0.520	13.2	772	1150	0.0423	0.1390
211 600	4/0	107	19 <sup>C</sup>	0.475	12.1	653	972	0.0500	0.1640
167 800	3/0	85.0	19 <sup>C</sup>	0.423	10.8	518	771	0.0630	0.2060
133 100	2/0	67.4	19 <sup>C</sup>	0.376	9.57	411	611	0.0795	0.2610
105 600	1/0	53.5	19 <sup>C</sup>	0.336	8.55	326	485	0.1000	0.3280
83 690	1	42.4	19 <sup>C</sup>	0.299	7.60	259	385	0.1260	0.4130

<sup>A</sup> 58 wires minimum<sup>B</sup> 35 wires minimum<sup>C</sup> 18 wires minimum

accordance with Section 4 (Explanatory Notes 3 and 4).

## 9. Density

9.1 For the purpose of calculating mass, cross sections, etc., the density of the copper shall be taken as 8.89 g/cm<sup>3</sup> (0.32117 lb/in.<sup>3</sup>) at 20°C.

NOTE 2—The term mass is used in this specification as being more technically correct. It replaces the term weight.

## 10. Mass and Resistance

10.1 The mass 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 and electrical resistance shall be taken as 2 %. The nominal masses and dc resistances 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.

10.2 In cases where the lay is definitely known, the increment may be calculated if desired (Explanatory Note 5).

## 11. Variation in Area

11.1 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.

11.2 The manufacturer shall determine the cross-sectional area by Test Method B 263. In applying this method, the increment in mass resulting from stranding may be the applicable value specified in 10.1 or may be calculated from the measured dimensions of the sample under test. In case of question regarding area compliance, the actual mass increment due to stranding shall be calculated.

## 12. Variation in Diameter

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

TABLE 2 Temperature Correction Factors for Conductor Resistance

Temperature, °C	Multiplying Factor for Reduction 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

## 13. Workmanship, Finish, and Appearance

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

## 14. Inspection

14.1 Unless otherwise specified in the contract or purchase order, the manufacturer shall be responsible for the performance of all inspections and test requirements specified.

14.2 All inspections and tests shall be made at the place of manufacturer unless otherwise especially agreed upon between the manufacturer and the purchaser at the time of the purchase.

14.3 The manufacturer shall afford the inspector representing the purchaser all reasonable manufacturer's facilities to satisfy him that the material is being furnished in