



Standard Specification for Cored, Annular, Concentric-Lay-Stranded Copper Conductors¹

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1. Scope

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

1.2 The constructions prescribed herein are suitable for bare conductors, or for conductors to be covered with weather-resistant (weather-proof) material, or for conductors to be insulated with rubber, varnished cloth, or impregnated paper, except types such as “oil-filled” or “gas-filled” (Explanatory Note 3).

1.3 Cored, annular conductor constructions not included in this specification shall be specifically agreed upon between the manufacturer and the purchaser when placing the order.

1.4 These constructions are not recommended for use as electric furnace leads where great flexibility is required and special conductor designs are indicated in consideration of the particular service requirements.

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

2. Referenced Documents

The following documents of the issue in effect at the time of reference form a part of these methods to the extent referenced herein:

2.1 ASTM Standards:

- B 3 Specification for Soft or Annealed Copper Wire²
- B 8 Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft²
- B 33 Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes²
- B 172 Specification for Rope-Lay-Stranded Copper Conductors Having Bunch-Stranded Members, for Electrical Conductors²
- B 173 Specification for Rope-Lay-Stranded Copper Conductors Having Concentric-Stranded Members, for Electrical Conductors²

¹ 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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² *Annual Book of ASTM Standards*, Vol 02.03.

B 174 Specification for Bunch-Stranded Copper Conductors for Electrical Conductors²

B 189 Specification for Lead-Coated and Lead-Alloy-Coated Soft Copper Wire for Electrical Purposes²

B 263 Test Method for Determination of Cross-Sectional Area of Stranded Conductors²

B 354 Terminology Relating to Uninsulated Metallic Electrical Conductors²

2.2 *American National Standard:*

ANSI C42.35 Definitions of Electrical Terms³

2.3 *NIST:*

*NBS Handbook 100—Copper Wire Tables*⁴

3. Ordering Information

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

3.1.1 Quantity of each size,

3.1.2 Conductor size: circular-mil area (Section 7 and Table 1),

3.1.3 Whether coated or uncoated; if coated, designate type of coating (Section 11),

3.1.4 Specific kind and treatment of core material (Section 4),

3.1.5 Details of special-purpose lays, if required (see 6.1 and 6.2 and Explanatory Note 3),

3.1.6 Package size (Section 14),

3.1.7 Lagging, if required (see 14.2),

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

3.1.9 Place of inspection (Section 13).

4. Core

4.1 The core may be of any material or materials suitable for the purpose as agreed upon by the manufacturer and the purchaser when placing the order.

4.2 The size of the core and its surface firmness as a base for the overlaid wires shall be adequate to prevent the forcing or dropping of any wire out of its layer position (Explanatory Note 4).

4.3 If a specific kind of fibrous core is required by the purchaser (such as manila rope, sisal, asbestos, or the like) it

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

⁴ *NBS Handbook 100* is for sale from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.



B 226

TABLE 1 Construction of Cored, Annular, Concentric-Lay-Stranded Copper Conductors

Nominal Area of Copper Cross Section, cmils	Approximate Diameter of Core, in.	Diameter of Wires, in.	Number of Strands in Layers				Calculated Area of Copper, Cross Section, cmils	Maximum Outside Diameter, ^A in.
			1st	2nd	3rd	Total		
5 000 000	2.875	0.1620	57	63	69	189	4 960 116	3.897
4 500 000	2.500	0.1620	50	56	62	168	4 408 992	3.517
4 000 000	2.250	0.1620	45	51	57	153	4 015 332	3.262
3 500 000	2.000	0.1620	40	45	52	137	3 595 428	3.007
3 000 000	1.625	0.1620	33	38	45	116	3 044 304	2.627
2 500 000	1.500	0.1440	34	40	46	120	2 488 320	2.394
2 000 000	1.313	0.1284	34	40	46	120	1 978 387	2.114
1 750 000	1.125	0.1280	30	35	42	107	1 753 088	1.923
1 500 000	1.000	0.1255	26	32	38	96	1 512 024	1.783
1 250 000	0.750	0.1255	21	26	33	80	1 260 020	1.533
1 000 000	0.563	0.1255	16	21	28	65	1 023 766	1.346
900 000	0.500	0.1172	16	22	28	66	906 565	1.234
800 000	0.468	0.1110	16	21	28	65	800 865	1.164
750 000	0.375	0.1172	12	18	24	54	741 735	1.108

^A The following plus tolerances are included in the calculation of maximum outside diameters:

Nominal Area, cmils	Plus Tolerance Included, mils
5 000 000 to 4 500 001	50
4 500 000 to 4 000 001	45
4 000 000 to 3 500 001	40
3 500 000 to 3 000 001	35
3 000 000 to 750 000	30

shall be specified by him when placing the order (Explanatory Note 4).

4.4 The proper treatment of the fibrous core, if any treatment be required, shall be left to the discretion of the manufacturer unless other arrangements are made at the time of purchase.

4.5 If a metal supporting type of core is required, special arrangements will be necessary between the manufacturer and the purchaser.

5. Joints

5.1 No splice shall be made in the conductor as a whole. Welds or brazes may be made in the finished individual wires. Not more than one of the wires in any given layer shall be spliced in any 1-ft length of that layer.

5.2 All joints shall be made in a workmanlike manner and shall be approximately the diameter of the unjointed wire.

6. Lay

6.1 The length of lay of the respective layers of wires shall be at the option of the manufacturer unless otherwise agreed upon with the purchaser (Explanatory Note 3).

6.2 The direction of lay of the outer layer of wires shall be left hand, unless specified otherwise by the purchaser (Explanatory Note 3).

6.3 The direction of lay shall be reversed in successive layers (Explanatory Note 3).

7. Construction

7.1 The nominal conductor size, number of layers of wires, number, diameter, and lay-up of wires, approximate core diameter and maximum conductor diameter shall conform to the requirements prescribed in Table 1 (Explanatory Note 4).

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 conductor, but need not be made upon both. Care shall be taken to avoid mechanical injury to wire removed 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 11.2.

8.4 The physical properties of wires removed from the completed stranded conductor shall be permitted to vary from the applicable requirements of 11.2 by the following amounts (Explanatory Note 5):

8.4.1 *Average of Results Obtained on All Wires Tested*—The minimum elongation required shall be reduced in numerical value 5 (for example, from 30 to 25 %) from the numerical requirements for the wire before stranding.

8.4.2 *Results Obtained on Individual Wires*—The elongation of individual wires shall be reduced in numerical value 15 from the minimum requirements before stranding (that is, 10 in addition to the 5 allowed in 8.4.1) but in no case shall the elongation of any individual wire be less than 5 %.

8.5 In the event that the requirements prescribed in 8.4.2 are met but those prescribed in 8.4.1 are not met, a retest shall be permitted wherein all wires of the conductor shall be tested for the purpose of final determination of conformance to 8.4.

8.6 Elongation tests to determine compliance shall not be made on the conductor as a unit.

8.7 If a tinning, lead coating, or lead alloy-coating test is