



Standard Specification for Standard Nominal Diameters and Cross-Sectional Areas of AWG Sizes of Solid Round Wires Used as Electrical Conductors¹

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1. Scope

1.1 This specification prescribes standard nominal diameters and cross-sectional areas of American Wire Gage (AWG) sizes of solid round wires, used as electrical conductors, and gives equations and rules for the calculation of standard nominal mass and lengths, resistances, and breaking strengths of such wires (Explanatory Note 1).

1.2 The SI values for density 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.

2. Referenced Documents

2.1 ASTM Standards:

- A 111 Specification for Zinc-Coated (Galvanized) "Iron" Telephone and Telegraph Line Wire²
- A 326 Specification for Zinc-Coated (Galvanized) High Tensile Steel Telephone and Telegraph Line Wire²
- B 1 Specification for Hard-Drawn Copper Wire³
- B 2 Specification for Medium-Hard-Drawn Copper Wire³
- B 3 Specification for Soft or Annealed Copper Wire³
- B 9 Specification for Bronze Trolley Wire³
- B 33 Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes³
- B 47 Specification for Copper Trolley Wire³
- B 105 Specification for Hard-Drawn Copper Alloy Wires for Electrical Conductors³
- B 189 Specification for Lead-Coated and Lead-Alloy-Coated Soft Copper Wire for Electrical Purposes³
- B 227 Specification for Hard-Drawn Copper-Clad Steel Wire³
- B 230 Specification for Aluminum 1350-H19 Wire for Electrical Purposes³
- B 314 Specification for Aluminum 1350 Wire for Communication Cable³
- B 396 Specification for Aluminum-Alloy 5005-H19 Wire for Electrical Purposes³

¹ This specification is under the jurisdiction of ASTM Committee B-1 on Electrical Conductors and is the direct responsibility of Subcommittee B01.02 on Methods of Test and Sampling Methods.

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² *Annual Book of ASTM Standards*, Vol 01.06.

³ *Annual Book of ASTM Standards*, Vol 02.03.

B 398 Specification for Aluminum-Alloy 6201-T81 Wire for Electrical Purposes³

B 415 Specification for Hard-Drawn Aluminum-Clad Steel Wire³

B 609 Specification for Aluminum 1350 Round Wire, Annealed and Intermediate Tempers, for Electrical Purposes³

B 800 Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes—Annealed and Intermediate Tempers³

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications⁴

F 205 Test Method for Measuring Diameter of Fine Wire by Weighing⁵

3. Standard Reference Temperature

3.1 For the purpose of this specification, all wire dimensions and properties shall be considered as occurring at the internationally standardized reference temperature of 20°C (68°F).

4. Standard Rules for Rounding

4.1 All calculations for the standard nominal dimensions and properties of solid round wires shall be rounded in the *final* value only, in accordance with rounding method of Practice E 29.

5. Standard Nominal Diameters

5.1 Standard nominal diameters of AWG sizes of solid round wires shall be calculated in accordance with the conventional mathematical law of the American Wire Gage (see Explanatory Note 1) and in accordance with Section 4.

5.2 For wire sizes 4/0 to 44 AWG, inclusive, nominal diameters shall be expressed in no more than four significant figures but in no case closer than the nearest 0.1 mil (0.0001 in.).

5.3 For wire sizes 45 to 56 AWG, inclusive, nominal diameters shall be expressed to the nearest 0.01 mil (0.00001 in.).

5.4 The standard nominal diameters expressed in mils have been calculated in accordance with these rules and are given in Table 1 for convenient reference (Explanatory Note 2).

⁴ *Annual Book of ASTM Standards*, Vol 14.02.

⁵ *Annual Book of ASTM Standards*, Vol 10.04.

TABLE 1 Standard Nominal Diameters and Cross-Sectional Areas of AWG Sizes of Solid Round Wires at 20°C

Size, AWG	Diameter, mils	Cross-Sectional Area		Size, AWG	Diameter, mils	Cross-Sectional Area	
		cmils	in. ²			cmils	in. ²
4/0	460.0	211 600	0.1662	29	11.3	128	0.000100
3/0	409.6	167 800	0.1318	30	10.0	100	0.0000785
2/0	364.8	133 100	0.1045	31	8.9	79.2	0.0000622
1/0	324.9	105 600	0.08291	32	8.0	64.0	0.0000503
1	289.3	83 690	0.06573	33	7.1	50.4	0.0000396
2	257.6	66 360	0.05212	34	6.3	39.7	0.0000312
3	229.4	52 620	0.04133	35	5.6	31.4	0.0000246
4	204.3	41 740	0.03278	36	5.0	25.0	0.0000196
5	181.9	33 090	0.02599	37	4.5	20.2	0.0000159
6	162.0	26 240	0.02061	38	4.0	16.0	0.0000126
7	144.3	20 820	0.01635	39	3.5	12.2	0.00000962
8	128.5	16 510	0.01297	40	3.1	9.61	0.00000755
9	114.4	13 090	0.01028	41	2.8	7.84	0.00000616
10	101.9	10 380	0.008155	42	2.5	6.25	0.00000491
11	90.7	8 230	0.00646	43	2.2	4.84	0.00000380
12	80.8	6 530	0.00513	44	2.0	4.00	0.00000314
13	72.0	5 180	0.00407	45	1.76	3.10	0.00000243
14	64.1	4 110	0.00323	46	1.57	2.46	0.00000194
15	57.1	3 260	0.00256	47	1.40	1.96	0.00000154
16	50.8	2 580	0.00203	48	1.24	1.54	0.00000121
17	45.3	2 050	0.00161	49	1.11	1.23	0.000000968
18	40.3	1 620	0.00128	50	0.99	0.980	0.000000770
19	35.9	1 290	0.00101	51	0.88	0.774	0.000000608
20	32.0	1 020	0.000804	52	0.78	0.608	0.000000478
21	28.5	812	0.000638	53	0.70	0.490	0.000000385
22	25.3	640	0.000503	54	0.62	0.384	0.000000302
23	22.6	511	0.000401	55	0.55	0.302	0.000000238
24	20.1	404	0.000317	56	0.49	0.240	0.000000189
25	17.9	320	0.000252				
26	15.9	253	0.000199				
27	14.2	202	0.000158				
28	12.6	159	0.000125				

6. Standard Nominal Cross-Sectional Areas

6.1 Standard nominal cross-sectional areas in circular mils and square inches shall be calculated in accordance with the following equations and shall be rounded in accordance with Section 4 to the same number of significant figures as used in expressing the standard diameters, but in no case to less than three significant figures:

$$\text{Area, cmil} = d^2$$

$$\text{Area, in.}^2 = d^2 \times 0.7854 \times 10^{-6}$$

where:

d = diameter of the wire in mils as given in Table 1.

Standard nominal cross-sectional areas in circular mils and square inches have been calculated in accordance with the foregoing rules and are given in Table 1 for convenient reference.

7. Rules for Calculations Involving Mass and Length

7.1 Standard nominal mass and lengths shall be calculated from the standard wire diameters specified in Table 1, in accordance with the following equations. They shall be rounded in the *final* value only, in accordance with Section 4, to the same number of significant figures as used in expressing the standard diameters, but in no case to less than three significant figures:

ASTM B258-96

$$W = d^2 \times \delta \times 0.34049 \times 10^{-3}$$

$$L = (1/d^2) \times (1/\delta) \times 2.9369 \times 10^6$$

where:

W = mass, lb/1000 ft,

d = diameter of the wire in mils as given in Table 1,

δ = density of the wire material at 20°C in g/cm³ as given in Table 2, and

L = length, ft/lb.

8. Rules for Calculations Involving Resistivity

8.1 Standard nominal resistances and other values derived from the resistivity units shall be calculated from the standard wire diameters specified in Table 1 in accordance with the following equations. All values so derived shall be rounded in the *final* value only, in accordance with Section 4, to the same number of significant figures as used in expressing the standard diameters, but in no case to less than three significant figures:

$$\text{D-c resistance at 20°C, } \Omega/1000 \text{ ft} = [\rho/(d^2 \times \delta)] \times 105.35$$

$$\text{D-c resistance at 20°C, } \Omega/\text{lb} = [\rho/(\delta^2 \times d^4)] \times 0.30940 \times 10^{-6}$$

$$\text{Length at 20°C, ft}/\Omega = [(d^2 \times \delta)/\rho] \times 9.4924$$

$$\text{Mass at 20°C, lb}/\Omega = [(\delta^2 \times d^4)/\rho] \times 3.2321 \times 10^{-6}$$