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Standard Specification for Standard Nominal Diameters and Cross-Sectional Areas of AWG Sizes of Solid Round Wires Used as Electrical Conductors[1]

This standard is issued under the fixed designation B258; 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.

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

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 values stated in inch-pound or SI units are to be regarded separately as standard. Each system shall be used independently of the other. Combining values of the two systems may result in nonconformance with the specification. For conductor sizes designated by AWG or kcmil sizes, the requirements in SI units have been numerically converted from the corresponding values stated or derived, in inch-pound units. For conductor sizes designated by SI units only, the requirements are stated or derived in SI units.

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 *ASTM Standards:*[2]

A111 Specification for Zinc-Coated (Galvanized) "Iron" Telephone and Telegraph Line Wire
A326 Specification for Zinc-Coated (Galvanized) High Tensile Steel Telephone and Telegraph Line Wire (Withdrawn 1990)[3]
B1 Specification for Hard-Drawn Copper Wire
B2 Specification for Medium-Hard-Drawn Copper Wire
B3 Specification for Soft or Annealed Copper Wire
B9 Specification for Bronze Trolley Wire
B33 Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes
B47 Specification for Copper Trolley Wire
B105 Specification for Hard-Drawn Copper Alloy Wires for Electric Conductors
B189 Specification for Lead-Coated and Lead-Alloy-Coated Soft Copper Wire for Electrical Purposes
B193 Test Method for Resistivity of Electrical Conductor Materials
B227 Specification for Hard-Drawn Copper-Clad Steel Wire
B230/B230M Specification for Aluminum 1350–H19 Wire for Electrical Purposes
B314 Specification for Aluminum 1350 Wire for Communication Cable (Withdrawn 1994)[3]
B396 Specification for Aluminum-Alloy 5005-H19 Wire for Electrical Purposes (Withdrawn 2003)[3]
B398/B398M Specification for Aluminum-Alloy 6201-T81 and 6201-T83 Wire for Electrical Purposes
B415 Specification for Hard-Drawn Aluminum-Clad Steel Wire
B609/B609M Specification for Aluminum 1350 Round Wire, Annealed and Intermediate Tempers, for Electrical Purposes
B800 Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes—Annealed and Intermediate Tempers
E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

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

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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.

[3] The last approved version of this historical standard is referenced on www.astm.org.

F205 Test Method for Measuring Diameter of Fine Wire by Weighing

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 E29.

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).

6. Standard Nominal Cross-Sectional Areas

6.1 Standard nominal cross-sectional areas in circular mils and square millimetres 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:

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

$$\text{Area, mm}^2 = d^2 \times 5.067 \times 10^{-4}$$

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

Size	Diameter		Cross-Sectional Area		Size	Diameter		Cross-Sectional Area	
AWG	mils	mm	cmils	mm^2	AWG	mils	mm	cmils	mm^2
4/0	460.0	11.684	211 600	107.2	29	11.3	0.287	128	0.0647
3/0	409.6	10.404	167 800	85.0	30	10.0	0.254	100	0.0507
2/0	364.8	9.26	133 100	67.4	31	8.9	0.226	79.2	0.0401
1/0	324.9	8.25	105 600	53.5	32	8.0	0.203	64.0	0.0324
1	289.3	7.35	83 690	42.4	33	7.1	0.180	50.4	0.0255
2	257.6	6.54	66 360	33.6	34	6.3	0.160	39.7	0.0201
3	229.4	5.82	52 620	26.7	35	5.6	0.142	31.4	0.0159
4	204.3	5.19	41 740	21.1	36	5.0	0.127	25.0	0.0127
5	181.9	4.62	33 090	16.8	37	4.5	0.114	20.2	0.0103
6	162.0	4.11	26 240	13.3	38	4.0	0.102	16.0	0.00811
7	144.3	3.67	20 820	10.6	39	3.5	0.0890	12.2	0.00621
8	128.5	3.26	16 510	8.37	40	3.1	0.0787	9.61	0.00487
9	114.4	2.91	13 090	6.63	41	2.8	0.0711	7.84	0.00397
10	101.9	2.59	10 380	5.26	42	2.5	0.0635	6.25	0.00317
11	90.7	2.30	8 230	4.17	43	2.2	0.0559	4.84	0.00245
12	80.8	2.05	6 530	3.31	44	2.0	0.0508	4.00	0.00203
13	72.0	1.83	5 180	2.63	45	1.76	0.0447	3.10	0.00157
14	64.1	1.63	4 110	2.08	46	1.57	0.0399	2.46	0.00125
15	57.1	1.45	3 260	1.65	47	1.40	0.0356	1.96	0.000993
16	50.8	1.29	2 580	1.31	48	1.24	0.0315	1.54	0.000779
17	45.3	1.15	2 050	1.04	49	1.11	0.0282	1.23	0.000624
18	40.3	1.02	1 620	0.823	50	0.99	0.0252	0.980	0.000497
19	35.9	0.904	1 290	0.653	51	0.88	0.0224	0.774	0.000392
20	32.0	0.813	1 020	0.519	52	0.78	0.0198	0.608	0.000308
21	28.5	0.724	812	0.412	53	0.70	0.0178	0.490	0.000248
22	25.3	0.643	640	0.324	54	0.62	0.0158	0.384	0.000195
23	22.6	0.574	511	0.259	55	0.55	0.0140	0.302	0.000153
24	20.1	0.511	404	0.205	56	0.49	0.0125	0.240	0.000122
25	17.9	0.455	320	0.162					
26	15.9	0.404	253	0.128					
27	14.2	0.361	202	0.102					
28	12.6	0.320	159	0.0804					

TABLE 2 Density and Resistivity of Electrical Conductor Materials

Material	Density, δ, at 20°C, g/cm³	Resistivity[A], ρ, at 20°C, Ω· lb/mile²
Copper (Specifications B1, B2, B3, B33, B47 and B189), Volume Conductivity, % IACS:		
100	8.89	875.20
97.66	8.89	896.15
97.16	8.89	900.77
96.66	8.89	905.44
96.16	8.89	910.15
94.16	8.89	929.52
93.15	8.89	939.51
Bronze (Specification B9):		
Class A	8.89	2188
Class B	8.89	1346
Class C	8.89	1094
Copper Alloys (Specification B105[B]):		
Grade 8.5	8.78	10 169
Grade 13	8.78	6649
Grade 15	8.54	5605
Grade 20	8.89	4376
Grade 30	8.89	2917
Grade 40	8.89	2188
Grade 55	8.89	1591
Grade 65	8.89	1346
Grade 74	8.89	1183
Grade 80	8.89	1094
Grade 85	8.89	1030
Aluminum, 1350 (Specifications B230/B230M, B314, and B609/B609M), Volume Conductivity, % IACS:		
61.8	2.705	430.91
61.2	2.705	435.13
61.0	2.705	436.56
Aluminum Alloys (Specifications B396 and B398/B398M)		
Alloy 5005–H19	2.70	496.84
Alloy 6201–T81	2.69	504.43
Aluminum Alloy 8000 Series (Specification B800) Volume Conductivity, % IACS:		
61.0	2.71	437.36
Aluminum-Clad Steel (Specification B415)	6.59	3191
Copper-Clad Steel (Specification B227):		
Grade 30 HS	8.15	2728
Grade 30 EHS	8.15	2728
Grade 40	8.15	2045
Grade 40 EHS	8.15	2045
Galvanized Steel (Telephone and Telegraph) (Specification A111):		
Class A Coating:		
Grade EBB (Non-Copper Bearing)	7.78	5000
Grade BB (Copper Bearing)	7.78	5800
Grade BB (Non-Copper Bearing)	7.78	5600
Class B Coating:		
Grade EBB (Non-Copper Bearing)	7.78	4900
Grade BB (Copper Bearing)	7.78	5600
Grade BB (Non-Copper Bearing)	7.78	5450
Class C Coating:		
Grade EBB (Non-Copper Bearing)	7.78	4800
Grade BB (Copper Bearing)	7.78	5400
Grade BB (Non-Copper Bearing)	7.78	5300
Galvanized Steel (Telephone and Telegraph) (Specification A326):		
Class A Coating:		
Grade 85	7.83	5800
Class B Coating:		
Grade 135	7.83	6500
Grade 85	7.80	5600
Grade 135	7.80	6300
Class C Coating:		
Grade 85	7.77	5400
Grade 135	7.77	6100

[A] To convert from Ω·lb/mile² to Ω·g/m² ~~multiply~~divide by 5710.0. See Table 1 in Test Method B193.
[B] Various compositions are permitted for some of the grades in Specification B105 and the density value may not apply to all materials supplied to this specification. In case of doubt, the density value should be determined or obtained from the manufacturer.

where:

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

~~where:~~

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

Standard nominal cross-sectional areas in circular mils and square millimetres 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:

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

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