American wire gauge

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American wire gauge (**AWG**), also known as the **Brown & Sharpe wire gauge**, is a standardized wire gauge system used in the United States and other countries, especially for nonferrous, electrically conducting wire. The steel industry uses a different numbering system for their wire thickness gauges (for example, W&M Wire Gauge or US Steel Wire Gauge or the different Music Wire Gauge) so data below does not apply to steel wire.

Increasing gauge numbers give decreasing wire diameters, which is similar to many other non-metric gauging systems. This seemingly-counterintuitive numbering is derived from the fact that the gauge number is related to the number of drawing operations that must be used to produce a given gauge of wire; very fine wire (for example, 30 gauge) requires far more passes through the drawing dies than does 0 gauge wire.

Note that for gauges 5 through about 14, the wire gauge is effectively the number of bare solid wires that, when placed side by side, span 1 inch. That is, 8 gauge is about 1/8 inches in diameter.

In the same fashion, AWG is also commonly used to specify body piercing jewelry sizes, especially smaller sizes.[1]

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Formula

By definition, No. 36 AWG is 0.005 inches diameter, and No. 0000 is 0.46 inches diameter. The ratio of these sizes is 92, and between them are 38 sizes, with equal ratios between each adjacent pair of sizes. (The 40 different sizes result in 39 size changes.) (Sizes with multiple zeros are successively larger than No. 0 and can be denoted using "*number of zeros*/0", for example 4/0 for 0000.) Therefore, the diameter of a No. *n* AWG wire is

$$d_n = 0.005 \text{ inch} \times 92^{\frac{36-n}{39}}$$

and its cross-section area is

$$A_n = \frac{\pi}{4} d_n^2 = 0.000019635 \text{ inch}^2 \times 92^{\frac{36-n}{19.5}}.$$

For an *m*/0 AWG wire, use $n = -(m-1)$ in the above formulas. For instance, for No. 0000 or 4/0, use n = −3.

The ratio between successive sizes is the 39th root of 92, or approximately 1.1229322.[2]

The sixth power of this ratio is very close to 2, which means for an increase in six gauge numbers, the wire diameter is changed by a ratio of 2 (No. 10 is about one-half the diameter of No. 4 AWG). A decrease of three gauge numbers doubles the area of a wire. A decrease of ten gauge numbers, for example from No. 10 to 1/0, multiplies the area and weight by approximately 10 and reduces the resistance by approximately 10.

Table of AWGs and approximate corresponding sizes

The table below shows various data including both the resistance of the various wire gauges and the allowable current (ampacity) based on plastic insulation. The diameter information in the table applies to *solid* wires. Stranded wires are calculated by calculating the equivalent cross sectional copper area. The table below assumes DC, or AC frequencies equal to or less than 60 Hz, and **does not** take skin effect into account. Turns of wire is on a best-case scenario when winding tightly packed coils.

AWG	Diameter		Turns of wire		Area		Copper resistance	Copper resistance[3]	Copper wire current rating with 60 °C raceway	Approximate stranded metric equivalents
	(inch)	(mm)	(per inch)	(per cm)	(kcmil)	(mm²)	(Ω/1 km)	(Ω/1000 ft)	(A)	
0000 (4/0)	0.460	11.7	2.17	0.856	212	107	0.16*	0.049*	195	
000 (3/0)	0.410	10.4	2.44	0.961	168	85.0	0.2*	0.062*	165	
00 (2/0)	0.365	9.27	2.74	1.08	133	67.4	0.25*	0.077*	145	
0 (1/0)	0.325	8.25	3.08	1.21	106	53.5	~0.3281	~0.1	125	
1	0.289	7.35	3.46	1.36	83.7	42.4	0.4*	0.12*	110	
2	0.258	6.54	3.88	1.53	66.4	33.6	0.5*	0.15*	95	
3	0.229	5.83	4.36	1.72	52.6	26.7			85	196/0.4
4	0.204	5.19	4.89	1.93	41.7	21.2	0.8*	0.24*	70	
5	0.182	4.62	5.50	2.16	33.1	16.8				126/0.4

6	0.162	4.12	6.17	2.43	26.3	13.3	1.5*	0.47*	55	
7	0.144	3.66	6.93	2.73	20.8	10.5				80/0.4
8	0.128	3.26	7.78	3.06	16.5	8.37	2.2*	0.67*	40	
9	0.114	2.91	8.74	3.44	13.1	6.63				>84/0.3
10	0.102	2.59	9.81	3.86	10.4	5.26	3.2772	0.9989	30	<84/0.3
11	0.0907	2.30	11.0	4.34	8.23	4.17	4.1339	1.26		56/0.3
12	0.0808	2.05	12.4	4.87	6.53	3.31	5.21	1.588	20	
13	0.0720	1.83	13.9	5.47	5.18	2.62	6.572	2.003		50/0.25
14	0.0641	1.63	15.6	6.14	4.11	2.08	8.284	2.525	15	
15	0.0571	1.45	17.5	6.90	3.26	1.65	10.45	3.184		>30/0.25
16	0.0508	1.29	19.7	7.75	2.58	1.31	13.18	4.016	10	<30/0.25
17	0.0453	1.15	22.1	8.70	2.05	1.04	16.614	5.064		32/0.2
18	0.0403	1.02	24.8	9.77	1.62	0.823	20.948	6.385		>24/0.2
19	0.0359	0.912	27.9	11.0	1.29	0.653	26.414	8.051		<24/0.2
20	0.0320	0.812	31.3	12.3	1.02	0.518	33.301	10.15		16/0.2
21	0.0285	0.723	35.1	13.8	0.810	0.410	41.995	12.8		
22	0.0253	0.644	39.5	15.5	0.642	0.326	52.953	16.14		7/0.25
23	0.0226	0.573	44.3	17.4	0.509	0.258	66.798	20.36		
24	0.0201	0.511	49.7	19.6	0.404	0.205	84.219	25.67		1/0.5, 7/0.2, 30/0.1
25	0.0179	0.455	55.9	22.0	0.320	0.162	106.201	32.37		
26	0.0159	0.405	62.7	24.7	0.254	0.129	133.891	40.81		7/0.15
27	0.0142	0.361	70.4	27.7	0.202	0.102	168.865	51.47		
28	0.0126	0.321	79.1	31.1	0.160	0.0810	212.927	64.9		
29	0.0113	0.286	88.8	35.0	0.127	0.0642	268.471	81.83		
30	0.0100	0.255	99.7	39.3	0.101	0.0509	338.583	103.2		1/0.25, 7/0.1
31	0.00893	0.227	112	44.1	0.0797	0.0404	426.837	130.1		
32	0.00795	0.202	126	49.5	0.0632	0.0320	538.386	164.1		1/0.2, 7/0.08
33	0.00708	0.180	141	55.6	0.0501	0.0254	678.806	206.9		
34	0.00630	0.160	159	62.4	0.0398	0.0201	833	260.9		
35	0.00561	0.143	178	70.1	0.0315	0.0160	1085.958	331		
36	0.00500	0.127	200.	78.7	0.0250	0.0127	1360.892	414.8		
37	0.00445	0.113	225	88.4	0.0198	0.0100	1680.118	512.1		
38	0.00397	0.101	252	99.3	0.0157	0.00797	2127.953	648.6		
39	0.00353	0.0897	283	111	0.0125	0.00632	2781.496	847.8		

40	0.00314	0.0799	318	125	0.00989	0.00501	3543.307	1080		

(*)insulation included

The "Approximate stranded metric equivalents" column lists commonly available cables in the format "number of strands / diameter of individual strand (mm)" which is the common nomenclature describing cable construction within an overall cross-sectional area. Where a common cable is midway between two AWG sizes, it is listed and being ">" one AWG and "<" another AWG. Cables sold in Europe are normally labeled according to the combined cross section of all strands in mm^2, which can be compared directly with the *Area* column.

In the North American electrical industry, conductors larger than 4/0 AWG are generally identified by the area in thousands of circular mils (**kcmil**), where 1 kcmil = 0.5067 mm^2. A *circular mil* is the area of a wire one mil in diameter. One million circular mils is the area of a rod with 1000 mil = 1 inch diameter. An older abbreviation for one thousand circular mils is *mcm*. The term "mil" is capable of being misinterpreted because the term "mil" is used sometimes as a colloquial term for millimeter, milliliter, and so-forth.

Outside North America, wire sizes for electrical purposes are usually given as the cross sectional area in square millimeters. International standard manufacturing sizes for conductors in electrical cables are defined in IEC 60228.

Note that the area in mm^2 may differ somewhat from the numbers given in the table, depending on number of strands etc.

Pronunciation

AWG is colloquially referred to as *gauge* and the zeros in large wire sizes are referred to as *aught* (pronounced /ɔːt/). Wire sized 1 AWG is referred to as "one gauge"; similarly, smaller diameters are pronounced "*x* gauge", where *x* is the positive integer AWG number. Larger wire (#0 and up) is referred to as "one aught", "two aught" etc, depending on how many zeros are in the AWG rating.[4]

References

- Donald G. Fink and H. Wayne Beaty, *Standard Handbook for Electrical Engineers, Eleventh Edition*,McGraw-Hill, New York, 1978, ISBN 0-07-020974-X, page 4-18 and table 4-11.

1. ^ http://www.steelnavel.com/reference.asp
2. ^ http://www.ultracad.com/articles/wiregauge.pdf
3. ^ Bare, solid copper wire at 68 °F — Resistance data is from Belden *Master Catalog*, 1995.
4. ^ http://www.event-solutions.com/web_extras/february_2006/glossary_of_power_terms

See also

- IEC 60228 for international standard wire sizes

- Imperial Wire Gauge & British Standard Gauge
- A chart comparing all known wire gauges

External links

- Wire Gauge to Diameter—Diameter to Wire Gauge Converter (http://www.66pacific.com/calculators/wire_calc.aspx) - Online calculator converts gauge to diameter or diameter to gauge for any wire size.
- How to Gauge Traces (http://www.ultracad.com/articles/wiregauge.pdf)
- Conversion and calculation of cable diameter to AWG and vice versa (http://www.sengpielaudio.com/calculator-cross-section.htm)
- Table of wire resistivities for bigger gauge (insulation included) (http://www.bnoack.com/index.html?http&&&www.bnoack.com/data/wire-resistance.html)
- Bare copper wire AWG NEMA/IEC metric standard sizes (http://www.litz-wire.com/wirediminsions.html)
- Reference for conversions and maximum safe current loads (http://www.powerstream.com/Wire_Size.htm)

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