



# AWG APPROXIMATE RELATION

## AMERICAN WIRE GAUGE STANDARD

Area formulas are for plane figures, solid round conductor.

AWG of a solid wire is determined by the cross-sectional area of the conductor. Because there are small gaps between the strands in stranded wire, stranded wire will always have a slightly larger overall diameter than a solid wire with the same AWG gauge number. The conductance of a solid conductor will be greater than a stranded wire of equal diameter.

AWG / metric table measures are approximations.

Circular units = area calculated of a plane circle.

Circular area = 0.78539 of square area.

1 mil = 0.001 inch = 0.0254 mm.

Area of a plane circle =  $\pi r^2 = \pi(d/2)^2 = 0.78539 d^2$ .

Founders of the National Electric Code (NEC) adopted the Brown and Sharpe (B&S) wire gauge system—developed by J.R. Brown in 1857 for non-ferrous round wire—as the national standard and renamed it the American Wire Gauge (AWG). B&S specifications included such data as the approximate area for each gauge, the quality and composition of the drawn wire, tolerance, and target Ampere capacity.

A few characteristics of the B&S / AWG system are: The smaller the gauge number the larger the wire, the gauge was based on the drawing properties of copper and similar diamagnetic metals such as silver, and solid conductor area doubles approximately every three sizes. The steel industry does not use AWG and prefers other wire gauges.

James P. Lux

Spacecraft Telecommunications Equipment Section / Jet Propulsion Laboratory  
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Gauges are sort of arbitrary... Originally, the difference between sizes was the amount the wire was drawn down in each pass through a die. For mechanical reasons, this leads to a progression where the ratio of diameters between successive gauges is constant (i.e. each gauge is some percentage of the next bigger size). There were variations, though, depending on drawing technique, the metal being drawn, etc. [Initial U.S. standardization] was based on a strict geometric progression, starting with AWG 10 and AWG 40, and dividing it up into even geometric steps, and then extending either side of that range using the same ratio.

As a practical matter, too, the standard only calls for limited precision, so depending on whose wire you are buying, what lot it came from, etc. it can vary by several percent. To be cynical, I would suspect that when copper prices rise, the measured diameter for a given gauge will shrink... Just a bit more speed on the drawing machine and you get a few more feet per ton of copper. By the by, some automated drawing machines actually use the resistance to determine the gauge and hence to automatically adjust the drawing speed through the die.

Sheet metal gauges are totally different, and based on the number of square feet you get from a pound of metal. Shotgun gauges are based on the number of lead balls you can make from a pound of lead. The gauge scheme depends on the original manufacturing technique, hammering a lump flat (sheet metal), casting a lump (ball ammo), or drawing through a die (wire)...

AWG	D-INCH	D-MM	A-INCH <sup>2</sup>	A=MM <sup>2</sup>
0000	0.4600	11.684	0.1662	107.220
000	0.4096	10.404	0.1318	85.012
00	0.3648	9.266	0.1045	67.432
0	0.3249	8.252	0.0829	53.482
1	0.2893	7.348	0.0657	42.409
2	0.2576	6.543	0.0521	33.624
3	0.2294	5.827	0.0413	26.667
4	0.2043	5.189	0.0328	21.147
5	0.1819	4.620	0.0260	16.764
6	0.1620	4.115	0.0206	13.298
7	0.1443	3.665	0.0164	10.551
8	0.1285	3.264	0.0130	8.367
9	0.1144	2.906	0.0103	6.631
10	0.1019	2.588	0.0082	5.261
11	0.0907	2.305	0.0065	4.172
12	0.0808	2.053	0.0051	3.309
13	0.0720	1.828	0.0041	2.624
14	0.0641	1.628	0.0032	2.081
15	0.0571	1.450	0.0026	1.650
16	0.0508	1.291	0.0020	1.309
17	0.0453	1.150	0.0016	1.038
18	0.0403	1.024	0.0013	0.823
19	0.0359	0.912	0.0010	0.653
20	0.0320	0.812	0.0008	0.518
21	0.02846	0.7229	0.00064	0.4104
22	0.02535	0.6439	0.00050	0.3256
23	0.02257	0.5733	0.00040	0.2581
24	0.02010	0.5105	0.00032	0.2047
25	0.01790	0.4547	0.00025	0.1624
26	0.01594	0.4049	0.00020	0.1288
27	0.01420	0.3606	0.00016	0.1022
28	0.01264	0.3211	0.00013	0.0810
29	0.01126	0.2860	0.00010	0.0642
30	0.01003	0.2548	0.00008	0.0510
31	0.008925	0.22670	0.000063	0.04036
32	0.007950	0.20193	0.000050	0.03202
33	0.007080	0.17983	0.000039	0.02540
34	0.006305	0.16015	0.000031	0.02014
35	0.005615	0.14262	0.000025	0.01598
36	0.005000	0.12700	0.000020	0.01267
37	0.004453	0.11311	0.000016	0.01005
38	0.003965	0.10071	0.000012	0.00797
39	0.003531	0.08967	0.000010	0.00632
40	0.003145	0.07988	0.000008	0.00501