American Wire Gauge

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In the United States, wire diameters are specified according to the American Wire Gauge (AWG). There are 40 different sizes, ranging from 36 (smallest) to 0000 (largest, also written "4/0"): $36, 35, 34, \ldots, 2, 1, 0, 00, 000, 0000$.

The diameter D_{36} of 36 AWG wire is $0.005''$ (= 0.127 mm). The ratio of each diameter to the previous one is $92^{1/39} = 1.1229322$ (I am not joking—you can't make this stuff up). Therefore, the diameter of n AWG wire is

$$D_n = D_{36}\, 92^{\frac{36-n}{39}},$$

where n must be negative for sizes 00 and larger. For example,

$$D_{22} = D_{36}\, 92^{14/39} = (0.127 \text{ mm}) \times 5.06931731 = 0.6438 \text{ mm}.$$

Some common sizes:

AWG	**Diameter**
10	2.588 mm = $0.1019''$
14	1.628 mm = $0.0641''$
18	1.024 mm = $0.0403''$
22	0.644 mm = $0.0253''$
24	0.511 mm = $0.0201''$

What is the resistance of a length L of n AWG copper wire? The resistivity of copper is $\rho_{\mathrm{Cu}} = 1.678 \times 10^{-8}\ \Omega{\cdot}\mathrm{m}$ at 20 °C.

$$R = \rho_{\mathrm{Cu}} L/A,$$

where A is the cross-sectional area of the wire. So

$$R = \frac{4\rho_{\mathrm{Cu}} L}{\pi D_n^2} = \frac{4\rho_{\mathrm{Cu}} L}{\pi D_{36}^2\, 92^{\frac{2\times(36-n)}{39}}}.$$

Working in SI units, $D_{36} = 1.27 \times 10^{-4}$ m, so

$$\frac{4\rho_{\mathrm{Cu}}}{\pi D_{36}^2} = 1.3246\ \Omega/\mathrm{m}.$$

Then

$$R = \frac{1.3246 L}{92^{\frac{72-2n}{39}}} = 1.3246 \cdot 92^{\frac{2n-72}{39}}\, L\ \Omega,$$

where L is in meters.

Example: for $n = 22$ and $L = 0.3$ m, $R = 1.55 \times 10^{-2}\ \Omega$.