S&W WIRE

America's Premium Magnet Wire Service
45 Progress Avenue • Cranberry Industrial Park
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Conductor Properties

COPPER AND ALUMINUM CONDUCTORS — **AREA, WEIGHT AND RESISTANCE**

WEIGHT OF BARE CONDUCTOR

Pounds Per 1000 Feet

General Formula: Lbs./M Ft. = 0.000433526 (d) (A)
Copper: Lbs./M Ft. = 0.0038540A
Aluminum: Lbs./M Ft. = 0.0011718A
Where: A = Bare conductor cross-sectional area in Square Mils.
d = Density of conductor, grams/cm^3.

For round conductor, where the cross-sectional area may be more conveniently expressed in Circular Mils, the following formulas are useful:

General Formula: Lbs./M Ft. = 0.00034047 (d) (D^2)

WEIGHT OF BARE CONDUCTOR (cont'd)

Copper: Lbs./M Ft. = 0.003027 D^2
Aluminum: Lbs./M Ft. = 0.0009203 D^2
Where: D = Diameter of bare conductor, mils.
d = Density of conductor metal, grams/cm^3.

Formulas for weight are based on a density of 8.89 for copper and 2.703 for aluminum.

Feet Per Pound

For any conductor, Ft./Lb. = 1000/Lbs./M Ft.

CROSS-SECTIONAL AREA

Round Wire

Circular Mil Area = D^2
Square Mil Area = $\pi/4\ D^2 = 0.7854\ D^2$
Square Inch Area = $0.7854 \times 10^{-6} D^2$
Where: D = Diameter of bare conductor in mils (1/1000 inches), i.e. 0.0403" Diam. = 40.3 mils

Square and Rectangular Wire

Circular Mil Area = $1.2732\ (Wt - 0.8584R^2)$
Square Mil Area = $WT - 0.8584R^2$
Square Inch Area = $1 \times 10^{-6}(WT - .8584R^2)$, or
$= wt - 0.8584r^2$, when w, t and r are expressed in inches.
Note: 1 sq. mil = 10^{-6} sq. inches.
Where: T = Thickness in mils. W=Width in mils.
R = Corner Radius in mils.
For square wire: W = T.
For rectangular wire with full rounded edges:
R = T/2

Notes: When calculations involve any of the following standard ASTM corner radii, the values for Corner Area Loss listed below may be substituted for the term "$0.8584R^2$" in the above formulas.

Nominal ASTM* Corner Radii (Inches)	Corner Area Loss Factors
0.094	7585.
0.063	3407.
0.040	1373.
0.032	879.0
0.026	580.3
0.020	343.4
0.016	219.8

*ASTM Standard B48-88 for Copper.
*ASTM Standard B324-88 for Aluminum.

CONDUCTOR RESISTANCE

Ohms Per 1000 Feet

Round Conductor:

General Formula: Ohms/M Ft. = 1000 R/D^2
Copper: Ohms/M Ft. = $10371/D^2$
Aluminum: Ohms/M Ft. = $16782/D^2$

Where R = Volume resistivity, ohm-circ.mil/ft.
D = Bare conductor diameter, mils.

Square and Rectangular Conductor:

General Formula: Ohms/M Ft. = 785.4 R/A
Copper: Ohms/M Ft. = 8145.5/A
Aluminum: Ohms/M Ft. = 13180/A

Where: R = Volume resistivity, ohm-circ.mil/ft.[1]
Copper = 10.371 ohm-circ. mil/ft.
Aluminum = 16.782 ohm-circ. mil/ft.
A = Cross-sectional area, square mils.

Ohms Per Pound

For any conductor, Ohms/Lb. = Ohms/M Ft./Lbs./M Ft.

Feet Per Ohm

For any conductor, Feet/Ohm = 1000/Ohms/M Ft.

[1]The volume resistivity factors at 20°C are based on conductivities of 100% and 61.8%. IACS, for soft, annealed copper and aluminum respectively. Conductivities for hard drawn conductors are: Copper 97%; and Aluminum, 61%.

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