ANIXTER

DEFINITION

American Wire Gauge (AWG), also known as Brown & Sharpe Gage, is the United States' standard method for denoting the cross-sectional areas of round, solid conductors. The cross-sectional area is useful in determining a conductor's current-carrying capacity and resistivity. Rather than using fractional inches, gauges are based on whole numbers with 38 commonly known sizes (4/0 to 36 AWG). Sizes smaller than 36 AWG can be calculated in gauge, but wires larger than 4/0 are commonly expressed in 1,000 circular mils (kcmil or MCM) where one cmil is the area of a circle with a diameter of one mil (1/1,000 inch).

A fact that is often confusing to the beginner is that smaller gauge numbers correspond to larger conductor diameters: physical size and the AWG number are inversely proportional. This relationship was influenced from the number of drawing operations needed to produce a designated gauge size. Smaller wires were required to be drawn multiple times through drawing dies to be thinned out, while larger diameter wires required less processing.[1] The relationship between gauge sizes is not linear, but logarithmic. More detailed information about the relationship between sizes can be found in the Anixter Technical Information Handbook.[2]

SOLID AND STRANDED CONDUCTORS

The cross-sectional area of a solid conductor is straightforward and easy to calculate. The area of a conductor is found by squaring its diameter in mils. The gauge size can be found by using the cross-sectional area and tables provided in American Society of Testing and Materials (ASTM) 258-08 Standard Specification for Standard Nominal Diameters and Cross-Sectional Areas of AWG Sizes of Solid Round Wires Used as Electrical Conductors.

The gauge size of a stranded conductor is determined by summing the cross-sectional areas of the individual solid strands and using the tables provided in ASTM standards. The overall diameter is determined by geometry of the strands. Stranded conductors have larger diameters compared to solid conductors because of air gaps and spacing between the strands. Consequently, the same gauge size solid and stranded conductor can have different diameters.

Stranded conductors, with the same gauge size, can also have different diameters because of the various conductor strand types. The three most common strand types are compact, compressed and concentric, although hundreds, possibly thousands of combinations of strand types and number of strands exist. Conductors with compact and compressed stranding have approximately 7–9 percent and 2–3 percent smaller conductor diameters respectively when compared to concentric stranding.[3] Figure 1 below shows the differences in sizes between common strand types for a 1,000 kcmil conductor.

| Solid | Compact | Compressed | Concentric |
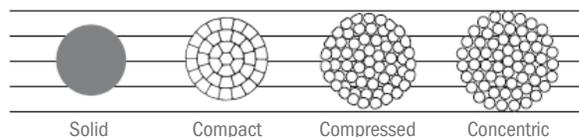
Figure 1: Comparative Sizes and Shapes of Conductors

ELECTRICAL PROPERTIES

The greatest impact AWG has on a wire's electrical properties is the wire's resistance. Wire conductors, such as copper, aluminum and silver, have different resistances. The cross-sectional area of a conductor is inversely related to the resistance of a conductor. The larger the conductor, the lower the resistance of the conductor.

The electrical resistance of a stranded conductor is a function of the length of lay and is larger than its solid counterpart. Approximate resistance can be found by using increments listed in various ASTM standards. Table 1 below contains increment values for concentric lay stranded conductors. The increase in resistance is found by multiplying the resistance of the solid conductor with the same gauge size, by one of the values shown in the table below.[4]

Type of Conductor	Increment of Resistance and Mass %
Class AA, Size 1 to 4 AWG	1
Classes AA,*A, B,C, and D, 2 000 000 cmil and under	2
Over 2 000 000 to 3 000 000 cmil	3
Over 3 000 000 to 4 000 000 cmil	4
Over 4 000 000 to 5 000 000 cmil	5

* No. O AWG and larger
Table 1: Concentric Conductor's Increment Increase[4]

METRIC CONVERSION

Outside of the United States, wire sizes are commonly expressed in mm^2 and the diameters in mm. Stranded wire notation usually states the number of strands first, followed by the diameter. For example, 7/0.533 means the stranded conductor contains 7 strands, each a diameter of 0.533 mm with an overall cross-sectional area of 1.5 mm^2. Table 2 below lists the conversion factors between the two systems.

American Wire Gauge	Metric Units	AWG to Metric Multiplier	Metric to AWG
Inches (in.)	Millimeters (mm)	25.4	0.0394
Circular Mil (cmil)	Square Millimeters (mm2)	0.000507	1973.5
Ohms/1,000 ft. (Ω/ft.)	Ohms/kilometers (Ω/km)	3.28	0.3048

Table 2: Metric Conversions

1. Warner, Mark. The Electric Vehicle Conversion Handbook HP1568. New York: Penguin Group, 2011. Print.
2. "Anixter Technical Information Handbook" Anixter Inc. 2013. Print.
3. "National Electric Code 2011." National Fire Protection Association, 2010. Print.
4. "ASTM B8-04 Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft." ASTM International.

For more information, contact your local Anixter sales representative at 1.800.ANIXTER or visit anixter.com.

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