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AWG

WHITE PAPER

AWG

01 The origins

AWG is a standardized wire gauge system that has been used since the 1850s in North America for the diameters of round, solid, nonferrous, electrically conducting wire. The principles of this wire size system are based on two aspects:

1. Every increase of 3 AWG will halve the cross-sectional area (and conversely, a decrease of 3 AWG doubles the cross-sectional area).
2. Every increase of 6 AWG will decrease the wire diameter by half (and conversely, a decrease of 6 AWG doubles the diameter).

In this standard, the diameter of the wire is inversely related to the AWG size. That is, the larger the AWG number, the smaller the wire diameter. For example, a 24 AWG wire is thinner than a 12 AWG wire. It might seem counterintuitive, but it's just the way the standard is defined.

The AWG standard includes solid and stranded wire, with the gauge specified for solid wire being applicable to the total cross-sectional area of the stranded wire variant. In the stranded variant, each strand typically has a gauge that is much larger (smaller diameter) than the gauge of the whole wire.

02 Why do we keep using AWG in Europe despite the metric system?

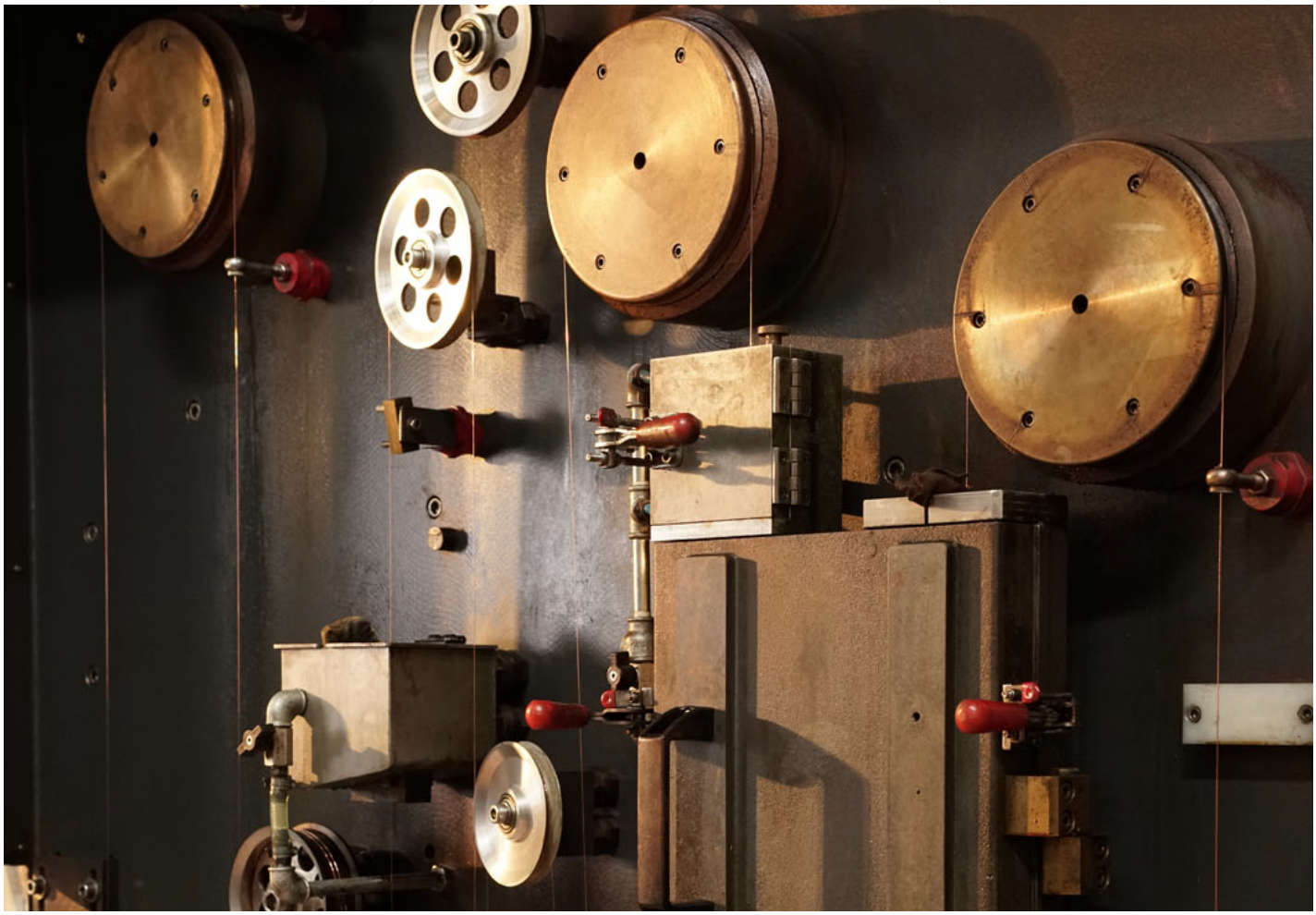
Although the metric system is widely used in Europe, there are several reasons why AWG (American Wire Gauge) might also be used, especially in cabling systems:

1. International Standards: Some industries have standardized around certain AWG sizes. For instance, the electronics industry often uses AWG due to the widespread adoption of certain AWG sizes in connectors, terminals, and other components. The global nature of these industries means that AWG is used worldwide, including in Europe.

2. Products from the US: A large amount of electronic and electrical equipment is designed and manufactured in the US or designed to US standards. This equipment often uses AWG measurements for wiring; thus, even in Europe, the AWG standard may need to be used to ensure compatibility.

3. Data and Telecommunications: AWG has been widely adopted in the field of data and telecommunications. For instance, Ethernet cables (like CAT5, CAT6, etc.) are often specified using AWG. Because these are global standards, Europe also uses AWG in these contexts.

4. Historical Legacy and Consistency: Certain sectors have historically used AWG and have maintained use of the system for consistency, even as other sectors have switched to metric.



03 AWG in Structured Cabling

In the field of structured cabling systems, the American Wire Gauge (AWG) is commonly used to specify the thickness of the wire used in various categories of cables. The AWG values typically range from 22 to 26.

For instance, Category 7a (Cat7a) cables use AWG22. Both Category 6a (Cat6a) and Category 6 (Cat6) cables use AWG23. Even though Cat6a wires are physically larger, they share the same AWG with Cat6 due to similar conductor diameters. Category 5e (Cat5e) cables use AWG24.

When it comes to stranded wires, which are composed of several smaller wires bundled together, AWG34 is typically used.

The choice of AWG is significant as it ensures the compatibility between wires and their corresponding connectors. Using the correct AWG ensures proper fit and connectivity, which is essential for the efficient operation of the cabling system. Therefore, it's important to match the AWG of the wire with the AWG specified for the connector to guarantee optimal performance of the system.

Minimum diameter of copper conductor for DATAcables (table source from IEC 60228)

Conductor size (AWG)	Diameter of solid conductor		Cross-sectional area of stranded conductor	
	mm	in	mm^2	cmit
30	0.251	0.0099	0.0497	98
29	0.284	0.0112	0.0633	125
28	0.318	0.0125	0.0790	156
27	0.358	0.0141	0.100	198
26	0.384[a]	0.0151[a]	0.126	248
25	0.432[a]	0.0170[a]	0.159	314
24	0.485[a]	0.0191[a]	0.201	396
23	0.546[a]	0.0215[a]	0.254	501

[a] *Minimum acceptable diameter (0,95 x nominal) of a solid conductor of this size*

04 What are the conversion Rules between AWG and mm and how to calculate mm2

In order to translate AWG into millimeters, one must consider both diameter and cross-sectional area, rounding to the nearest equivalent AWG values

a. Some formulaes to concert Wire Diameter from AWG to mm and mm2

The diameter of a wire with n gauge, represented as dn in millimeters (mm), can be calculated by multiplying 0.127mm (the diameter of a 36-gauge wire) by 92, raised to the power resulting from the subtraction of the gauge number n from 36, all divided by 39. It can be represented as:

$$d_{n\,(mm)} = 0.127 \times 92^{(36-n)/39}$$

Conversely, for an Excel-friendly formula to determine the equivalent AWG starting from a wire diameter given in millimetres, you can use the following:

$$n = 36\text{-}39\times \log(d_{n\,(mm)} / 0.127) / \log(92)$$

b. To compute the cross-sectional area in mm² from a given AWG, use the formula:

The diameter of a wire with n gauge, represented as dn in millimeters (mm), can be calculated by multiplying 0.127mm (the diameter of a 36-gauge wire) by 92, raised to the power resulting from the subtraction of the gauge number n from 36, all divided by 39. It can be represented as:

$$S_{n\,(mm^2)} = (\pi/4)\times d_n^{\,2} = 0.012668\ mm^2 \times 92^{(36-n)/19.5}$$

In reverse, if you have the cross-sectional area in square millimeters and want to find the corresponding AWG, you can use this Excel-compatible formula:

$$n = 36\ 19{,}5\times \log(S_{n\,(mm)} / 0.012668) / \log(92)$$

In these formulas, 'Sn' denotes the cross-sectional area in square millimeters, 'dn' represents the wire diameter in millimeters, and 'n' refers to the wire gauge in AWG. The 'log' function represents the logarithm.

05 Conclusion

Selecting the appropriate AWG wires depends on a range of factors, including the anticipated application such as high-speed data transmission or Power over Ethernet Type 4 or type 1, cost considerations, external diameter of the wire, and the constraints of the space where the cabling system will be installed.For this reason, our Unikkern connector is designed with versatility in mind. It features two insert bars to accommodate a range of AWG sizes. The orange-colored insert bar is compatible with AWG 22 and below, accommodating thicker wire applications. The green-colored insert bar, on the other hand, is designed to work with AWG 23, ensuring a secure and reliable connection for this specific wire size. By providing these options, our Unikkern connector ensures the optimal performance for your cabling needs regardless of the AWG of your wires.

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