# ELECTRIC CURRENT

## WHAT IS CURRENT?

Electric current is the flow of electrons through a conductor. Electrons are submicroscopic particles of matter that exist in all conductors such as copper and aluminum. Current flows when electrons are pushed by the force of an applied voltage. Current is measured in units of amperes or amps (usually abbreviated as A). Engineers generally use the symbol I to represent current in mathematical expressions. The magnitude of the current is directly proportional to the volume of electrons moving through a wire per unit of time.

## ALTERNATING AND DIRECT CURRENT

Electric current can come in two different forms: direct current (DC) and alternating current (AC). Direct current flows in a constant direction and polarity and is generally produced by batteries or solar cells. Alternating current reverses flow in a cyclical manner. The voltage of alternating current can be changed via a power transformer, which is why most long-distance transmission of electricity is carried out with AC. Alternating current is typically supplied to businesses and residences and is the kind of current available at a standard household wall outlet.

## HOW DOES CURRENT RELATE TO WIRE AND CABLE?

The best way to understand current is to use an analogy. Insulated wire can be viewed as a garden hose in which the electric current is represented by the flow of water. Each electron is represented by individual drops of water. To increase the volume of water flowing through the hose, the diameter of the hose needs to be increased, say 3/4 inch instead of 1/2 inch.

Likewise with wire, if more electric current is needed, the conductor's diameter needs to be increased, for example a 10 AWG instead of a 16 AWG. If the cable's cross-sectional area is doubled, the current carrying capacity (also known as the ampacity) of the wire is also approximately doubled. For example, a 2 AWG wire with 66,360 circular mils of cross-sectional area can carry more than twice as much current as a 6 AWG wire with only 26,240 circular mils.

Undersized conductors are dangerous because the conductor can heat up and the insulation could start to deteriorate. Copper or aluminum conductors are not perfect conductors of electricity and contain some amount of resistance. When current flows down a wire, instead of flowing smoothly, the electrons bounce and cause vibrations. These vibrations emit energy (heat) that radiates into the insulation, causing it to deteriorate. The larger the conductor, the more room the electrons have to travel and the less the vibrations occur. For more information on conductor resistance, please check out the Wire Wisdom™ on *Conductor Resistance.*

## HOW TO SELECT AN APPROPRIATE CABLE

Ampacity is the maximum current an insulated conductor can safely carry without exceeding its insulation and jacket temperature limitations. The ampacity of the cable should equal or exceed the maximum current the cable will be expected to carry during its service life. Conductors that are undersized can overheat, cause damage to the insulation or jacket of the cable, and potentially cause harm to equipment or people. General ampacity ratings for conductors can be found in the National Electric Code 2011 Article 310 *Conductors for General Wiring.*

Depending on the installation environment of the cable, ampacity ratings may need to be adjusted or derated. Temperature ratings depend on the heat resistance of the materials used for the insulation and jacket of the cable. The higher a material's heat resistance, the less likely it will deteriorate in higher temperatures. Just like undersized conductors, if incorrect insulation and jacket materials are used, damage via heat transfer can occur.

There are many factors that affect the appropriate conductor and cable selection, and incorrect product choices can be costly.

For more information, contact your local Anixter sales representative or view additional Wire Wisdoms at anixter.com/techrefs/wire-wisdom

**About Anixter:** anixter.com/aboutus
**Legal Statement:** anixter.com/legalstatement



**Anixter Inc. World Headquarters**
2301 Patriot Boulevard
Glenview, Illinois 60026
224.521.8000

WIREwisdom™