Wŏrd Pow´ẽr

Renewable Energy Terms

Ohm—Unit of Electrical Resistance

Ian Woofenden

Derivation: Named for Georg Simon Ohm, 19th century German physicist and mathematician. Ohm made key discoveries about the nature of electrical resistance.

Picture some kids sliding down a playground slide. If we cover the slide with a thin coat of vegetable oil, the kids will slide down it pretty quickly. But if we cover it with molasses (in January), their ride will slow down considerably. Throw sand on the molasses, and the sliding party will come to a grinding halt.

We usually don't see kids' slides covered with oil, molasses, or sand. They are generally made with slick plastic or metal surfaces so kids will slip down them easily. Similarly, we don't see electrical conductors made out of wood or rubber. Instead, they are copper and aluminum. This is because wood and rubber have a very high resistance to electron flow, while aluminum and copper have a relatively low resistance to electron flow.

The ohm is the unit that quantifies this resistance. Its symbol is the Greek letter Omega—Ω. Technically, 1 ohm is the resistance in a material in which an electrical potential ("pressure") of 1 volt causes 1 ampere to flow. Electrical resistance acts like friction to the flow of electrons through a material.

Well, just as our kids want a fast ride down the slide, we want our electrons to flow quickly and easily to our appliances. High resistance on the slide raises the tempers of the kids. High resistance in a wire raises the temperature—we lose energy as heat. If there is too much electron flow for the size of the wire, there may be enough heat to melt the insulation on the wire and start a fire.

Different conductors (materials which contain easily-moved electrons) have different levels of resistance. Aluminum has about 1.6 times the resistance of copper. It's cheaper than copper, but when we use it, we have to use a larger wire to carry the same amount of energy (at a given voltage) without increasing the losses. Steel has about 9 times the resistance of copper, so we don't see it being used as an electrical conductor. And nichrome, an alloy of nickel, iron, and chromium, has about 60 times the resistance of copper. It is used for heating elements because, while it does let electrons flow, its high resistance results in lots of heat.

Materials with very high resistances are called "insulators." Things like rubber, glass, and mica have more than a million times the resistance of a good conductor. We use this property of these materials to keep the electron flow where we want it—in the wires.

The size of conductors is also important in understanding resistance. Just as a big pipe has far less fluid friction than a small pipe, a larger wire resists the flow of electrons less than a small wire. A #14 (2 mm^2) copper wire, common in 120 VAC house wiring, has 2.57 ohms of resistance per 1,000 feet at 70°F. A #4/0 (107 mm^2) copper wire, commonly used for battery interconnects, has only 0.05 ohms of resistance per 1,000 feet at 70°F. Sizing for minimal losses in your wiring just makes good sense.

While you won't run into ohms very often in your everyday RE life, it's crucial that the designers of your system, and the designers of the products in your system, understand the need for low resistance. Renewable energy is precious, so it makes no sense to waste it heating up undersized wires. Investing in the right type and size of wire will keep those electrons sliding along to your appliances.

Access

Author: Ian Woofenden, PO Box 1001, Anacortes, WA 98221 • Fax: 360-293-7034
ian.woofenden@homepower.com