# Electrical Resistance Encyclopedia Article

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# Electrical Resistance

The electrical resistance of a wire or circuit is a way of measuring the resistance to the flow of an electrical current. A good electrical conductor, such as a copper wire, will have a very low resistance. Good insulators, such as rubber or glass insulators, have a very high resistance. The resistance is measured in ohms, and is related to the current in the circuit and **voltage** across the circuit by **Ohm's law**. For a given voltage, a wire with a lower resistance will have a higher current.

The resistance of a given piece of wire depends on three factors: the length of the wire, the cross-sectional area of the wire, and the resistivity of the material composing the wire. To understand how this works, think of water flowing through a hose. The amount of water flowing through the hose is analogous to the current in the wire. Just as more water can pass through a fat fire hose than a skinny garden hose, a fat wire can carry more current than a skinny wire. For a wire, the larger the cross-sectional area, the lower the resistance; the smaller the cross-sectional area, the higher the resistance. Now consider the length. It is harder for water to flow through a very long hose simply because it has to travel farther. Analogously, it is harder for current to travel through a longer wire. A longer wire will have a greater resistance. The resistivity is a property of the material in the wire that depends on the chemical composition of the material but not on the amount of material or the shape (length, cross-sectional area) of the material. Copper has a low resistivity, but the resistance of a given copper wire depends on the length and area of that wire. Replacing a copper wire with a wire of the same length and area but a higher resistivity will produce a higher resistance. In the hose analogy, it is like filling the hose with sand. Less water will flow through the hose filled with sand than through an identical unobstructed hose. The sand in effect has a higher resistivity to water flow. The total resistance of a wire is then the resistivity of the material composing the wire times the length of the wire, divided by the cross-sectional area of the wire.