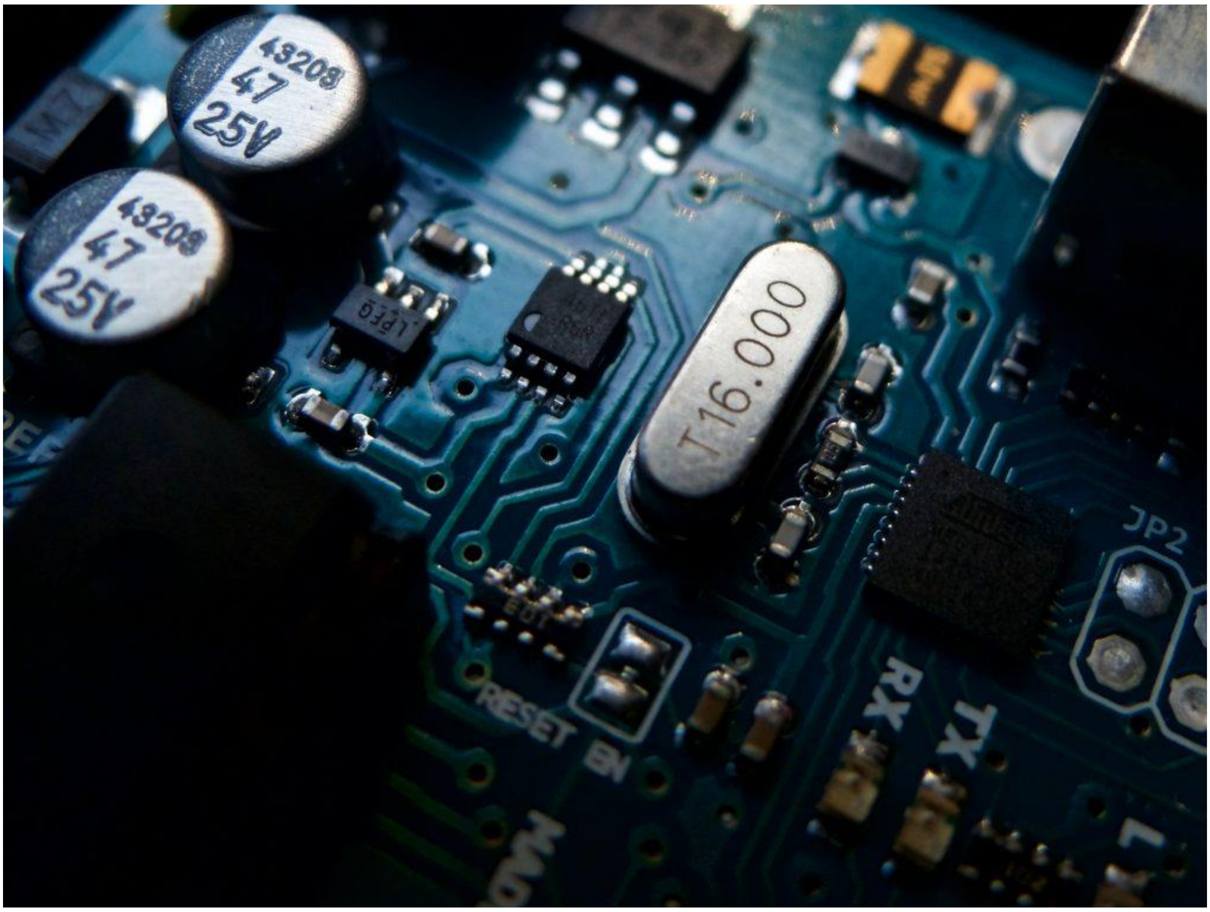
Table of Electrical Resistivity and Conductivity

This entry was posted on January 16, 2019 by Anne Helmenstine (updated on April 27, 2024)



A resistor has high electrical resistance while a conductor has high conductivity. (Nicolas Thomas)

This is a table of the electrical resistivity and electrical conductivity of several materials. Included are metals, elements, water, and insulators.

Electrical resistivity, represented by the Greek letter ρ (rho), is a measure of how strongly a material opposes the flow of electric current. The lower the resistivity, the more readily the material permits the flow of electric charge. The higher the resistivity, the harder it is for current to flow. Materials with high resistivity are electrical resistors.

Electrical conductivity is the reciprocal quantity of resistivity. Conductivity is a measure of how well a material conducts an electric current. Materials with high electrical conductivity are electrical conductors. Electric conductivity may be represented by the Greek letter σ (sigma), κ (kappa), or γ (gamma).

Table of Resistivity and Conductivity at 20°C

Material	**ρ (Ω•m) at 20 °C Resistivity**	**σ (S/m) at 20 °C Conductivity**

Silver	1.59×10^{-8}	6.30×10^{7}
Copper	1.68×10^{-8}	5.96×10^{7}
Annealed copper	1.72×10^{-8}	5.80×10^{7}
Gold	2.44×10^{-8}	4.10×10^{7}
Aluminum	2.82×10^{-8}	3.5×10^{7}
Calcium	3.36×10^{-8}	2.98×10^{7}
Tungsten	5.60×10^{-8}	1.79×10^{7}
Zinc	5.90×10^{-8}	1.69×10^{7}
Nickel	6.99×10^{-8}	1.43×10^{7}
Lithium	9.28×10^{-8}	1.08×10^{7}
Iron	1.0×10^{-7}	1.00×10^{7}
Platinum	1.06×10^{-7}	9.43×10^{6}
Tin	1.09×10^{-7}	9.17×10^{6}
Carbon steel	(10^{10})	1.43×10^{-7}
Lead	2.2×10^{-7}	4.55×10^{6}
Titanium	4.20×10^{-7}	2.38×10^{6}
Grain oriented electrical steel	4.60×10^{-7}	2.17×10^{6}
Manganin	4.82×10^{-7}	2.07×10^{6}
Constantan	4.9×10^{-7}	2.04×10^{6}

Stainless steel	6.9×10^{-7}	1.45×10^{6}
Mercury	9.8×10^{-7}	1.02×10^{6}
Nichrome	1.10×10^{-6}	9.09×10^{5}
GaAs	5×10^{-7} to 10×10^{-3}	5×10^{-8} to 10^{3}
Carbon (amorphous)	5×10^{-4} to 8×10^{-4}	1.25 to 2×10^{3}
Carbon (graphite)	2.5×10^{-6} to 5.0×10^{-6} //basal plane 3.0×10^{-3} ⊥basal plane	2 to 3×10^{5} //basal pla 3.3×10^{2} ⊥basal plane
Carbon (diamond)	1×10^{12}	$\sim10^{-13}$
Germanium	4.6×10^{-1}	2.17
Sea water	2×10^{-1}	4.8
Drinking water	2×10^{1} to 2×10^{3}	5×10^{-4} to 5×10^{-2}
Silicon	6.40×10^{2}	1.56×10^{-3}
Wood (damp)	1×10^{3} to 4	10^{-4} to 10^{-3}
Deionized water	1.8×10^{5}	5.5×10^{-6}
Glass	10×10^{10} to 10×10^{14}	10^{-11} to 10^{-15}
Hard rubber	1×10^{13}	10^{-14}
Wood (oven dry)	1×10^{14} to 16	10^{-16} to 10^{-14}
Sulfur	1×10^{15}	10^{-16}
Air	1.3×10^{16} to 3.3×10^{16}	3×10^{-15} to 8×10^{-15}
Paraffin wax	1×10^{17}	10^{-18}

Fused quartz	7.5×10^{17}	1.3×10^{-18}
PET	10×10^{20}	10^{-21}
Teflon	10×10^{22} to 10×10^{24}	10^{-25} to 10^{-23}

Factors That Affect Electrical Conductivity

There are three main factors that affect the conductivity or resistivity of a material:

1. **Cross-Sectional Area:** If the cross-section of a material is large, it can allow more current to pass through it. Similarly, a thin cross-section restricts current flow. For example, a thick wire has a higher cross-section than a fine wire.
2. **Length of the Conductor:** A short conductor allows current to flow at a higher rate than a long conductor. It's sort of like trying to move a lot of people through a hallway compared with a door.
3. **Temperature:** Increasing temperature makes particles vibrate or move more. Increasing this movement (increasing temperature) decreases conductivity because the molecules are more likely to get in the way of current flow. At extremely low temperatures, some materials are superconductors.