

Resistivity of Materials

What is Resistivity

Resistivity is a measure of the resistance of a given size of a specific material to electrical conduction and it is an important parameter for all substances associated with electrical usage, electronic circuit design, etc.

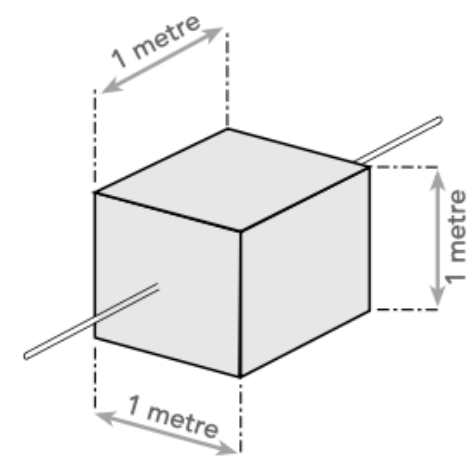
The unit of resistivity are ohm metre Ωm .

The values of resistivity for different materials can vary very widely. For example copper is around 1.7×10^{-8} ohm metre whereas an insulator may have a resistivity of 10^{16} ohm metres.

Definition of Resistivity

The resistivity of a substance is the resistance of a cube of that substance having edges of unit length, with the understanding that the current flows normal to opposite faces and is distributed uniformly over them.

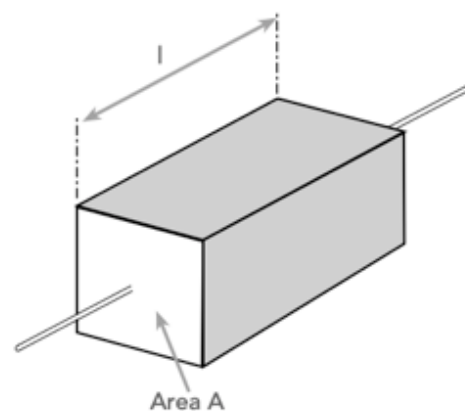
The electrical resistivity is the electrical resistance per unit length and per unit of cross-sectional area at a specified temperature.



Resistivity formulas

$$\rho = \frac{E}{J}$$

$$\rho = R \frac{A}{l}$$



ρ is the resistivity of the material in ohm metres, $\Omega \cdot \text{m}$
 E is the magnitude of the electric field in volts per metre, $\text{V} \cdot \text{m}^{-1}$
 J is the magnitude of the current density in amperes per square metre, $\text{A} \cdot \text{m}^{-2}$
 R is the electrical resistance of a uniform specimen of the material measured in ohms
 l is the length of the piece of material measured in metres, m
 A is the cross-sectional area of the specimen measured in square metres,

Resistivity regions

RESISTIVITY REGIONS FOR DIFFERENT CATEGORIES OF MATERIALS

MATERIAL TYPE	RESISTIVITY REGION
Electrolytes	Variable*
Insulators	$\sim 10^{16}$
Metals	$\sim 10^{-8}$
Semiconductors	Variable*
Superconductors	0

Resistivity of common materials

MATERIAL	ELECTRICAL RESISTIVITY AT 20°C OHM METRES
Aluminium	2.8×10^{-8}
Antimony	3.9×10^{-7}
Bismuth	1.3×10^{-6}
Brass	$\sim 0.6 - 0.9 \times 10^{-7}$
Cadmium	6×10^{-8}
Cobalt	5.6×10^{-8}
Copper	1.7×10^{-8}
Gold	2.4×10^{-8}
Carbon (Graphite)	1×10^{-5}
Germanium	4.6×10^{-1}
Iron	1.0×10^{-7}
Lead	1.9×10^{-7}
Manganin	4.2×10^{-7}
Nichrome	1.1×10^{-6}
Nickel	7×10^{-8}
Palladium	1.0×10^{-7}
Platinum	0.98×10^{-7}
Quartz	7×10^{17}
Silicon	6.4×10^2
Silver	1.6×10^{-8}
Tantalum	1.3×10^{-7}
Tin	1.1×10^{-7}
Tungsten	4.9×10^{-8}
Zinc	5.5×10^{-8}