CURRENT ELECTRICITY

RESISTIVITY OF VARIOUS MATERIALS

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The resistivities of various common materials are listed in. The materials are classified as conductors, semiconductors and insulators depending on their resistivities, in an increasing order of their values. Metals have low resistivities in the range of 10^{-8} Ωm to 10^{-6} Ωm. At the other end are insulators like ceramic, rubber and plastics having resistivities 1018 times greater than metals or more. In between the two are the semiconductors. These, however, have resistivities characteristically decreasing with a rise in temperature. The resistivities of semiconductors can be decreased by adding small amount of suitable impurities. This last feature is exploited in use of semiconductors for electronic devices.

TABLE RESISTIVITIES OF SOME MATERIALS

MATERIAL	RESISTIVITY, P (Ω M) AT 0°C	TEMPERATURE COEFFICIENT OF RESISTIVITY, A (°C) $^{-1}$ $\frac{1}{\rho}\frac{d\rho}{dt}$ AT 0 C
CONDUCTORS		
Silver	1.6×10^{-8}	0.0041
Copper	1.7×10^{-8}	0.0068
Aluminum	2.7×10^{-8}	0.0043
Tungsten	5.6×10^{-8}	0.0045
Iron	10×10^{-8}	0.0065
Platinum	11×10^{-8}	0.0039
Mercury	98×10^{-8}	0.0009
Nichrome	$\sim 100 \times 10^{-8}$	0.0004
(ALLOY OF NI, FE, CR)		
Manganin (alloy)	48×10^{-8}	$0.002 \times 10{-}3$
SEMICONDUCTORS		
Carbon (graphite)	3.5×10^{-5}	– 0.0005
Germanium	0.46	– 0.05
Silicon	2300	– 0.07

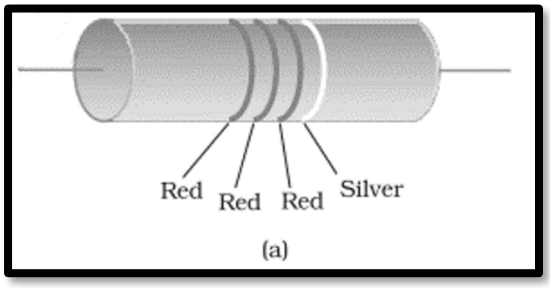
INSULATORS		
Pure Water	2.5×10^5	
Glass	$10^{10} - 10^{14}$	
Hard Rubber	$10^{13} - 10^{16}$	
NaCl	$\sim 10^{14}$	

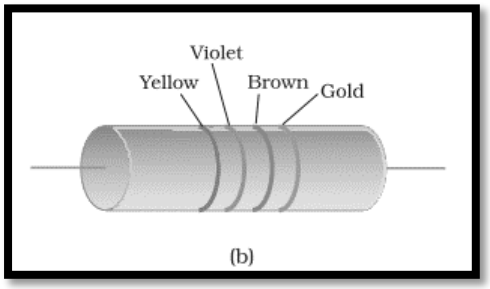
Commercially produced resistors for domestic use or in laboratories are of two major types: wire bound resistors and carbon resistors. Wire bound resistors are made by winding the wires of an alloy, viz., manganin, constantan, nichrome or similar ones. The choice of these materials is dictated mostly by the fact that their resistivities are relatively insensitive to temperature. These resistances are typically in the range of a fraction of an ohm to a few hundred ohms.

Resistors in the higher range are made mostly from carbon. Carbon resistors are compact, inexpensive and thus find extensive use in electronic circuits. Carbon resistors are small in size and hence their values are given using a color code.

TABLE RESISTOR COLOUR CODES			
COLOUR	NUMBER	MULTIPLIER	TOLERANCE (%)
Black	0	1	
Brown	1	10^1	
Red	2	10^2	
Orange	3	10^3	
Yellow	4	10^4	
Green	5	10^5	
Blue	6	10^6	
Violet	7	10^7	
Gray	8	10^8	
White	9	10^9	
Gold		10^{-1}	5
Silver		10^{-2}	10
No color			20

The resistors have a set of co-axials colored rings on them whose significance are listed in. The first two bands from the end indicate the first two significant figures of the resistance in ohms. The third band indicates the decimal multiplier the last band stands for tolerance or possible variation in percentage about the indicated values. Sometimes, this last band is absent and that indicates a tolerance of 20%. For example, if the four colors are orange, blue, yellow and gold, the resistance value is $36 \times 104\ \Omega$, with a tolerance value of 5% Color coded resistors (a) $(22 \times 102\ \Omega) \pm 10\%$, (b) $(47 \times 10\ \Omega) \pm 5\%$


Red
Red
Red
Silver
(a)


Violet
Yellow
Brown
Gold
(b)