SIEMENS

Magnetic Units

Magnetic Induction vs. Magnetic Field

Magnetic induction and magnetic field are often used synonymously. In many cases it is easy to conclude from magnetic induction to magnetic field and vice versa.

The magnetic field H describes the field generated by a free current only, the magnetic induction B describes the field generated by a current plus the effect of magnetization of a material. Materials can decrease or increase the magnetic induction. They are then called paramagnetic or diamagnetic materials.

The relation between magnetic induction and magnetic field in vacuum as well as in air or any other nonmagnetic environment is constant:

$$B = \mu_0 \times H.$$

The proportional factor μ_0 is called constant of permeability and has a value of $4\pi \times 10^{-7}$ Vs/Am or 1.256×10^{-6} Vs/Am in SI[1] units.

The relation is extended in magnetic materials to

$$B = \mu_r \times \mu_0 \times H,$$

where μ_r is a positive number. μ_r equals 1 in vacuum or air and can reach values above 1000 for soft magnetic materials.

Unit System	Magnetic Induction B	Magnetic Field H
SI[1] units	Tesla: 1 T = 1 Vs/Am^2	A/m
Older units	Gauss: 1 G = 10^{-4} T	Oersted: 1 Oe = $10^3/4\pi$ A/m

Conversion Table for Common Magnetic Units

	mT (Tesla)	G (Gauss)	kA/m	Oe (Oersted)
1 mT	= 1.0000	= 10.000	= 0.7960*	= 10.000*
1 G	= 0.1000	= 1.0000	= 0.0796*	= 1.0000*
1 kA/m	= 1.2560*	= 12.560*	= 1.0000	= 12.560
1 Oe	= 0.1000*	= 1.0000*	= 0.0796	= 1.0000

* in free air

[1] The SI units (“système internationale”) form a metric system of physical units all derived from the basic units kilogram kg for mass, meter m for length, second s for time, Ampere A for current, candela Cd for light intensity and mol for amount of mass. SI units are legally prescribed in many countries and should always be preferred!