Magnetic field of a finite length solenoid

\[ B = \frac{1}{2} \mu_0 n I \left( \frac{1}{\sqrt{l^2 + r^2}} \right) \]

Where: \( \mu_0 \) = magnetic permeability

\( n \) = number of turns

\( I \) = current

\( l \) = length of the solenoid

\( r \) = radius of the solenoid

Magnetic field of a multi-layered finite length solenoid

\[ \sum_{i=1}^{m} B_m = \frac{1}{2} \mu_0 n I \left( \frac{1}{\sqrt{l^2 + r_m^2}} \right) \]

Where: The sum of the magnetic fields of all the layers gives the total magnetic field

Magnetic force of a solenoid

\[ F = I L \times B \]

Where: \( I \) = current

\( L \) = length of the solenoid

\( B \) = magnetic field