25. A piece of copper wire has a resistance per unit length of 5.90 x 10^{-3} Ω/m. The wire is wound into a thin, flat coil of many turns that has a radius of 0.140 m. The ends of the wire are connected to a 12.0-V battery. Find the magnetic field strength at the center of the coil.

$$B_{coil} = \frac{N\mu_0 i}{2R_{Coil}}$$

We find current by using Ohm's Law

$$i = \frac{V}{R}$$

Resistance is found from

$$R = \lambda L$$

Where λ is resistance per length, L is found from the Number of turns times circumfrence

$$R = \lambda L = \lambda N 2\pi R_{Coil}$$

So current is

$$i = \frac{V}{R} = \frac{V}{\lambda N 2\pi R_{Coil}}$$

So the magnetic field is

$$B_{coil} = \frac{N\mu_0 i}{2R_{Coil}} = \frac{N\mu_0}{2R_{Coil}} i = \frac{N\mu_0}{2R_{Coil}}\left(\frac{V}{\lambda N 2\pi R_{Coil}}\right) = \frac{\mu_0 V}{4\pi\lambda R_{Coil}^2}$$

$$B_{coil} = \frac{\mu_0 V}{4\pi\lambda R_{Coil}^2} = \frac{\left(4\pi\ x\ 10^{-7}\ {T\ m}/{A}\right)(12.0\ V)}{4\pi\left(5.90\ x\ 10^{-3}\ {\Omega}/{m}\right)(0.140\ m)^2} = 1.038\ x\ 10^{-2}\ T$$

$$\boxed{B_{coil} = 1.04\ x\ 10^{-2}\ T}$$