Answer on Question #53348, Physics / Other

Task: A magnetic field of 100G(1G=10^{-4}T) is required which is uniformly in a region of linear dimension about 10 cm and area of cross section about $10^{-3}m^2$. The maximum current carrying capacity of a given coil of wire is 15 ampere and no of turns per unit length, that can be wound round a core is at most 1000 turns m^{-1}. Suggest some appropriate design particulars of a solenoid for required purpose, assume that core is not ferromagnetic.

Answer:

B=100G=100*10^{-4} T.

Number of turns per unit length that can be wound round the core,

$n \le 1.000 m^{-1}$

Now, $B = \mu_0 nI$ or $nI = \frac{B}{\mu_0} = \frac{100*10^{-4}}{4\pi*10^{-7}} \approx 8.000 Am^{-1}$

The maximum current-carrying capacity of the given coil of wire is 15 A. Let us take 10A as the safe limit. Then, n=8000/10=800m^{-1}, which is close to the permissible limit.

So that magnetic field is uniform over a length of 10cm, the coil may be wound on the core of length, say 5times 10cm i.e. 50cm. since n=800 m^{-1} , 400 turns will have to be wound.

Further, so that magnetic field is uniform over a cross-section , say 5times 10^{-3} m^2. If r is radius of the core, than $\pi r^2 \approx 5*10^{-3} \Rightarrow r = (5*10^{-3}/\pi)^{1/2} = 0.04m = 4cm$

Therefore, suggested particulars of the solenoid are: length=50cm, radius=4cm, current=10A and number of turns=400.