**Finite Element Analysis – Problem Sheet 2**

**Magneto-statics**

Figure 1 shows a cross-section through a cylindrical linear actuator (of a type which is often called a 'pot-core' solenoid actuator). This needs to be modelled as a 2D **axisymmetric** problem and not a planar problem. The actuator consists of a moving core which is simply an iron disk and a stator core which incorporates a simple cylindrical coil. The stroke of the actuator (i.e. the difference between the maximum and minimum airgap) is 2mm. The minimum airgap when the moving core is in its 'closed' position is 0mm. The coil can be represented as region with a uniform current density of 5MA/$m^2$ (i.e. 5A/$mm^2$).

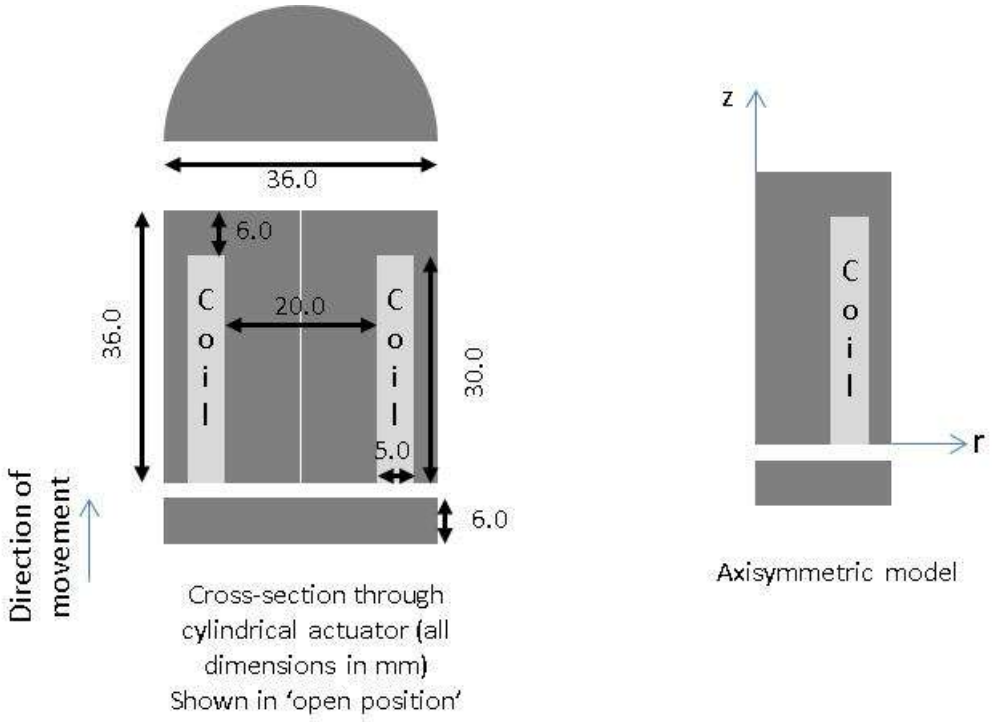


Figure 1 Details of pot-core solenoid

a) Assuming that the moving and stationary iron cores have a fixed relative permeability of 2000, calculate the following the force produced by the actuator for airgaps between the stator and moving element of 2mm and 0.1mm.

b) By replacing the core material by 'Pure Iron' from the FEMM materials library, re-calculate the forces at 2mm and 0.1mm. Any suggestions for the differences observed?

**Solutions**

For fixed μr of 2000 for core: Force at 2mm gap = 15.6N; Force at 0.1mm gap = 3745N

For 'Pure Iron': Force at 2mm gap = 16.4N; Force at 0.1mm gap = 628N

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