

72. The coil-solenoid mutual inductance is

$$M = M_{cs} = \frac{N\Phi_{cs}}{i_s} = \frac{N(\mu_0 i_s n \pi R^2)}{i_s} = \mu_0 \pi R^2 n N .$$

As long as the magnetic field of the solenoid is entirely contained within the cross-section of the coil we have  $\Phi_{sc} = B_s A_s = B_s \pi R^2$ , regardless of the shape, size, or possible lack of close-packing of the coil.