How Do Magnetic Shields Work?

Magnetic shielding materials re-direct a magnetic field so it lessens the field's influence on the item being shielded. Shielding does not eliminate or destroy magnetic fields, nothing does. It does, however, provide an easy path for the magnetic field to complete its path. You may think of it as a magnetic field conductor.

This leads to what type of material can provide the best path for magnetic fields and thus create shielding. Since the field is attracted to the shielding material it stands to reason that if a magnet is attracted to the material (ferromagnetic material), that material can provide some amount of magnetic shielding.

Technical data concerning the magnetic properties of shielding materials is based upon standard samples. Some variance in production runs may occur due to material thickness, annealing time and temperature tolerances.

We know that our shield will be dependent on the strength of the magnetic field it is in and how much of that field it occupies (the shield's physical size). We also know that the shield conducts or re-directs the magnetic field through the material from which the shield is made. Hence, the more material in the shield the more magnetic field it can re-direct. Putting all of this together we get a starting point for designing a shield.

B= (1.25*D*Ho) / t

Where:
»B = flux density in the shield material in gauss
»D = Diameter or diagonal of the shield in inches
»Ho = Ambient or source field in gauss
» t = Thickness of the shield in inches

B (flux density in the shielding material in Gauss) is the strength of the magnetic field that needs to be re-directed within the shield itself. It is important because once we estimate it we are able to see whether the shield can handle that much field. We do this by referring to the B-H (Flux Density - Magnetizing Force) curve for the shielding material. In our example we will use the curves for Magnetic Shield's Co-Netic and Netic materials.

Refer to Flux Density (B) vs. Permeability (µ) curve to obtain the permeability of the material when exposed to an ambient field that resulted in the B flux density obtained in Step 1. Find B on the left axis and scan across the graph to intersect the material curve. Find µ in the diagonal scales.

Approximate or expected attenuation can be determined by:
A = (µ * t) / D

Here is an example of using shielding equations to determine the attenuation obtained for a given material thickness:

Given a 2" diameter shield in a 2 gauss ambient field:

B= (1.25*2*2) / t = 5 / t

When t = .014, then B = 357 gauss.

From the flux density vs. permeability curve, when B = 357, the permeability of the shield material would be approximately 140,000 gauss.

Then = A = (µ * t) / D = (140,000 * .014") / 2" = 980