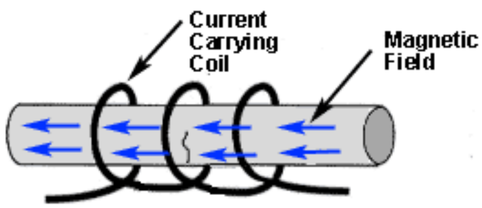
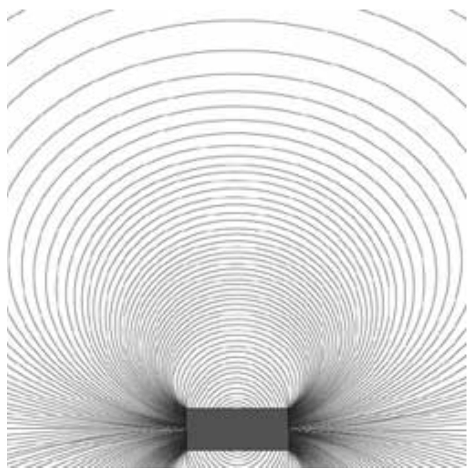
Longitudinal Magnetic Fields
Distribution and Intensity

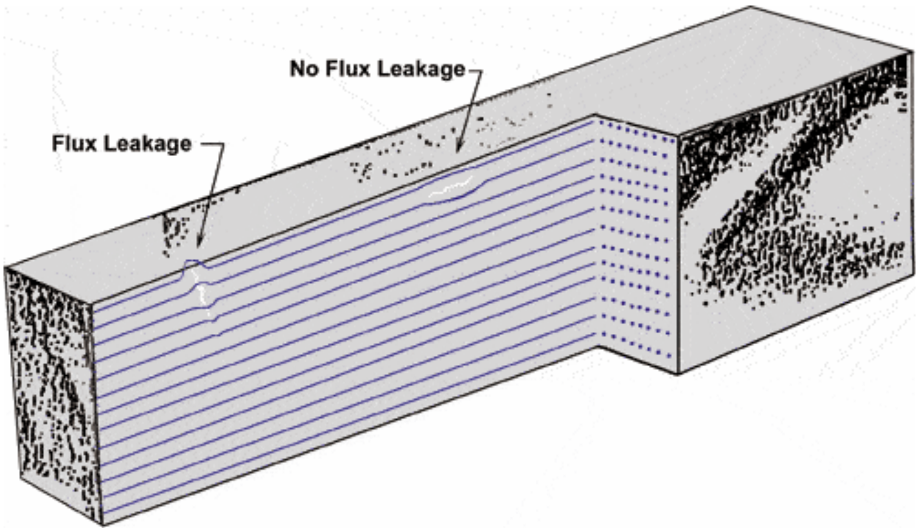


When the length of a component is several times larger than its diameter, a longitudinal magnetic field can be established in the component. The component is often placed longitudinally in the concentrated magnetic field that fills the center of a coil or solenoid. This magnetization technique is often referred to as a "coil shot."

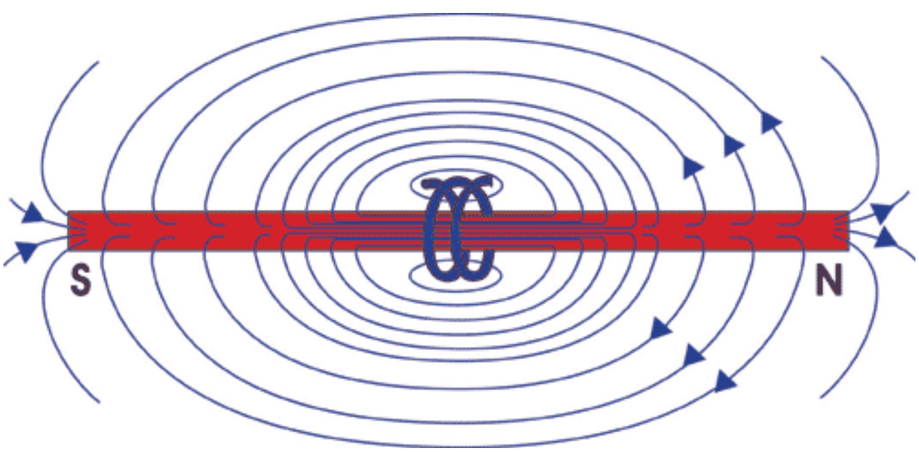


The magnetic field travels through the component from end to end with some flux loss along its length as shown in the image to the right. Keep in mind that the magnetic lines of flux occur in three dimensions and are only shown in 2D in the image. The magnetic lines of flux are much more dense inside the ferromagnetic material than in air because ferromagnetic materials have much higher permeability than does air. When the concentrated flux within the material comes to the air at the end of the component, it must spread out since the air can not support as many lines of flux per unit volume. To keep from crossing as they spread out, some of the magnetic lines of flux are forced out the side of the component.

When a component is magnetized along its complete length, the flux loss is small along its length. Therefore, when a component is uniform in cross section and magnetic permeability, the flux density will be relatively uniform throughout the component. Flaws that run normal to the magnetic lines of flux will disturb the flux lines and often cause a leakage field at the surface of the component.



When a component with considerable length is magnetized using a solenoid, it is possible to magnetize only a portion of the component. Only the material within the solenoid and about the same width on each side of the solenoid will be strongly magnetized. At some distance from the solenoid, the magnetic lines of force will abandon their longitudinal direction, leave the part at a pole on one side of the solenoid and return to the part at a opposite pole on the other side of the solenoid. This occurs because the magnetizing force diminishes with increasing distance from the solenoid. As a result, the magnetizing force may only be strong enough to align the magnetic domains within and very near the solenoid. The unmagnetized portion of the component will not support as much magnetic flux as the magnetized portion and some of the flux will be forced out of the part as illustrated in the image below. Therefore, a long component must be magnetized and inspected at several locations along its length for complete inspection coverage.



Solenoid - An electrically energized coil of insulated wire, which produces a magnetic field within the coil.

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