



AD-VANCE MAGNETICS, INC.

ISO 9001:2008 Certified Company

When And How To Use Magnetic Shielding

When electronic equipment intended to handle certain precise levels of input, whether logic or continuous signal, picks up undesired inputs at the operating, triggering or higher levels, a dysfunction occurs. The sources of EMI/RFI include conducted interference via wire, cable, and/or induced voltage and current attributable to electromagnetic fields that couple energy into the calibrated circuits. Sometimes the undesired source is obvious and can be subjected to line filtering or shielding suitable to the frequency and intensity encountered. However, unexpected and unpredicted sources and combinations may not be analyzed so easily.

The earth's magnetic field, of course, is pervasive but not always taken into consideration. Other unwanted fields including electromagnetic pulses of wide dynamic range can be caused by local severe thunderstorms and improperly grounded power cable systems acting as antennas for switching transients on the power lines, or for the low-frequency power currents. In aircraft, for example, instruments are closely packaged due to limited space. The radar tube's performance can be visibly distorted by nearby tachometers which may radiate a rotating magnetic field. The radar display is subject to some position shift each time the aircraft changes direction or attitude relative to the earth's field. A magnetic (i.e. permeable) shield enclosure minimizes these effects as well as supporting and positioning the tube. Clear, sharp CRT readouts are vital in many applications. Yet, without magnetic shielding at the tube neck, this cannot be optimally achieved. In electron microscopes, a magnetic shield around the vertical column prevents resolution deterioration caused by beam scattering, bending or displacement from normal optimum focus position. A sharp, clear focus is thus achieved, permitting full magnification.

Magnetic shielding is indispensable for providing an economical, repeatable controlled magnetic environment for determining response characteristics, sensitivity and orientation direction of magnetic sensor devices used for signature recognition, proximity sensing, etc. in a wide variety of industrial, military and commercial security applications. Complex, high resolution video recorded head assemblies must be shielded from a wide range of magnetic field interferences that may prevent full operational capability in recording/playback applications in TV studio/mobile, closed circuit, professional home and other video display systems.

Some comparatively new hazards to optimum electronic equipment functioning are still largely unrecognized, such as the low ceilings in modern concrete structures reinforced with steel beams. The metal in the ceilings is much closer to sensitive equipment than was the case in older, higher ceiled buildings. The resulting magnetic disturbance is substantially greater than 150 Gamma/cm, a typical magnetic field gradient in older reinforced concrete industrial buildings.

There are also hazards when analogue or digitized data on magnetic tape or cassettes is stored or transported. The fidelity of vital recorded information may be distorted or even stored



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or transported. The fidelity of vital recorded information may be distorted or even partially erased by unforeseen external magnetic fields, or by carelessness of unheeding or uninformed personnel, or by deliberate vandalism with powerful permanent magnets. Tape data protectors provide needed shielding against such hazards. The protectors are used by all branches of the armed forces, NASA, other governmental organizations and many private firms.

Once the offending field source is identified, one practical approach in determining needed shielding is to order a small quantity of heat treated ready-to-use magnetic shielding foil from a shielding manufacturer. It is available for immediate delivery in various convenient widths, lengths and shielding strengths for high or low permeability requirements with a range of electrical conductivities. Foil is easily, quickly cut with ordinary scissors and hand shaped to the desired outline. It is ideal for R/D, hard-to-get-at places, or for small quantity or extremely compact applications. Many shielding problems thus can be solved quickly. After hand shaping around the component to be shielded, the foil can be held in place with simple adhesive tape. Thickness and number of layers can be determined by ordinary trial and error procedure, or a formula to follow may be requested from the manufacturer. Begin by using a single layer and then adding layers until the desired shielding effect is achieved. When using multiple layers in steady fields and at low frequencies, the low permeability layer should be closest to the field source. This tends to increase the flux density shielding capabilities. The low permeability layer diverts the major portion of the field, permitting the high permeability layer or layers to operate in a lower reluctance mode. If you need relatively few shields or are experimenting, foil is the swift, economical solution.

Once foil shielding is functioning satisfactorily in either experimental or production applications, it is time to evaluate the economics. The cost of foil versus prefabricated shields for that particular application should be compared. A prefabricated shield is less costly in larger quantities and for certain complex applications. For designing and manufacturing prefabricated magnetic shields in-house, sheet stock may be ordered. Sheet stock may be formed by bending, stamping, drawing, finishing, etc. on ordinary sheet metal equipment and finished by plating, MIL spec painting, etc. For optimum magnetic shielding characteristics, shields must be heat treated after all forming, welding and machining operations. Ad-Vance Magnetics will guide you in the use of the various available states of heat treatment, such as the one which permits ease of forming (mill annealed) or the treatment which assures the maximum mechanically stable permeability or the absolute maximum permeability (which is not necessarily stable mechanically or thermally in some high nickel alloys). High electrical conductivity and high magnetic permeability both contribute to the effectiveness of thin foils in fast-rising pulse shielding by reducing the skin depth. Distinctions have lately been made between the case where the foil thickness exceeds the skin depth and where it is greater. This type of shielding against pulse-type interference achieves the highest order of shielding effectiveness generally obtained by any means. Attenuations between 300 dB and 1000 dB are not unusual.