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Wall Penetration in Shielded Rooms

This note provides suggestions for effectively dealing with slots, holes and ducts in a shielded room.

Most RF companies have a shielded room (or "screen room") for testing of sensitive circuits and equipment. In theory, the room takes advantage of Gauss' Law to keep out interfering noise and signals. However, power, ventilation and other utilities must be available, as well as signal lines connected to equipment located outside the room. Those penetrations of the shielded space must not allow unwanted energy into (or out of) of the room.

Panel Seams

An overlooked "gap" in the shielding is the area where segments of the wall, floor and ceiling shielding material meet. Those seams must be made RF-tight. The best method is welding or soldering. Compression joints with bolts or clamps are also common. In some cases, adequate performance may be achieved by simple overlapping of the shielding materials and taping with wide metal foil tape.

Doors

Doors are the most critical part of all shielded room installations. They are large and are used regularly. Obtaining good contact around the edges is critical, as is reliable construction that will maintain performance over time and heavy usage.

Door edges may achieve RF suppression through the use of conductive gaskets, with contact made by a sliding force (see Fig. 1) or by compression. There are a wide variety of materials available for the required flexible metal contacts (e.g., finger stock). Conductive rubber gaskets may also be used.

Air Vents

Ventilation is typically accomplished using metal "honeycomb" with cell size small enough to act as waveguide-below-cutoff at the highest frequency to be used. A 1-inch thick honeycomb with 3/16-inch cells will have 120 dB shielding performance from 100 kHz to 10 GHz.

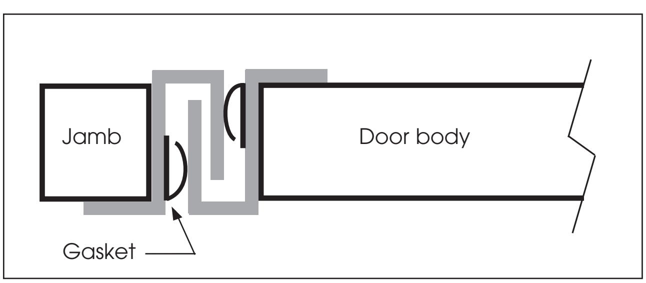

Figure 1 · A high performance door seal. The actual shape, and the attachment method for the gaskets, will vary among manufacturers.

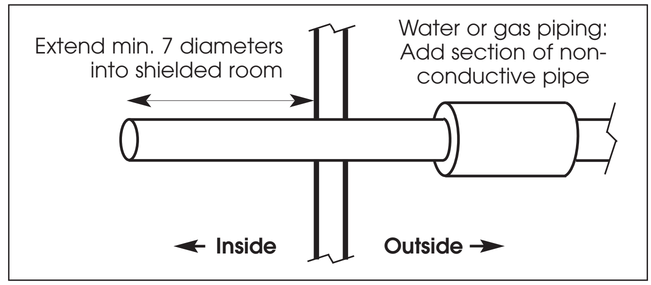

Figure 2 · Conduits, pipes and tubes must have a length sufficient to act as a waveguide (not a slot) and a small enough diameter for a high cutoff frequency. A rule of thumb is that the length/diameter ratio of the in-room section should be > 7.

Lighting

Lighting placed external to the room can shine through honeycomb material, similar to air vents, although this will be highly directional. The typical alternative is to use incandescent lighting powered by the filtered lines entering the shielded area.

Power and Control Wiring

Electrical wiring entering the shielded room should pass through a length of conduit that is bonded to the wall (see Fig. 2). The length and diameter must be appropriate to act as waveguide-below-cutoff at the highest desired shielding frequency. This wiring should also be RF filtered for both common-mode and differential-mode rejection.

Signal Wiring

Coaxial cables should have the shield bonded to the enclosure wall and should have common-mode EMI suppression (e.g., ferrites) to minimize noise and interference that may be transferred to the signal line. Data communications should be done using fiber optics, which can enter the room via small waveguide sections, such as a section of honeycomb material.

This note is just a list of reminders. Be sure to obtain reliable information before implementing a specific method. Finally, be sure to test the resulting installation to ensure that it achieves the desired level of performance.

Reference

1. Leland Hemming, *Architectural Electromagnetic Shielding Handbook*, Ch. 7-8, IEEE Press, 1992.