THE USE OF A COPPER CONDUCTIVE COATING FOR ARCHITECTURAL SHIELDING PURPOSES

A newly-formulated copper conductive coating proves to be an effective tool in achieving shielding effectiveness for walls, floors and ceilings in architecturally-shielded buildings and building areas.

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During the past decade, the term "architectural shielding" has been encountered with increasing frequency. Within both the military and the commercial sectors of the economy, there is now a vivid awareness of the need for shielding against electromagnetic interference (EMI). The term "architectural shielding" refers to an overall design and construction of an entire building or a building area with the specific intent to:

- Protect electronic equipment from external disruptive/destructive radio frequency emanations (radar, high power transmitters, nuclear/lightning electromagnetic pulse effects).
- Protect personnel working within buildings from hazardous environmental conditions.
- Prevent classified information processed within a building/area from being intercepted through the utilization of espionage techniques.

Simply stated an "architecturally-shielded" building features two dimensions of protection. Materials have been incorporated within its structure which will protect the people and/or equipment inside from the external electromagnetic environment, and electromagnetic emanations from internal equipment cannot exit the building. An electromagnetic shield consists of any barrier which reduces the level of the electromagnetic field. The extent to which the shield reduces (attenuates) the field is referred to as shielding effectiveness (SE).

In the way of a very brief review, the standard unit of measure for shielding effectiveness is the decibel (dB) and dB is expressed as the ratio of electromagnetic field strength before and after a shield is in place, *i.e.*,

$$SE = 20 \log E_1/E_2$$

where:

E_1 = field strength, no shield
E_2 = field strength, after imposing a shield

When stating the particular shielding effectiveness (SE) for a material, the SE versus frequency must be defined. Shielding effectiveness by itself is meaningless unless the frequency where SE was measured is stated.

The conventional method for shielding a building/area involves incorporating steel/copper/aluminum foil sheets within walls, floors and ceiling areas. This method has proven to be effective and, in many cases, must still be used because of specification requirements. However, these aforementioned methods become quite labor intensive and costly when used for shielding requirements of 60 dB between 100 kHz (electric field) and 1 GHz. This article will present an alternative method for achieving >60 dB of shielding effectiveness between 100 kHz to 1 GHz with the use of copper paint.

One manufacturer has developed a copper paint which can be utilized during the construction phases of entire buildings, or within selected building areas in order to achieve shielding effectiveness figures of 60 dB (minimum) between 100 kHz and 1 GHz. This architectural shielding wall paint is a specially-formulated copper conductive coating for use as a shielding system for walls, floors and ceilings of entire buildings or for selected internal areas. The copper paint may be applied by roller, brush or spray methods. The paint is totally compatible with masonry, wallboard, wood and a wide variety of plastics. The use of copper paint

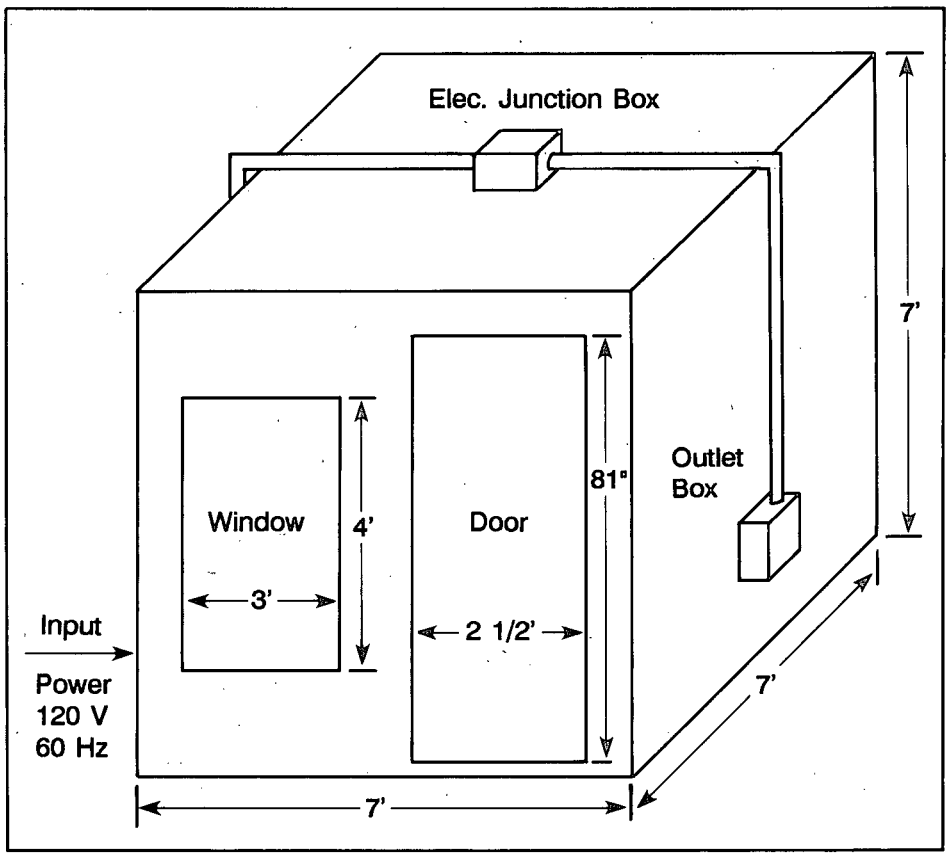

Figure 1. Basic Room Configuration.

as a shielding medium for business equipment / enclosures is widely known and for the most part, these paints have proven effective. This copper coating is a new water-based conductive coating and maintains all of the mechanical and electrical characteristics of the solvent based paints. This copper conductive paint has been tested for adhesion at the Underwriters Laboratory, and for mechanical integrity (wear) utilizing Tabor abrasion and Gardner scratch tests. The temperature/humidity testing was carried out at 140° F. Additionally the paint was evaluated in terms of oxidation and shielding effectiveness. In order to determine just how effective the paint would be when applied to wallboard utilizing standard construction methods (taping, etc.), a test sample room was constructed using 2" x 3" framing, wallboard and plywood. Room dimensions were 7' x 7' x 7'. The entire room was placed on a portable platform. Figure 1 illustrates the basic room configuration. The room contained a door, window, two duplex electrical outlets, a telephone jack outlet and track lighting. The room was constructed using the same construction techniques which would normally be used for a house/office where wallboard was used for walls and ceilings and where plywood was used for flooring. Joints were taped and finished with wallboard compound. Upon completion of the construction phase, all walls, and both the floor and door were painted with the copper architectural shielding paint. Paint was applied by roller and brush (for edges and corners). Once paint was dry, the electrical outlets, telephone jack, and track lighting were installed. Aluminum screening was placed over the window and stapled in place. As a final step, copper tape was placed around the window frame and screen. Conductive gasketing was placed around the door frame to provide an RF barrier.

Input 60 Hz power to the room was routed through a power line filter. The voltage output of the filter was routed via conduit to a junction box at the top center of the room (externally), where power was in turn routed to two duplex power outlets. Power to the track lighting was obtained via the external junction box. The telephone jack in the wall of room was filtered.

Essentially the test sample was a shielded room containing power, and lighting. The thickness of the

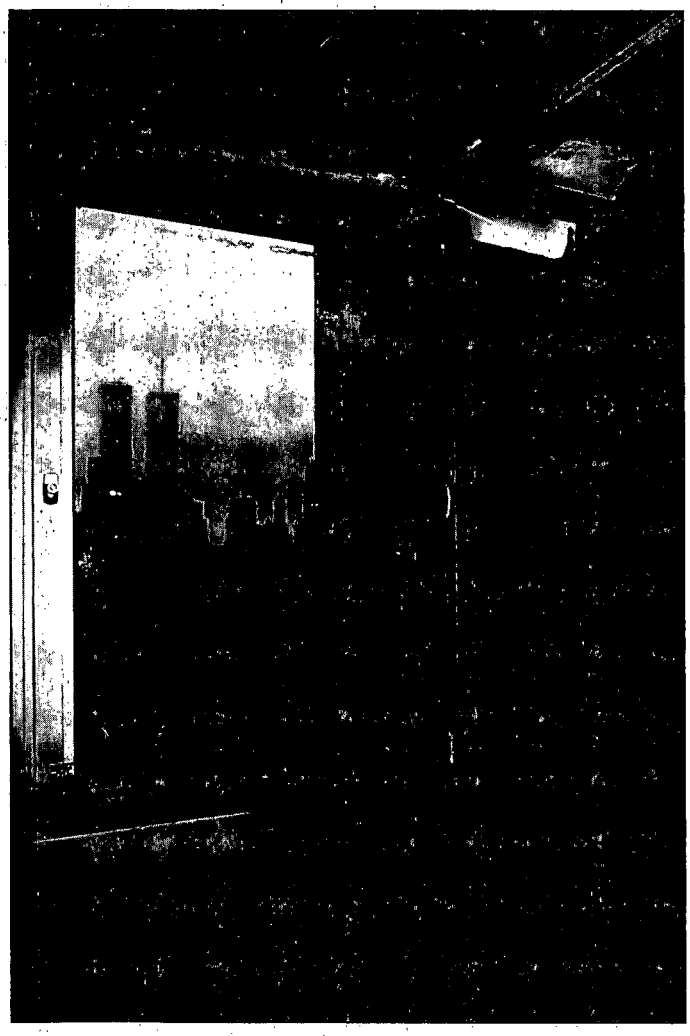

Figure 2. Studio Section Coated with Copper Conductive Paint.

copper paint was approximately 2 mils.

The sample was tested for shielding effectiveness utilizing MIL-STD-285 test techniques. The test equipment utilized had a dynamic range in excess of 80 dB throughout the applicable frequency range. Test results showed shielding effectiveness figures in excess of 60 dB between 10 kHz to 100 MHz (66 dB), with leakage occurring at the door frame and window frame areas. Even with the leakage area, shielding effectiveness maintained levels above 50 dB (1 point) from 100 MHz to 800 MHz - with most points above 60 dB.

It would appear from the overall test results that the copper paint does indeed provide a viable alternative to copper, aluminum/foils and copper screen for architectural purposes. A cost analysis of utilizing copper paint, rather than conventional methods currently in use, can present dramatic proof of reduction in the cost per square foot for a 60 dB room/building. The paint has been used with great success in several communication centers and at a large (10,000 square foot) recording studio in Brooklyn, New York. Figure 2 shows a section of that studio. This view was taken from inside looking through a shielded window towards the World Trade Center. Future plans call for the use of this paint on other enclosed facilities both in the United States and abroad.■

ADDITIONAL INFORMATION

The use of copper paint for architectural shielding purposes is a relatively recent development. For additional information on test results and detailed construction/application notes, contact Roy Bjorlin, Jr. at the Spraylat Corporation, Mt. Vernon, NY (914) 699-3030.