Department of Electrical and Computer Systems Engineering

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EPRI Shielded Room Testing

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1. Introduction

Monash University is constructing an electromagnetically screened room as a test chamber for its EPRI research group. The room is to provide at least 50 dB attenuation to radiated low frequency magnetic fields over the frequency range 10 kHz-10 MHz.

Testing the shielding effectiveness of the room is to be done at several stages of the room completion due to the rooms construction.

2. General Construction

The room comprises an outer shell of plaster-board on a wooden frame. Inside the wooden frame is a lining of particle board to which the copper screening sheets are attached by screws and liquid nails. Joints between the copper sheets are folded over and then soft soldered. Inside the copper screening sheets a second, independent wooden frame, unattached to the copper, has been built (Fig 1.). This second frame is to be lined with plasterboard and is for attaching the room fittings to.

Figure 1. Framing inside the copper cladding

3. Electrical Construction

3.1. The room is fully enclosed in sealed copper cladding. The joints between copper sheets are folded over and seam soldered. Screws into the particle-board through the copper have their heads soldered over onto the copper (Fig 2).

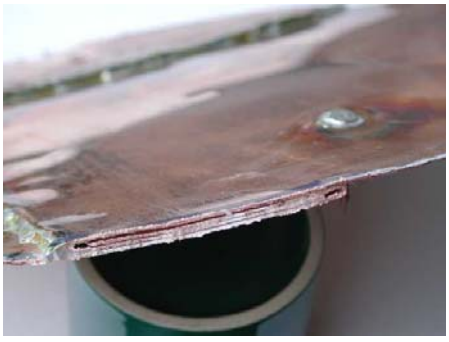


Figure 2. Section of the copper cladding (removed to fit the penetrations) showing the folded and soldered joining of the sheets and the soldering of one of the screw-heads to the copper sheet.

3.2. The room has special cut-off waveguide honeycomb ventilation and climate control penetrations through the copper cladding (fig. 3).

Figure 3. Cut-off waveguide ventilation penetration

3.3. Services such as compressed air and fibre optic data lines enter the room through single cut-off waveguide penetrations through the copper.
3.4. The copper clad access door is to be fitted with conductive spring fingers to seal against the brass door jam when the door is closed.

4. Stages of Testing for Radiated Field Penetration

The room is to be tested at three stages of construction

4.1. When the room is completely copper lined and with no penetrations from the outside world and the copper clad access door is electromagnetically sealed to the copper lining with wide strips of copper tape (before the spring fingers are fitted). The tape has conductive glue bonding it to the door and room lining
4.2. As in 4.1 but with the cut-off waveguide penetrations fitted into the screened room walls
4.3. As in 4.2 but with the door sealed to the brass door frame by beryllium spring fingers

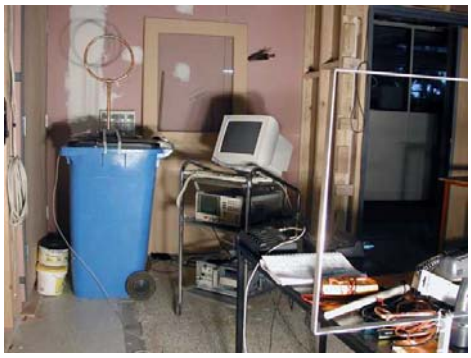
Measurements as per 4.1 have been conducted at this stage.

5. Radiated Field Penetration Tests

5.1. Testing of the walls of the room for radiated low-frequency magnetic screening was done using 12” diameter single turn loop antennas spaced 12” from either side of the wall being tested as per MIL STD 285 (see Figs. 4(a) and 4(b)).
The transmitting loop antenna was connected to a low frequency signal source and a low frequency power amplifier.
The receiving loop antenna connected to a low noise amplifier and a spectrum analyser.

The signal loss between the two antennas was then measured at 10 kHz, 1 MHz and 10 MHz.
The same equipment arrangement was set up out of doors but with no wall between the loop antennas. Again the loss between antennas was measured.
The difference between the signal loss measured with the wall between the antennas and that with no wall present was the attenuation provided by the wall to near field magnetic radiation.

Transmitting from inside the room
Figure 4(a)



Receiving outside the room
Figure 4(b)

This procedure was followed to measure the attenuation provided by each wall and by the copper door at each frequency.

6. Results of the Measurements

Frequency	North Wall Atten dB	East wall Atten dB	South Wall Atten dB	Door closed, Atten dB	Door Sealed Atten dB
10 kHz	>31	>31	>31	31	42
1 MHz	>46	>46	>46	22	53
10 MHz	>66	54	>66	>66	>66

Table 1. Wall attenuation to radiated, low frequency, near- field, magnetic fields in dB

At the time of measurement the ventilation penetrations had not yet been put in and so the measurements of the door and wall attenuations were taken with the doors closed but not sealed. These measurements established that the door was the major entry point for radiation.
Due to the limited measurement time available when the room was sealed by closing the doors and taping them with adhesive copper tape, measurements could only be re-taken of the door region.
When the ventilation penetrations are put into the room the measurements for the wall and door attenuations will be repeated with the door sealed by copper tape over the gaps between door and door-jam.
The tape will then be removed, electromagnetically sealing spring fingers will be fitted to the door jam and the attenuations will be re-measured.

7. Conclusions

7.1. The walls are providing the required screening level of more than 50 dB to near-field radiated magnetic fields at 10 MHz.

7.2. At lower frequencies radiation appeared to be entering the room through the gaps around the closed double doors. At 1 MHz the attenuation measured was 4 dB less than the required 50 dB but the dramatic increase in attenuation at the door when it was sealed as opposed to being merely closed (31 dB) suggests that the specified attenuation will be easily achieved once the door is properly sealed. At 10 KHz the sealing of the door with tape increased the door attenuation by 11 dB suggesting the wall attenuation will increase by at least this amount with sealed doors. This performance is expected to improve again when the beryllium EMC spring figures are fitted to the door-frame and the copper tape is dispensed with.

7.3. The tests must be repeated and passed at stages 4.2 and 4.3 of construction to validate the room performance.