MRI RF Shielded Room Shielding Effectiveness (SE) Testing Method

EEP
European EMC Products
Technical Datasheet

Final RF Test on an RF Shield

Final RF test carried out on completion of installation but prior to internal decorative lining and delivery of the MRI magnet.

1. Radiated Attenuation Test Method

1.1 Introduction

The aim of the test method is to outline the test procedures employed to verify the shielding effectiveness of the RF Shield meets the attenuation requirements when tested as per IEEE 299 – 2006, Standard Method for Measuring the Effectiveness of Electromagnetic Shielding Enclosures.

Shielding Effectiveness

The shielding effectiveness (SE) of an RF shield is defined by the ratio of signals strengths inside and outside of the shield, i.e., how much does the shield reduce the signal. To make this easier to use it is expressed as a ratio in dB (decibels).

Shielding effectiveness (dB) = 20 log V1/ V2.

V1 is the signal strength outside the shielding and V2 the signal strength inside the shield. As SE is expressed logarithmically it is important to note these ratios:

60 dB is a reduction by a factor of 1,000

80 dB is a reduction by a factor of 10,000

100dB is a reduction by a factor of 100,000.

1.2 Pre-requisites

The following requirements are to be undertaken prior to commencement of the testing programme: All doors, vents, access panels and apertures closed, or RF sealed.

1.3 Relevant Specifications

The testing shall be performed generally in accordance with the following test specification:

Title: IEEE 299 – 2006, Standard Method for Measuring the Effectiveness of Electromagnetic Shielding Enclosures

The Institute of Electrical and Electronics Engineers, Inc.

1.4 Radiated Attenuation Performance Requirements of Scanner Suppliers

GE	100dB (10MHz – 100MHz)	Planewave
Siemens	90 dB (15-128 MHz)	Modes not specified
Philips - H Field	10 MHz – 15 MHz	90dB E
Field & Plane Wave	5 MHz – 130 MHz	100dB

1.5 Test Frequencies

Tabulated below are the discrete frequencies, field, and attenuation requirements for the witnessed compliance testing of the MRI rooms. H = Magnetic mode E = electric mode.

All frequencies can be modified if scanner supplier has new requirements. For Siemens Scanner Rooms

For Siemens Scanner Rooms

Frequency (Hz)	Field	Specified Attenuation (dB)
15 M	E	90
50 M	E	90
100 M	E	90
115 M	E	90
128 M	E	90

For GE Scanner Rooms

Frequency (Hz)	Field	Specified Attenuation (dB)
10 M	E	100
50 M	E	10
100 M	E	100

For Philips Scanner Rooms

Frequency (Hz)	Field	Specified Attenuation (dB)
10 M	H	90
15 M	H	90
500 M	H	100
100 M	H	100
130 M	H	100
5 M	E	100
15 M	E	100
50 M	E	100
100 M	E	100
130 M	E	100

2. Test Procedure

A Shielding Effectiveness Test is a comparative measurement of a signal transmitted at a known frequency and signal strength with, and without the shield in place. The test comprises three parts:

a. Checking ambient signal levels (see para 2.1). This establishes the background electromagnetic environment and enables frequencies with high background signals which could mask test signals to be avoided.

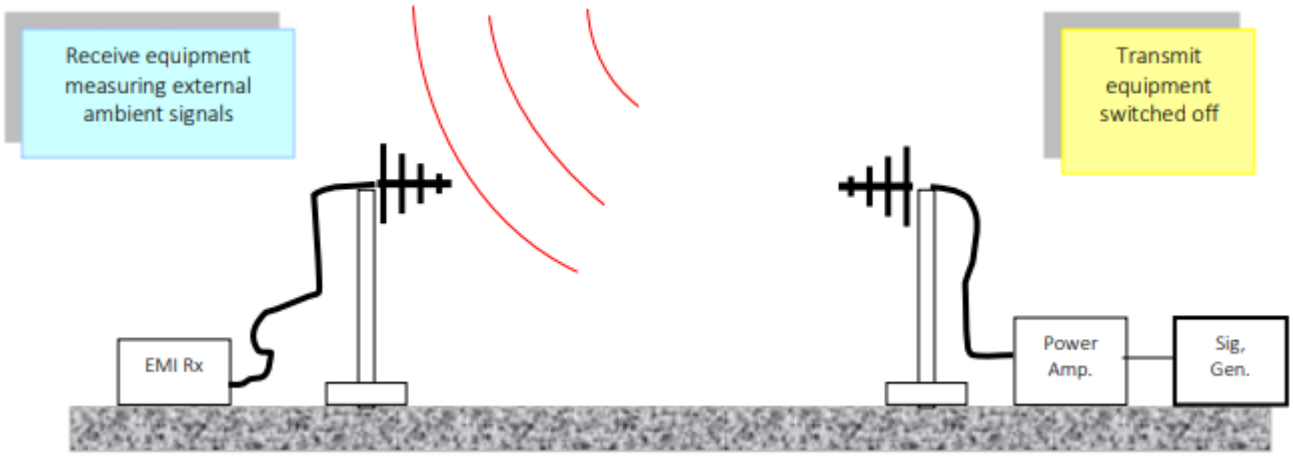
b. Setting reference measurement levels (see para 2.2). This is when signals are transmitted at a set frequency, antenna separation and power level and the actual signal level received is noted. This then becomes the measurement level that the shielding effectiveness is compared with.

c. Shielding Effectiveness Tests (see para 2.3). The reference measurement set up is repeated but with the transmit and receive antennas, and equipment now either side of the shielded enclosure. The difference between the recorded signal and the reference measurement is the SHIELDING EFFECTIVENESS of the enclosure. This process is repeated for the selected frequencies and test positions.

2.1 Ambient Measurements

At each selected test frequency, and OUTSIDE the shielded enclose a reading of the external electromagnetic environment is taken and noted. During this process the transmit equipment should be switched off in case leakage from the signal generator affects the reading.

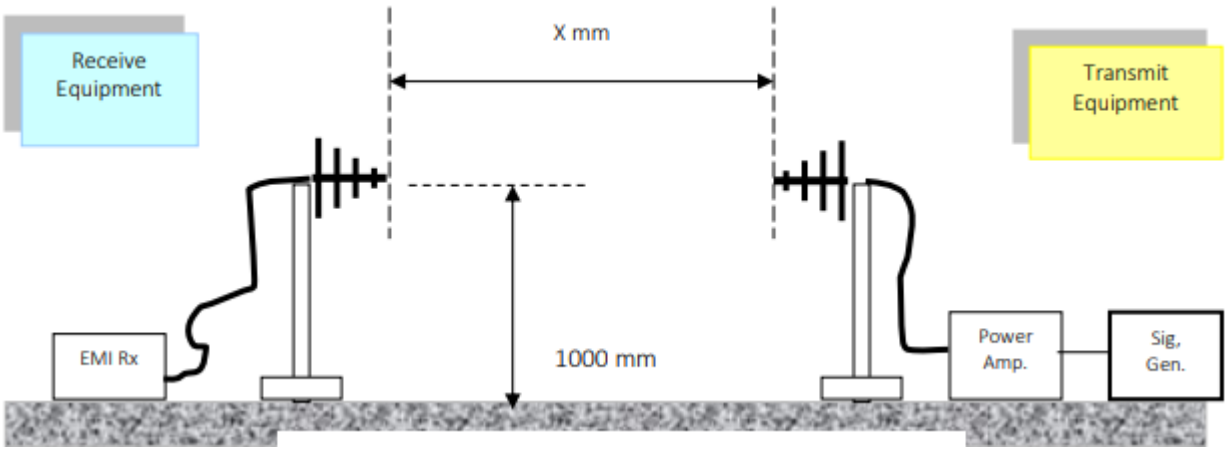
If a test frequency co-insides with a strong external signal, i.e. a radio or mobile communications frequency, then it is advisable to move the test frequency to the nearest suitable frequency with a low ambient level.



Ambient Measurement Set Up

2.2 Reference Measurements

As shielding effectiveness (SE) measurements are a ratio, prior to testing a reference level for each test frequency will be established. This confirms the power level being transmitted and the SE reading will be compared with this. The transmit and receive antenna separations (X in sketch below) may vary at different frequencies but will generally be between 600 and 1000 mm.

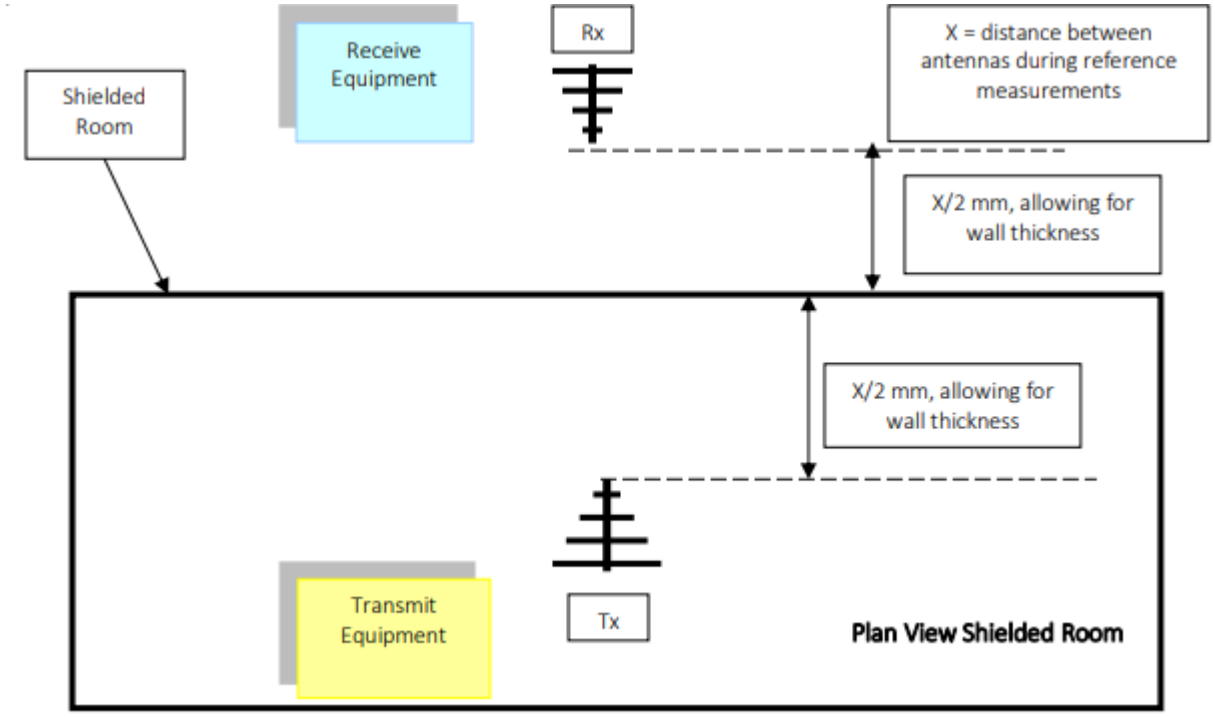


Reference Measurement Set Up

Reference measurements will be carried out within the Main Building but away from large metallic objects (i.e., the RF Shielded Rooms). A separation from metallic objects of at least 5 m should be maintained.

2.3 Shielding Effectiveness Tests

When the reference measurements have been completed the Transmit and Receive Tx/Rx configuration is repeated but this time with the antennas either side of the shielded room. The difference between the Receive (Rx) signal and the reference signal levels is the shielding effectiveness (SE). This is repeated at all the test points and all selected frequencies.



2.4 Test Positions

Door, Window and Filter Penetration Area

2.5 Test Results

Test results will be issued in tabular form for all test positions and frequencies. 2.6 Test Report and Certificate The test results shall be recorded and a report on the testing information will be issued along with a certificate of test for the RF shielded room.

About Us

Established in 1996, European EMC Products (EEP) are an established British company whose experience and understanding of the science of shielding makes it an ideal partner in whom you can place your trust with confidence.
The purpose of installing EEP shielding systems is to protect people and equipment against the threats posed by electromagnetic and radio frequency (RF) interference, radiation, magnetic fields and electromagnetic pulses.
Our diverse range of turnkey products and services, including design, project management, testing and consultancy are delivered across multiple sectors to an international client base.

Quality

European EMC Products Limited are registered to BS EN ISO 9001:2015, Certificate Number FS38901.
Registered Scope: The design, assembly, installation, servicing and testing of RF Shielded Structures and equipment including EMI Shielding, Blast Doors, Gas Tight Doors and specialised mobile Electromagnetic Pulse Protection (EMPP) containers.
Radio Frequency, Magnetic Shielding and Quench systems for MRI (Magnetic Resonance Imaging) scanners.
The design, assembly and installation of Ionising Radiation Protection facilities.
The design, manufacture and installation of LED lighting systems for medical applications.
EEP Filters Limited are registered to BS EN ISO 9001:2015, Certificate Number FS38901.
Registered Scope: The design, manufacture, management of installation and testing of high performance EMC and EMP Power and Data Line Filters.

Disclaimer

NB: All the information provided within this datasheet is for reference only. Product specifications are subject to change without notice.