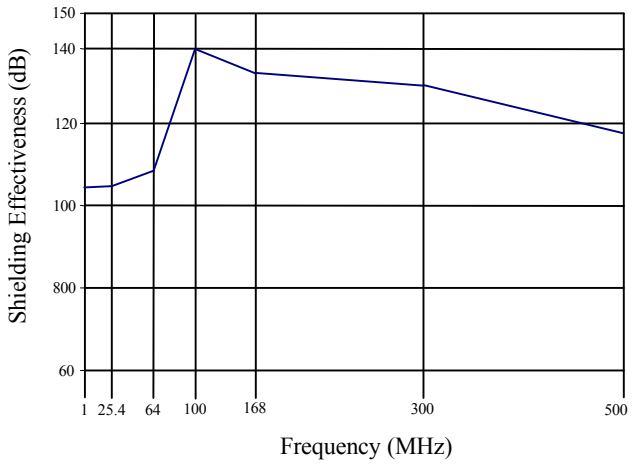
MRI Fabric for EMI & RFI Shielded Enclosures

Laird Technologies' Nickel/Copper Polyester Nonwoven Fabric is a unique shielding material manufactured using a patented, proprietary technology. The base layer is highly conductive copper, with an outer layer of nickel for corrosion resistance. Nickel/Copper Polyester Nonwoven Fabric offers excellent surface conductivity, shielding effectiveness, and corrosion resistance for MRI shielding applications.

Ni/Cu Polyester Nonwoven (3027-217)
Shielding Effectiveness per MIL-STD-285 (Mod.)



Physical Properties

Property	Units	Value	Advantage
Substrate		Polyester Nonwoven	Flexible, Breathable
Metal		Ni/Cu	Corrosion Resistant Highly Conductive
Basis Weight	oz./yd.^{2} g/m.^{2}	1.8 – 3.0 61 – 102	Light Weight
Thickness, (nominal) (ASTM D1777)	Inches microns	0.017 432	Provides excellent shielding
Metal Weight	oz./yd.^{2} g/m.^{2}	0.58 – 1.40 20 -47	Excellent Electrical Properties
Max Short Duration Temperature		210°C	Allows Thermal Processing

Electrical Properties

Property	Units	Value[fi]
Surface Resistively (ASTM F390)	ohms/square	≤ 0.07
Far-field Shielding	Effectiveness	(typical)
At 1 MHz	dB	104+
At 25.4 MHz	dB	104+
At 64 MHz	dB	107+
At 100 MHz	dB	140+
At 168 MHz	dB	133+
At 500 MHz	dB	118+

Mechanical Properties

Property	Units	Value[fi]
Tensile Strength CMD/MD◊ (ASTM D5035)	lb./in N/100mm	7.5/18.5 128/324
Elongation, MD (ASTM D5035)		9%

[fi] Typical values for greige fabric.
◊ Cross Machine Direction/Machine Direction

Product No.: 3027-217

Product Development & Analysis Group
Test Report – 09142004-B-03

Requested By: Mike Lambert

Distribution: M. Lambert, P. Stus, G. Fenical, F. Eaton, T. Kuhns, D. Fitzgerald. L. Ramirez

Objective:

Compare the radiated shielding effectiveness of Laird Technologies MRI "A" Fabric shielding material after accelerated aging for the equivalent of 10 and 20 years exposure. The comparison was to as-manufactured material.

Part Description:

- Standard (unexposed) MRI "A" Fabric 26" X 26"
- 10-Year Aged MRI "A" Fabric 26" X 26"
- 20-Year Aged MRI "A" Fabric 26" X 26"

Test Method:

Life Cycle Accelerated Corrosion Test - Mixed Flowing Gas II: This test is used to simulate the life-cycle performance of EMI product. The test was conducted at Battelle Laboratories in Columbus, Ohio in accordance with ASTM Test Method B827 " Standard Practice for Conducting Mixed Flowing Gas Environmental Tests" and ASTM B845 " Standard Guide for Mixed Flowing gas Test for Electrical Contacts". The MFG class II atmosphere was used for this testing, which simulates a standard office/hospital environment. The environment conditions during the MFG II test are listed in Table 1. Multiple MRI fabric test samples were hung in the MFG II environment for times that corresponded to either 10 or 20 years of exposure.

Table 1 MFG II Exposure Conditions

Parameter	Value
Temperature (°C)	30
Relative Humidity (%)	70
H_2S (ppb)	10
Cl_2 (ppb)	10
NO_2 (ppb)	200

Radiated Shielding Effectiveness: The radiated shielding effectiveness of the MRI fabric test samples, as well as an unexposed sample, was evaluated in accordance with a modified version of MIL-DTL-83528, "Gasketing Material, Conductive, Shielding Gasket, Electronic, Elastomer, EMI/RFI" (Radiated Test). A special 26" x 26" test fixture "picture frame" held the fabric in compression to the common wall 26" x 26" radiated test fixture. This configuration exposed a 26" x 26" section of the conductive fabric sheet to the radiated signal. The frequency range of the radiated test was 10 MHz to 18GHz.

For the test bandwidth of 10 MHz to 25 MHz, Dipole antennas were used. For the test bandwidth of 40 MHz – 200 MHz, Biconical antennas were used. For the test bandwidth of 200 MHz to 1 GHz, Log periodic antennas were used. Linear horn antennas were used from 1 GHz to 18 GHz. Radiated testing was performed utilizing an Marconi 2022D signal generator and a Rhode & Schwarz ESIB40 Spectrum Analyzer from 10 MHz – 200 MHz. Above 200 MHZ a Hewlett Packard 8722D vector network analyzer was used to perform swept measurements. Figure 1 shows the radiated test configuration.

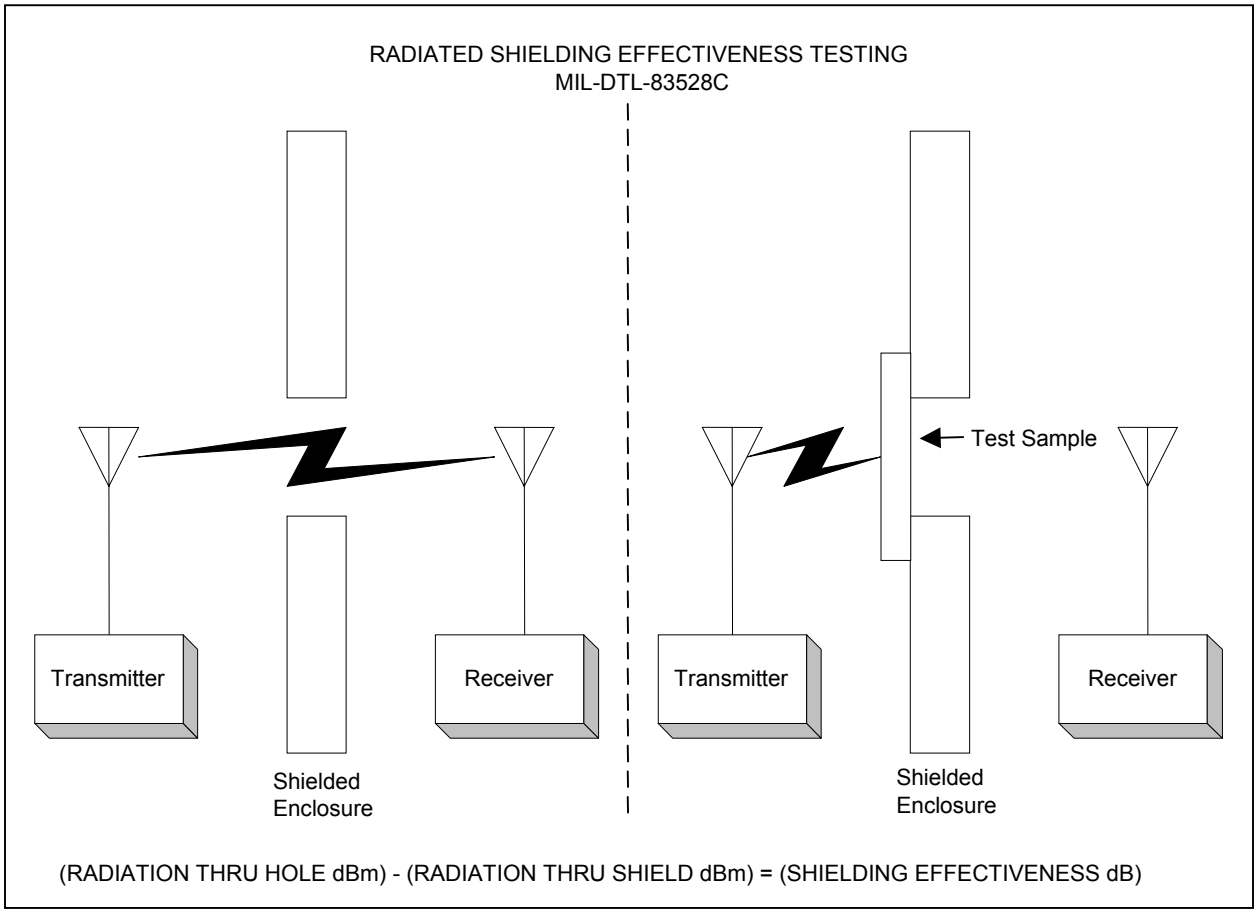


Figure 1 Test Set-Up Configuration

Table 2 Standard Radiated Shielding Effectiveness Test Equipment

Model Number	Description	Frequency Range
2022D	Marconi Signal Generator	10 kHz – 1000 MHz
ESIB40	Rhode & Schwarz Spectrum Analyzer	20 Hz – 40 GHz
HP 8722D	Vector Network Analyzer	50 MHz – 40 GHz
HP/8347A	RF Preamplifier	100 kHz – 3 GHz
HP 8449B	RF Preamplifier	1 GHz – 26.5 GHz
HP 83051A	Microwave System Preamplifier	45 MHz – 50 GHz

The absolute performance calibration of equipment requiring calibration is performed on an as needed basis in accordance with MIL-STD 45662. However, calibration periods do not exceed one (1) year. The test equipment is capable of making measurements within tolerances of at least +/- 2dB amplitude and +/- 2% frequency deviation. Equipment certifications showing traceability to NIST (National Institute of Standards and Technology) are maintained on file at Laird Technologies offices in Delaware Water Gap, PA. All equipment is checked and verified for proper operation before and after each series of tests. The standard pieces of test equipment are listed in Table 2.

Test Results:

The shielding effectiveness of the unexposed, 10 year and 20 year test samples are presented in Figure 2. The samples were tested over a frequency range of 10KHz to 18GHz. MRI rooms are evaluated at a limited number of discrete frequencies between 25MHz and 200 MHz. The graph shows that there is no difference in shielding performance between the three test samples. In addition, visual inspection of the exposed samples found not difference in appearance compared to the unexposed sample.

Conclusion:

Since there is no difference in shielding effectiveness for test samples with environmental exposures up to 20 years the data shows that this new MRI A fabric shielding product will remain very sable over the life of the MRI room. A typical MRI enclosure is specified to provide 100 dB of shielding effectiveness in the range of 25 MHz to 200 MHz. All samples provided greater then 100 dB of shielding at the lower frequency of 25 MHz and greater then 130 dB at 200 MHz.

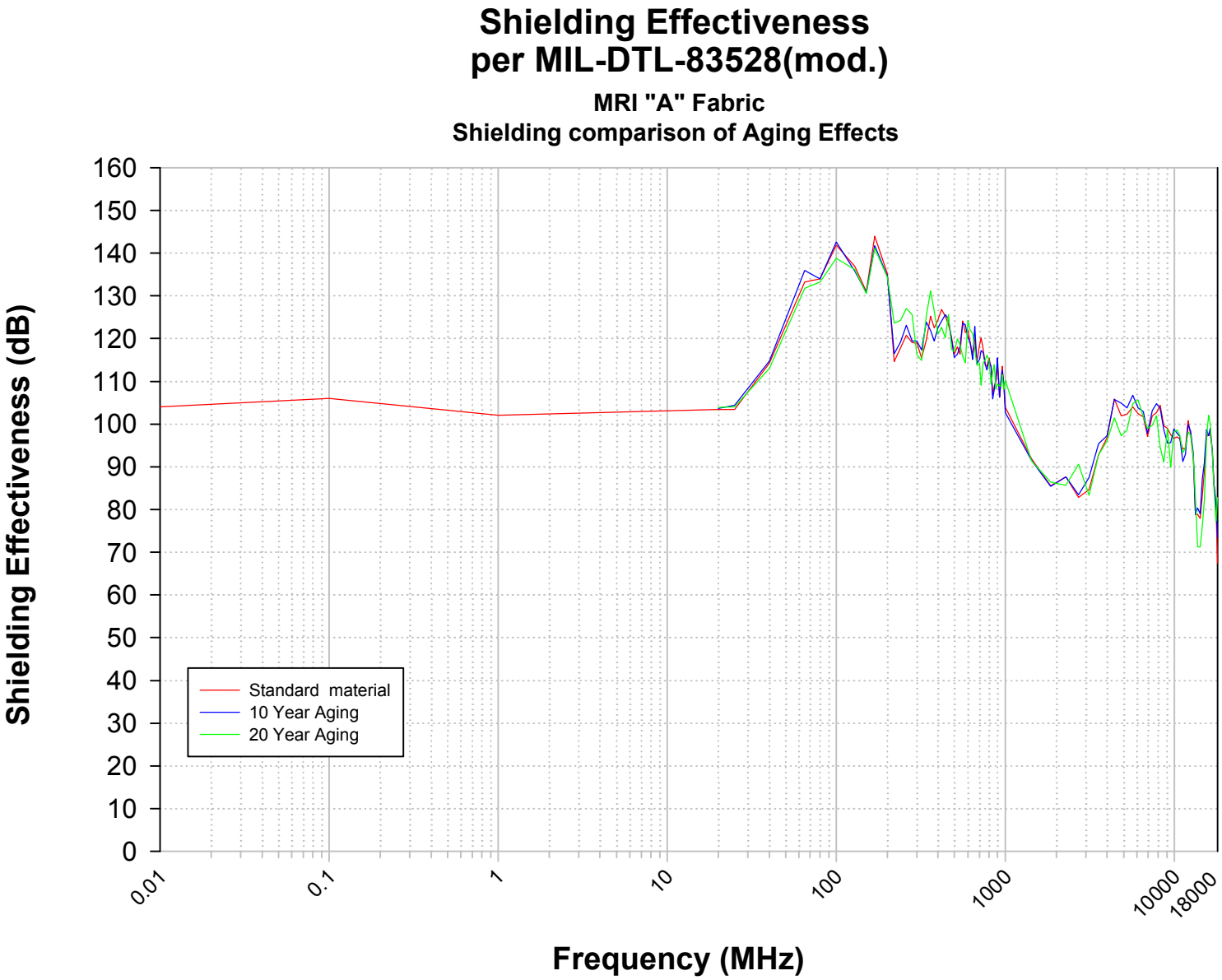


Figure 2. Radiated Shielding Effectiveness