Testing Tomorrow's Technology

Report Of

Shielding Effectiveness Test
For

SafeSleeve Radiation Shielding Technology

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I certify that I am authorized to sign for the test facility and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US Tech (Agent Responsible For Test):

By: 

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Title: Compliance Engineer – President

Date: June 10, 2015

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1 General Information

1.1 Characterization of Test Sample

Two test samples, referred to as SUT herein, used were received by US Tech on June 1, 2015 in good operating condition.

1.2 Product Description

The Sample Under Test (SUT) is a 26 cm by 29 cm sample of the shielding material used by SafeSleeve in their Shielding Technology. The SUT is a proprietary material which is used as a protective shield against RF and magnetic field radiation in consumer and professional applications.

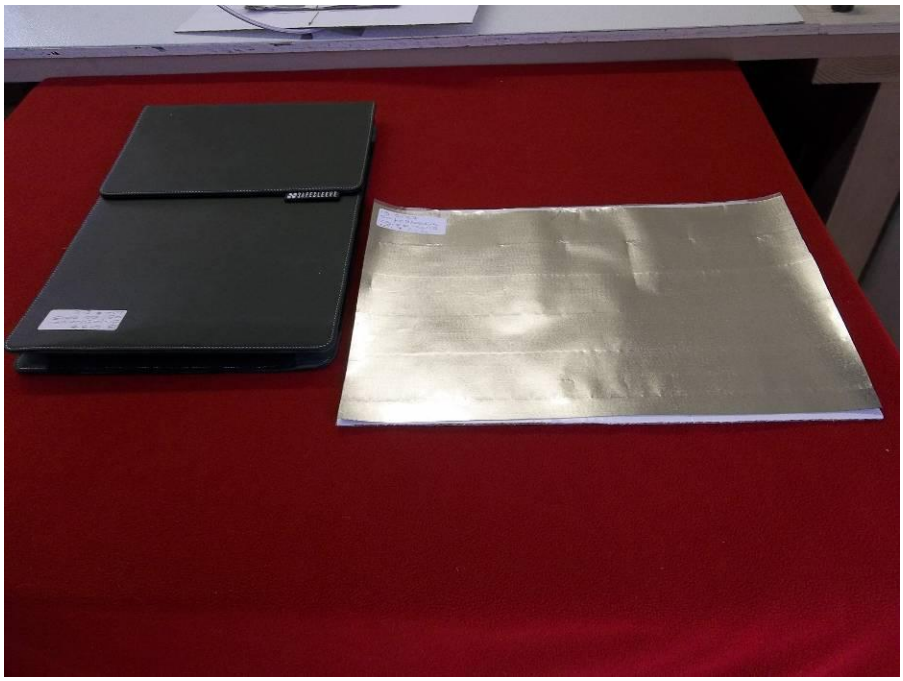

Figure 1. Photograph of Laptop Cover and SUT

2 Test Facility

Testing was performed at US Tech's test facility located in Alpharetta, Georgia. US Tech is an FCC Recognized (Designation Number US5117) and NVLAP Accredited (Lab Code 200162-0), third-party independent laboratory specializing in regulatory EMC Testing.

2.1 Test Equipment

A list of test equipment used for these measurements is found in Table 1, following.

Table 1. Test Instruments and Accessories Used

INSTRUMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	DATE OF LAST CALIBRATION
Audio Signal Generator	1G-5218	Heathkit	1G-5218-01	Adjusted with Calibrated meter
Spectrum Analyzer	E4407B	Agilent	US41442935	1/28/15
Log Periodic Yagi Antenna	LPY2	Ramsey Electronics	WA5VJB-1	N/A
Log Periodic Antenna	LPY26	Ramsey Electronics	WA5VJB-2	N/A
Signal Generator	70340A	Hewlett Packard	3339A00941	During Test
Signal Generator	8648B	Hewlett Packard	3642U01679	During Test
Audio Power Amplifier	EXA2950	GEM Sound	NA	Not Required
Graphic Multimeter	Fluke	867B	DM7060268	06/19/14
AC Milligauss Meter	UHS2	Alphalab, Inc.		Not Required for this test
Wire Spool	NA	Custom Made US Tech	NA	NA

Note: The calibration interval of the above test instruments is 12 months unless stated otherwise and all calibrations are traceable to NIST/USA.

3 Theory of Measurement

Shielding effectiveness is obtained by producing a strong CW signal and taking the difference of two measurements: one without any shield and one with the shield, provided that:

1. Nothing changes in the setup when placing the shield.
2. The dynamic range is greater than the anticipated attenuation by the shield.

Then, shielding effectiveness is determined by:

SE (in dB) = 20 log (E1/E2)
Or, in reduction in percentage: 100* (E1-E2)/E1,

where E1 and E2 are the signals measured by the receiving antenna/probe with and without the shield, using the same physical test setup for both measurements.

Since spectrum analyzers read power, shielding effectiveness is determined by the dB difference between the two shielded and unshielded power levels, read in dBm.

4 Test Configuration and Procedure

The objective is to measure shielding effectiveness of the SUT at different frequencies. Section 4.1 of this report outlines the procedures used to measure low frequency (60 and 300 Hz) magnetic field shielding, and Section 4.2 of this report outlines the procedures used to measure EMC shielding at higher frequencies.

4.1 Extremely Low Frequency (ELF) Electromagnetic Radiation (EMR) Shielding Effectiveness (Magnetic Component at 60 and 300 Hz)

4.1.1 Detailed Test Procedure

Before setting up the test, the dynamic range of the probe was noted to be from a few milligauss to about 1400 milligauss, and, the setup was examined to confirm the required system dynamic range for this test (40 dB).

An audio signal generator was set to generate 60 and 300 Hz signals, which were then amplified for power to drive a wire spool for generating large magnetic fields. An ammeter was used to measure the rms current through the wire spool. The sample was sandwiched between two flat pieces of cardboard, the same size as the sample and placed on the wire spool. Another smaller piece of cardboard, slightly larger than the milligauss meter, and also 1 cm thick was placed on top of the sample assembly. The perimeter of the small piece of cardboard was traced onto the sample to ensure that its position would be fixed for all tests.

With the milligauss meter on top of the small piece of cardboard, the signal was gradually increased for a good and reliable reading above 10 milligauss. This level was recorded as L1. The current was also monitored and recorded. Then the shield was removed without making any changes in the setup and the signal was measured and

recorded as L2. The current was also examined to make sure there were no changes. This technique was repeated for all the low frequencies.

The shielding effectiveness was computed as:

% SE = 100* (L2-L1)/L2

Test results are shown in the Summary and Test Results Section of this Report.

Figure 2 shows the test configuration used to measure the Magnetic Field component of Electromagnetic Radiation Shielding Effectiveness of the SUT at Extremely Low Frequencies of 60 and 300 Hz.

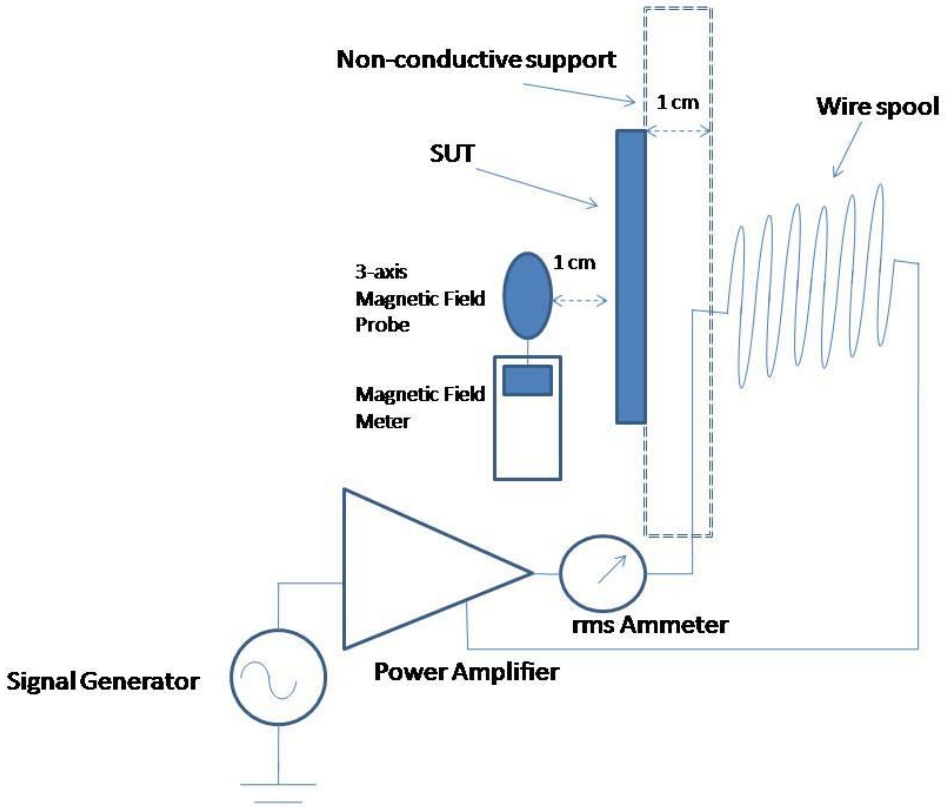

Figure 2. ELF EMR (Magnetic Component at 60 and 300 Hz) Test Configuration Diagram

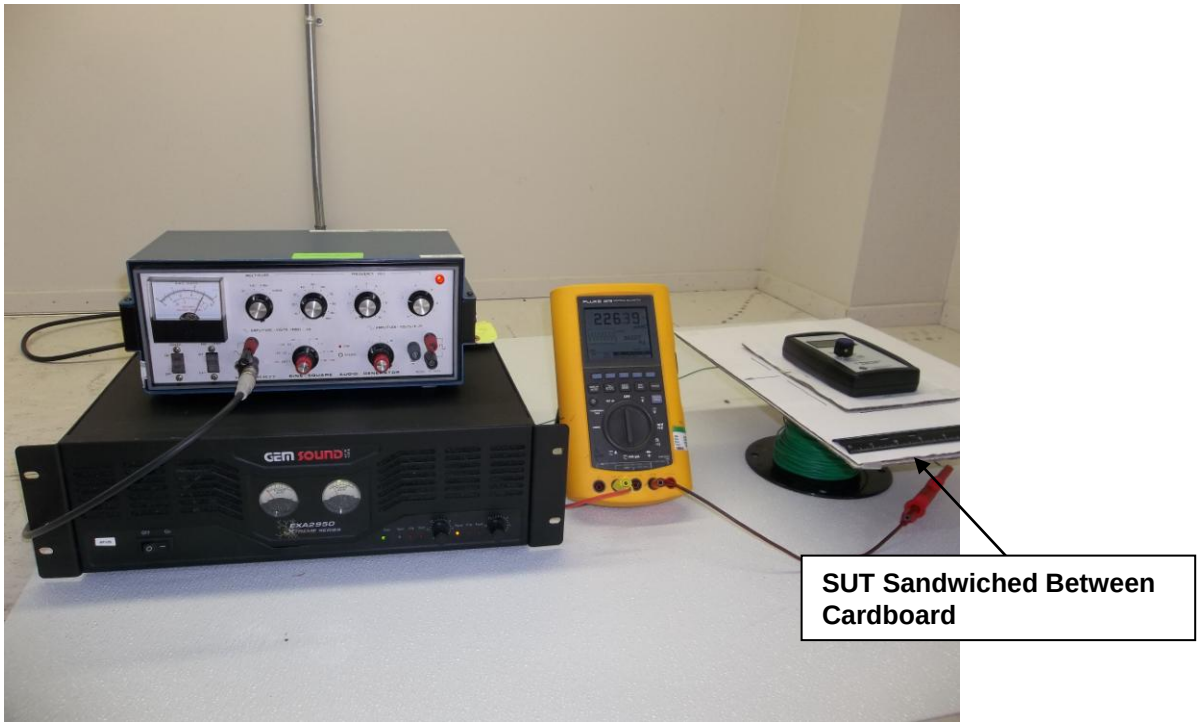

Figure 3. ELF EMR (Magnetic Component at 60 and 300 Hz) Test Configuration Photograph

4.2 Radio Frequency (RF) Electromagnetic Radiation (EMR) Shielding Effectiveness

4.2.1 Detailed Test Procedure

As required, the dynamic range of the test setup was confirmed to be greater than anticipated shielding effectiveness by at least 6 dB.

RF signal generators were used to provide the signals at different frequencies. A transmitting antenna was placed on a wooden table and connected to the signal generator. The SUT was sandwiched between two pieces of rectangular cardboard with the same width and length as the sample and a thickness of 1cm each and the assembly was placed on top of the transmitting antenna at a fixed position. The receiving antenna was affixed to the top of a smaller piece of cardboard and this assembly was placed on top the sample assembly and connected to the spectrum analyzer. Two measurements were taken: one with the SUT (P1) and one without it (P2).

The shielding effectiveness is calculated as below:

SE (dB) = P2 – P1 + any adjustment for increasing the signal generator output level
SE in percentage = 100*(v2-v1)/v2 where v2=10^(P2/10) and v1=10^(P1/10)

The spectrum analyzer settings were as follows: Resolution Bandwidth = 1 KHz, Video Bandwidth = 3 KHz, Span =100 KHz, dynamic range near 90 dB.

Note: If ambient signals were present at the test frequencies, the test frequencies were shifted slightly (less than 10 KHz) to avoid overlapping.

Figures 4 and 5 show the test configuration used to measure RF EMR Shielding Effectiveness of the SUT at high frequencies.

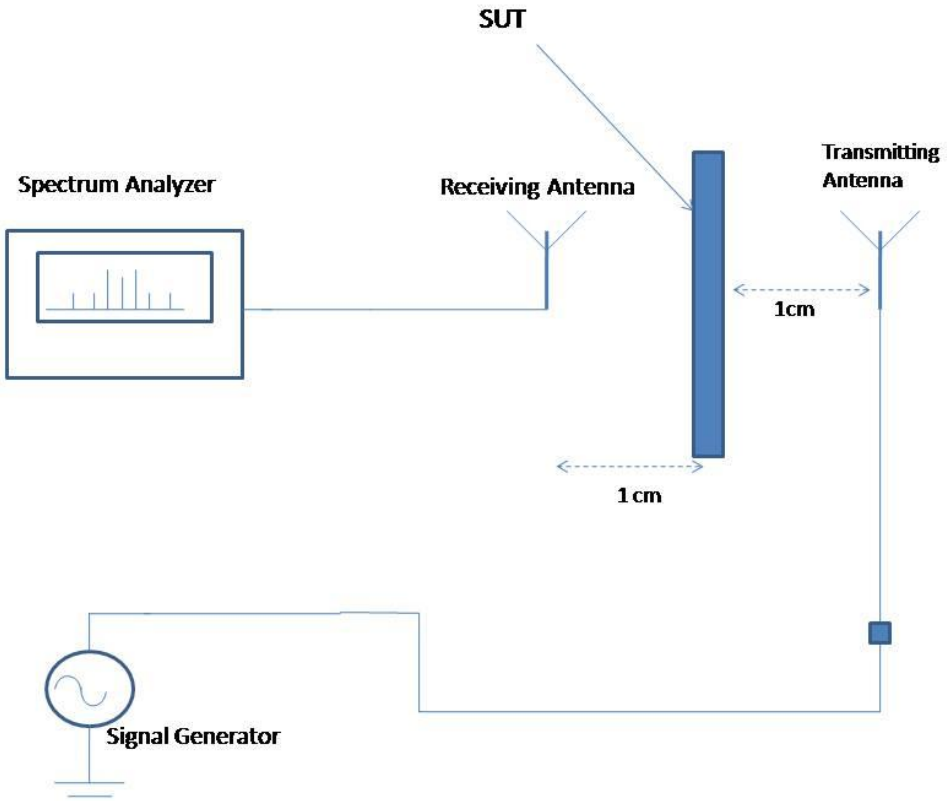

Figure 4. High Frequency (RF EMR) Test Configuration Diagram

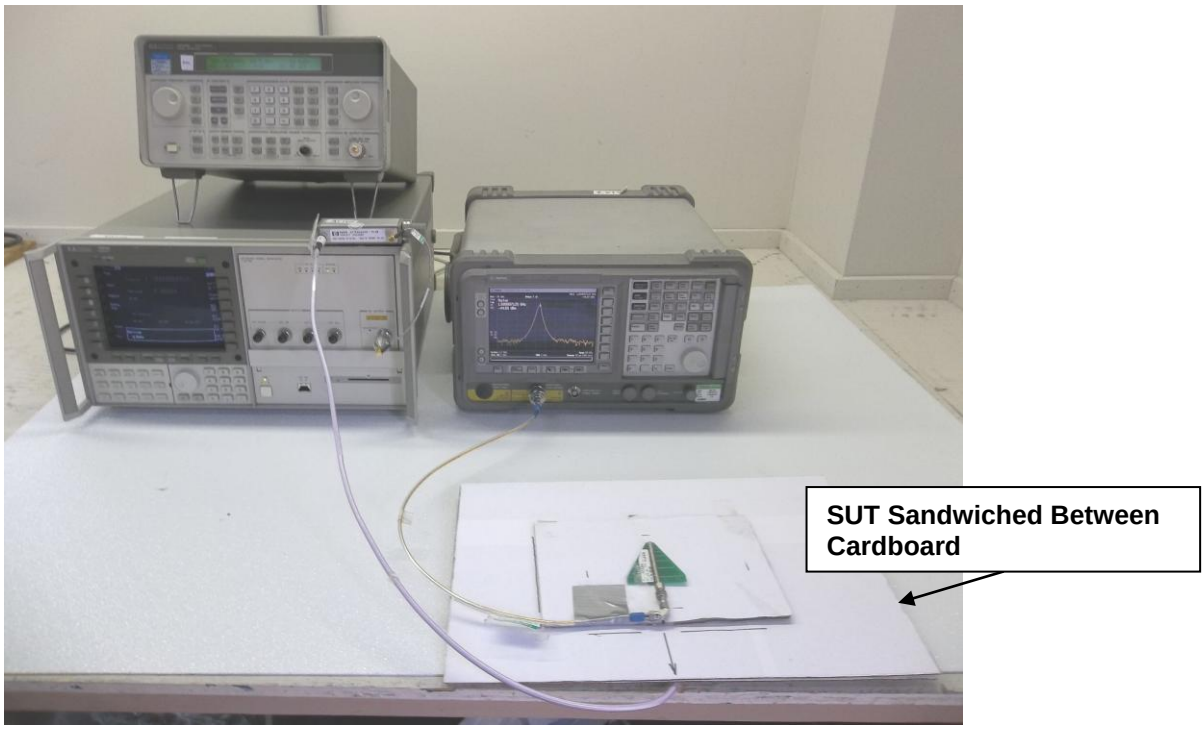

Figure 5. High Frequency (RF EMR) Test Configuration Photograph

5 Summary and Test Results

Following is a summary of the SafeSleeve shield Extremely Low Frequency (ELF) Electromagnetic Radiation (EMR) (Magnetic Component) and Radio Frequency (RF) Electromagnetic Radiation (EMR) Shielding Effectiveness results when the SUT is measured as described in this test report:

ELF EMR (Magnetic Component) Shielding Effectiveness @ 60 Hz is 92% and ELF EMR (Magnetic Component) Shielding Effectiveness @ 300 Hz is 92% as shown in Table 2 below.

RF EMR Shielding Effectiveness @ 800 MHz to 5 GHz ranges from 98 to 99% as shown in Table 3 below.

The measurement uncertainty (with a 95% confidence level) for these tests is ± 1 dB.

Table 2. Test Results for Low Frequency Measurements

Frequency	Current Through Solenoid	Without Shield (mgauss)	With Shield (mgauss)	Percentage Reduction
60 Hz	150 mA	1570	126	**92**
300 Hz	150 mA	1640	126	**92**

Table 3. Test Results for High Frequency Measurements

Frequency	Without Shield (dBm)	With Shield (dBm)	Delta (dB)	Percentage Reduction
800 MHz	-40.5	-63	22.5	**99.4377**
1.7 GHz	-23	-41	18	**98.4151**
1.9 GHz	-29	-49	20	**99.0000**
2.1 GHz	-29.6	-55	25.4	**99.7116**
5 GHz	-30	-62	32	**99.9369**