TEST REPORT
SHIELDING EFFECTIVENESS per FAR FIELD MEASUREMENT
CHOMERICS PREMIER™ CONDUCTIVE PLASTIC

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Chomerics Approved Signatory:

1. INTRODUCTION

This document is written to report the shielding effectiveness test method used to evaluate the Chomerics PREMIER conductive plastics materials per far field antenna measurement.

The shielding effectiveness test method for this report is a radiated field technique and is a modified version of IEEE-STD-299. The modifications are frequency range, test fixture and open reference.

This test method does not exactly duplicate the mechanical and/or electrical performance of PREMIER conductive plastic materials in an actual application. But it does allow evaluations of variation in the conductive plastic. Care should be taken in applying the absolute values obtained from these tests to other geometries or enclosure designs.

2. ADMINISTRATIVE DATA

2.1 Test Facility and Test Personnel

Chomerics Test Service in Woburn, Massachusetts shall perform all the evaluations of the PREMIER conductive plastics.
Chomerics Test Services in Woburn, Massachusetts is an American Association for Laboratory Accreditation (A2LA) accredited facility as defined on Certification Number 1980-01. For Emissions and Immunity testing, the Scope of Accreditation is limited to the following tests: CFR 47, FCC Part 15 Subpart B, CISPR 11, EN 55011, CISPR 13, EN55013, CISPR 14, EN55014-1, CISPR 22, EN55022, AS/NZS 3548, CNS 13438, CNS 13783-1, VCCI, EN 61000-3-2, EN 61000-3-3, EN 50081-1, EN55081-2, EN61000-6-3, EN 61000-6-4, EN 61000-4-2, EN 61000-4-3, EN61000-4-4, EN 61000-4-5, EN 61000-4-6, EN61000-4-8, EN 61000-4-11, EN 50082-1, EN 50082-2, EN 61000-6-1, EN 61000-6-2, IEC/EN 60601-1-2, EN 300 386, EN 61326, CISPR 24, EN55024, CISPR 14, EN 55014-2, EN 50083-2, EN 55103-1, and EN 55103-2. The A2LA Accreditation does not cover any tests in this report that are not listed above.

Chomerics test facility operates under the current revision of Chomerics Quality Assurance (QA) Manual Document Number QA002.

The QA Manual has been constructed to reflect a quality program in accordance with the requirements of the National Institutes of Standards and Technology (NIST), ISO 9002, ISO Guide 25, NIST Handbook 150, EN 45001, MIL-I-45208A, MIL-STD-461D, 462D and Chomerics Quality Assurance Program (QAP).

The QA Manual outlines and describes the procedures for establishing and maintaining the quality of analysis, research, inspection and testing within Chomerics Test Services (CTS).

This test report does not represent an endorsement by the U.S. Government.

The results and/or conclusions within this test report refer and/or apply only to the unit(s) tested as defined by this report.
Measurements performed for this test are traceable to the National Institute of Standards and Technology (NIST) based on the fact that all test equipment used for the measurements were previously calibrated using standards traceable to NIST.

The system amplitude accuracy for the measurements made during the radiated emission tests was +/- 3dB.

The test personnel performing or supervising this test are accredited by the National Association of Radio and Telecommunications Engineers, Inc. (NARTE) as Certified Electromagnetic Compatibility Engineers (N.C.E) and Technicians (N.C.T).

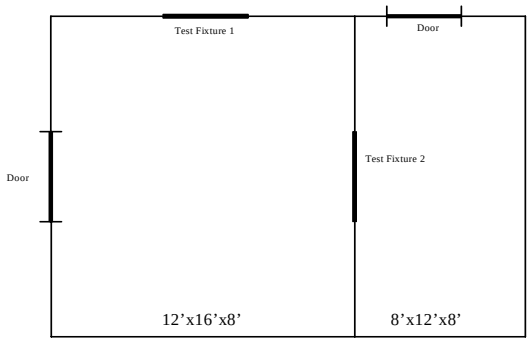
2.2 Test Site and Test Equipment

2.2.1 Chomerics' Test Chamber will be used for the test evaluation of PREMIER conductive plastic materials. Test Chamber A is located in the Seeger Building at Chomerics. Test Chamber A consists of two chambers welded together. The test chamber is constructed with 0.125" steel. All seams of the chamber are welded.

Test Chamber A has two test fixtures attached to its wall, test fixture 1 and 2 (Figure 1). Test fixture one has a 14" x 14" opening to test samples of a small size. Test fixture two is a brass test fixture that meets the requirements of MIL-G-83528.
Attenuation tests have demonstrated that the shielded enclosure meets the attenuation requirements of MIL-STD-285. The available AC power within the shielded enclosure is 110V AC, 220V AC, single and three phase, 60 cycle. The power line filters are rated for 100dB of attenuation from 10kHz to 10GHz.

Figure 1

Chomerics Test Chamber A



2.2.2 Support equipment, such as amplifiers, signal generators, and transmitting antennas should be located on one side of the shielded enclosure opening. The spectrum analyzer and receive antenna are located on the other side of the shielded enclosure opening. The following table lists equipment used for this test:

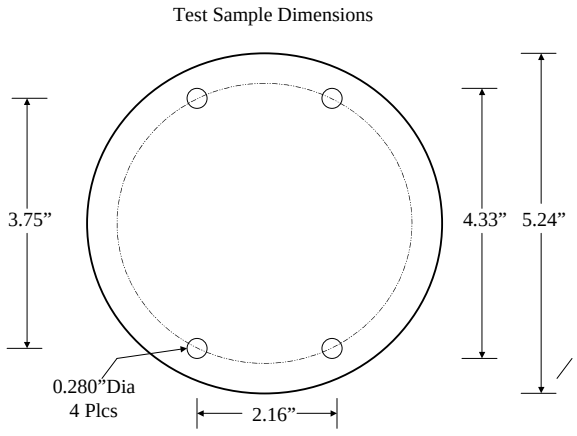
	2.2.2 Test Equipment	Asset #	Serial #
	Agilent E4440A Spectrum Analyzer	704	US4142136
	HP 83640A Signal Generator	38	3009A00188
	Logimetrics A300L-08 1-2GHz Amplifier	094	3015
	Logimetrics A300/S-08 2-4GHz Amplifier	133	3016
	Logimetrics A300/C-08 4-8GHz Amplifier	132	3012
	Logimetrics A300/IJ 8-18GHz Amplifier	134	3094
	EMCO 3115 Double Ridge Guide Antenna	375	2174
	EMCO 3115 Double Ridge Guide Antenna	376	2175

The calibration of Chomerics test facility equipment is controlled under the current revision of Chomerics Laboratory Test Equipment Calibration Manual Document Number QA001. The test equipment used throughout all tests conform to laboratory calibration standards, MIL-STD-45662, traceable to National Institute of Standards and Technology (NIST). All test equipment is calibrated in one-year intervals and listed in each test section for the applicable equipment.

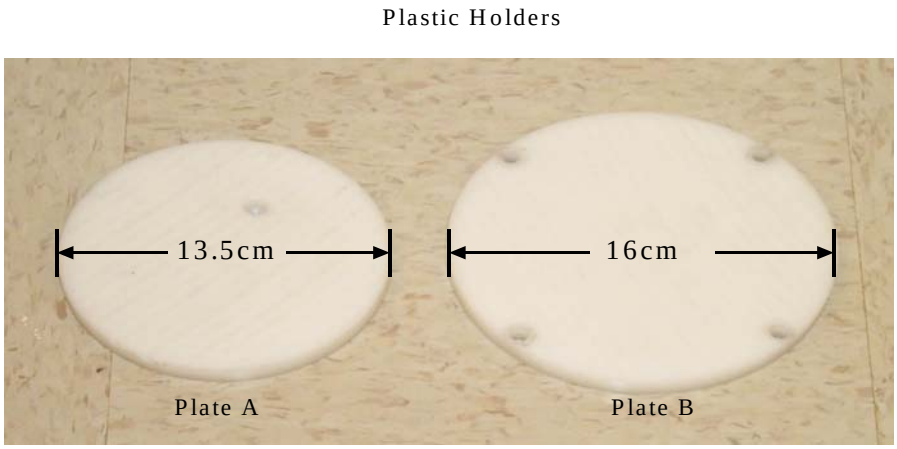
3. TEST SET UP AND CONFIGURATION

3.1 Test Samples

All test samples had the dimensions below.

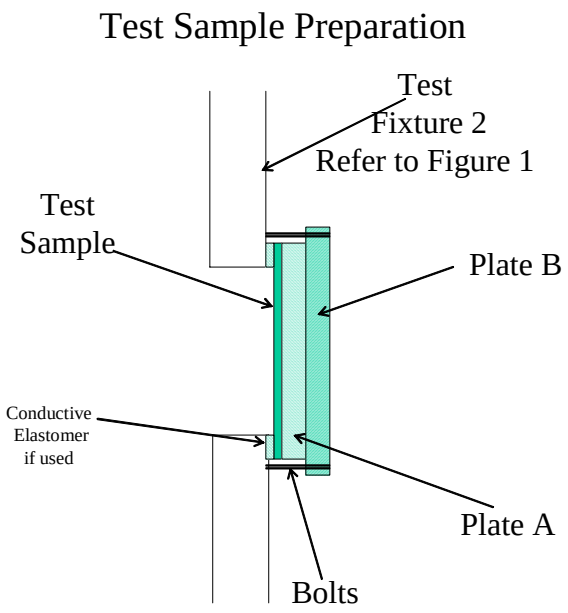


3.2 The shielding effectiveness test is performed on the wall of Test Chamber A “Test Fixture 1”. Costume test fixtures such as a steel plate, plastic spacers and compression plates have been created for this evaluation. Picture 1 shows compression plate and plastic spacer. Picture 2 shows test sample preparation.



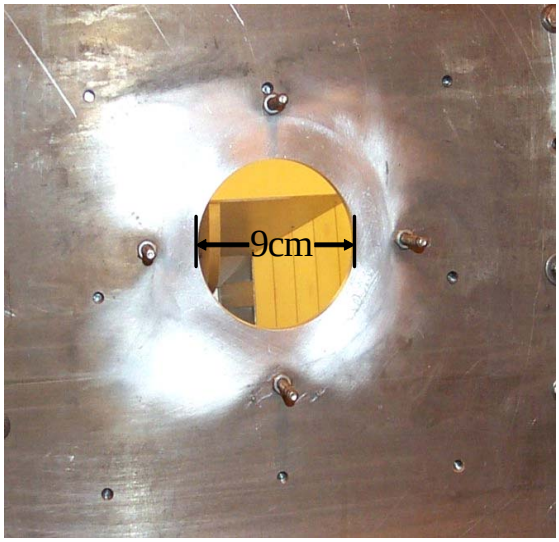
Picture 1

Picture 2



Picture 3

Test Fixture and Aperture



Each PREMIER “test sample” was mounted to the test fixture. The test fixture is 0.625 cm aluminum plate with a 9 cm circular hole. The test fixture is mounted to the wall of the shielded enclosure. The test sample was then placed over the 9 cm opening of the test fixture. The test sample was connected to Plate A. Plate B was then placed over Plate A and forced toward the test fixture with bolts.

Test samples include all resin grades of PREMIER conductive plastic materials: A220-HT, A230-HTHF, A240-HTHF, A220-FR, A230-FRHF, A240-FRHF, A220-ST, A230-ST, A240-ST. Shielding effectiveness data was collected for all the PREMIER grades listed. An average of all grades for each resin grade was used to plot shielding effectiveness values.

Two test configurations will be used during the test, the open and closed reference. Taking the power level from the open reference and subtracting it from the power level recorded in the closed reference measures the shielding effectiveness. The test set ups are depicted in Figures 2 and 3.

Shielding Effectiveness
Open Reference Test Setup

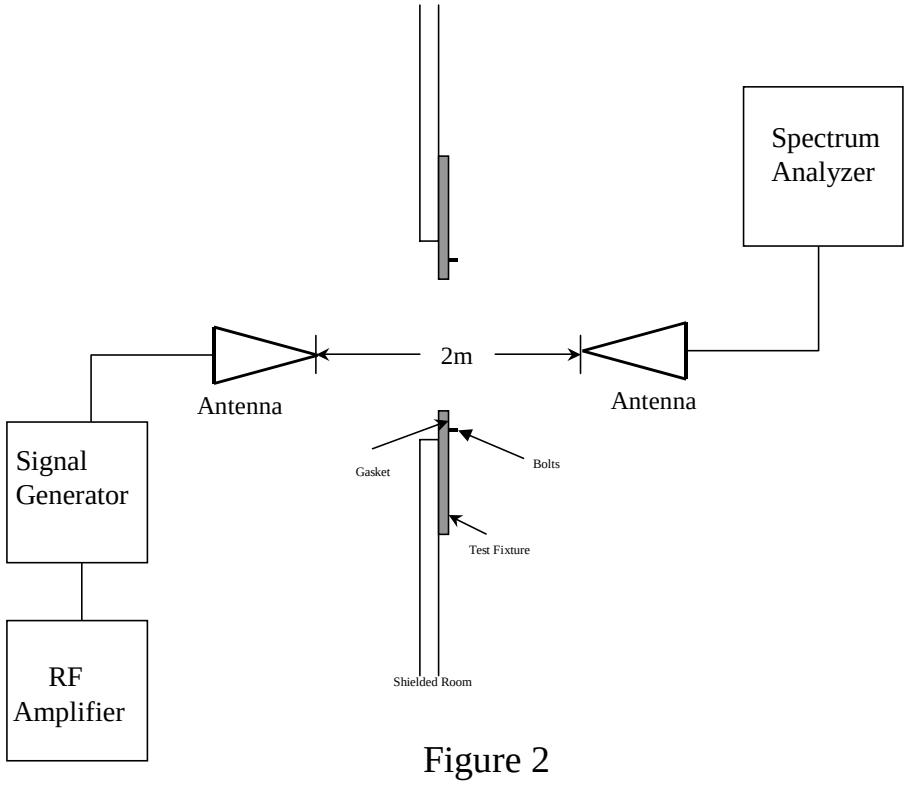


Figure 2

The open reference shall be set up by placing the transmit and receive antenna one meter from the wall of the shielded room and the test fixture. The appropriate signal generator and RF amplifier shall be attached to the transmit antenna. A spectrum analyzer shall be attached to the receive antenna.

Shielding Effectiveness
Closed Reference Test Setup

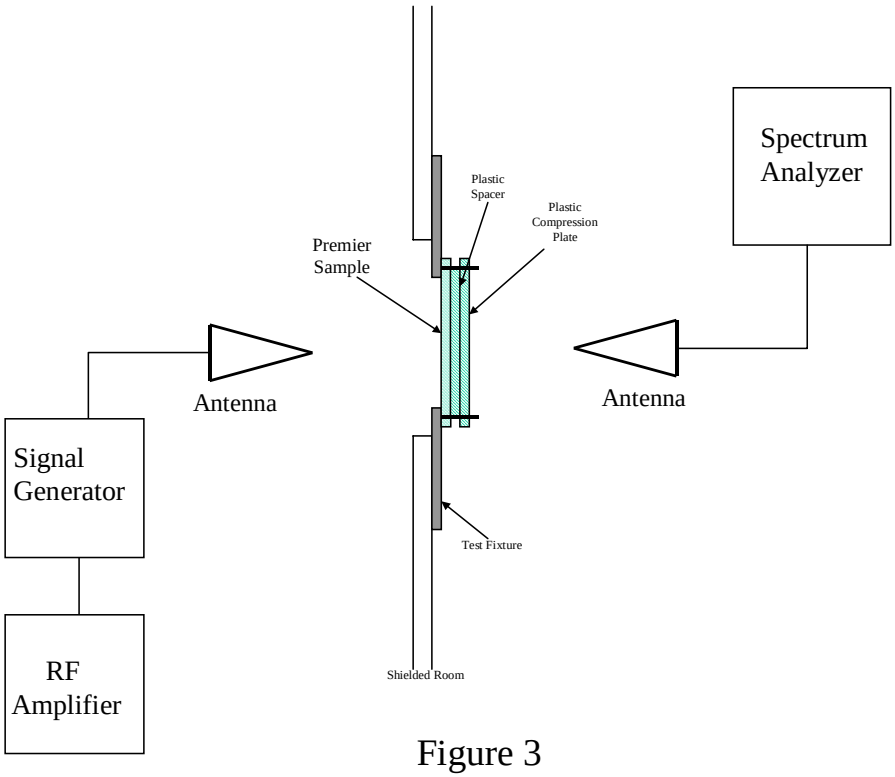


Figure 3

The closed reference shall be set up with the test equipment in the exact place as the open reference and placing the PREMIER test sample on the test fixture. The test sample shall be held in place with the plastic spacer and compression plate. The compression plate is used to hold the test sample in place and apply an even load.

The test was performed with and without a conductive gasket. The conductive gasket was Chomerics SOFT-SHIELD® 5000 Fabric Over Foam EMI Gasket. The gasket was placed between the test sample and the test fixture (refer to Picture 2 above).

4. SHIELDING EFFECTIVENESS TEST

Attenuation tests for radiated electric field signals shall be performed in accordance with a modified IEEE-STD-299 test method. Taking the power level from the open reference and subtracting from it the power level recorded in the closed reference measured the shielding effectiveness.

The test was performed at frequencies of 800MHz, 1000MHz, 2GHz, 4GHz, 6GHz, 8GHz, 10GHz, 12GHz and 18GHz.

The shielding effectiveness of the PREMIER sample was obtained by the following:

The transmitting antenna was placed outside the shielded room “opposite side of the test fixture and aperture”. The receiving antennas were placed inside the shielded room “opposite side of the test fixture and aperture”.

The open reference was taken by transmitting the test signal through the aperture in the test fixture. The closed reference was taken by transmitting the test signal through the test fixture with the test sample in place.

The difference between the closed reference and the open reference is the shielding effectiveness.

Sample calculations:

Open reference – Closed reference = Shielding Effectiveness

+10dB – (-102dB) = 112 dB

-20dB – (-80dB) = 60dB

5. PREMIER SHIELDING EFFECTIVENESS PERFORMANCE

Figures 4 and 5 present data on PREMIER performance. The graphs show shielding effectiveness per far field antenna measurement as outlined in this test report. All the data show increased shielding as frequency increases as predicted by the absorptive properties of PREMIER.

The tests were performed with and without an EMI gasket.

Figure 4

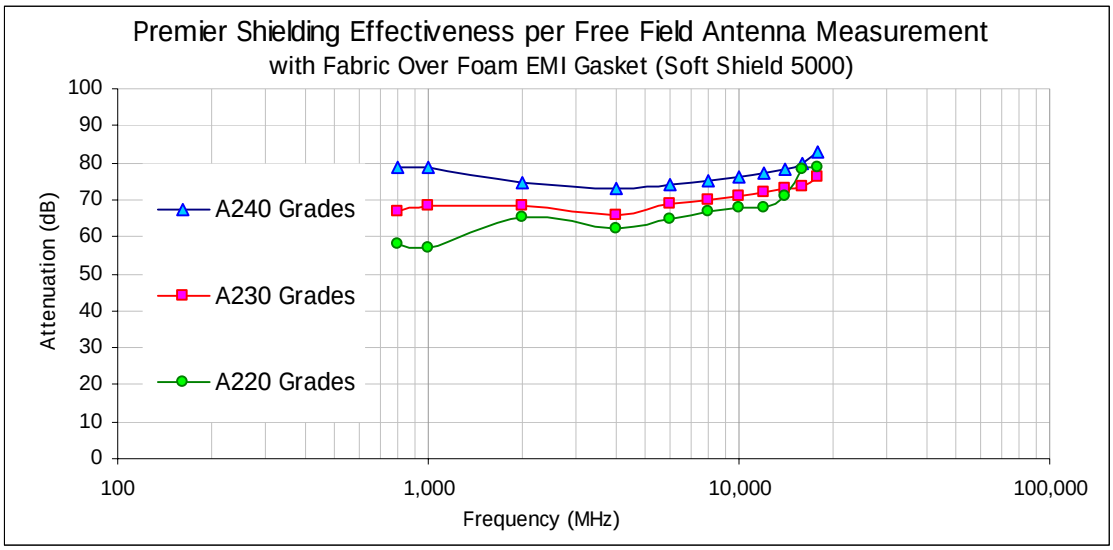
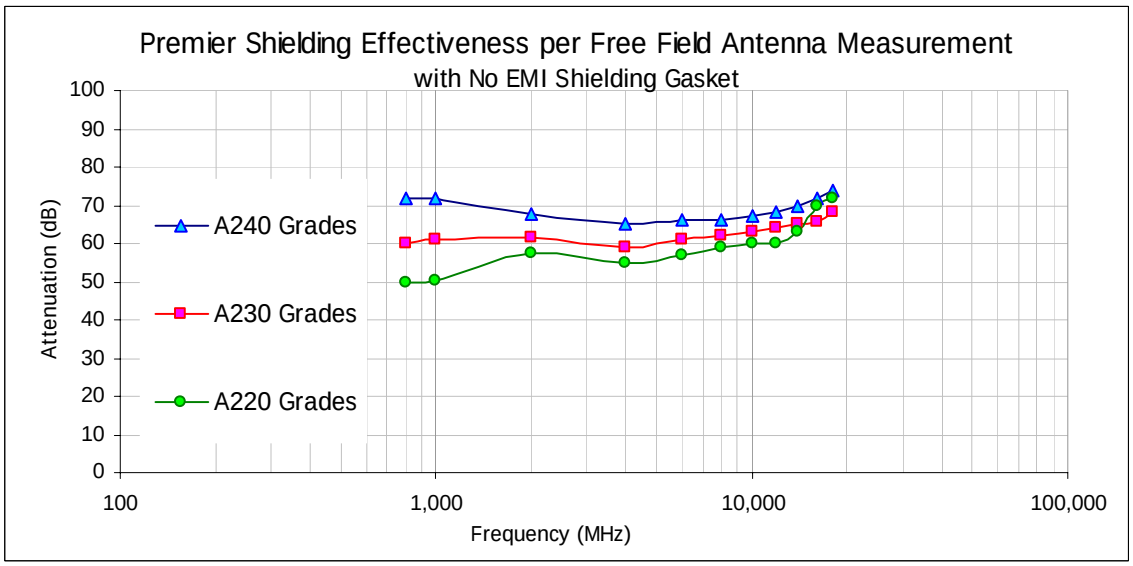


Figure 5



As figure 4 shows, PREMIER housing performance can be optimized (adding five to fifteen dB of shielding) by using a fabric-over-foam gasket such as Chomerics' SOFT-SHIELD® 3500, 5000 or 4800 Series, or a form-in-place conductive elastomer gasket, such as Chomerics CHO-FORM® family of materials or a hollow/spliced conductive extrusion captured in a groove. Additional information about any of the Chomerics products used in this report can be found at www.chomerics.com.

All the data show increased shielding as frequency increases as predicted by the absorptive properties of PREMIER. The data collected for the shielding effectiveness graphs are based on all resin grades of PREMIER (HT, FR, ST). Shielding effectiveness between resin grades within a filler level are virtually identical. The data reported is an average for that filler level and applies to all resin grades.