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TEST PROCEDURE TO MEASURE THE SHIELDING EFFECTIVENESS PERFORMANCE OF

CONDUCTIVE COATINGS

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List of Tables, Drawings, and Figures

1.0 PURPOSE

1.1 This is a test method for performing shielding effectiveness measurements on Chomerics Conductive Coating EMI material. Any Conductive Coating materials can be evaluated using this technique. Radiated methods are used to determine shielding effectiveness.

Different from other existing test procedures, this test procedure was developed to evaluate the shielding effectiveness of Chomerics Conductive Coating materials.

1.2 This test method covers fixture design, specimen preparation, and instrumentation to characterize Conductively Coated shielding materials for shielding effectiveness.

1.3 The Conductive Coating shielding materials applicable to this test method are: 26" square conductive coated plastic panels. Conductive coatings can be made up of nickel, silver, copper or other combinations of fillers.

1.4 This test method does not replicate the mechanical and/or electrical performance of a conductive coated panel in an actual electronic enclosure, but does allow evaluations of variation in conductive shielding materials in a standardized setup. The data obtained from these tests may or may not be equivalent to a conductive coating shield performance when installed in an actual piece of equipment or system (application). Variables such as metal surface treatment, thickness of coating, and grounding; as well as the source, amplitude, and frequency of electromagnetic fields all play a part in the shielding effectiveness of an enclosure shield. Care should be taken in applying the absolute values obtained from these tests to an end application.

2.0 APPLICABLE DOCUMENTS

The following documents are applicable to the extent described in this document.

2.1 CHO-TM-TP08: Shielding Effectiveness Test Method for Commercial Style EMI Gaskets, Revision A, April 1993.

2.2 IEEE-Std- 299: IEEE Standard Method for Measuring the Effectiveness of Electromagnetic Shielded Enclosures, April 1998.

2.3 MIL-DTL-83528: Military Specification: Gasketing Material, Conductive, Shielding Gasket, Electronic, Elastomer, EMI/RFI General Specification for, January, 2001.

2.4 MIL-C-5541E: Military Specification; Chemical Conversion Coatings on Aluminum and Aluminum Alloys, 30 November 1990.

3.0 SIGNIFICANCE AND USE

3.1 Conductive coating shielding systems are used on electronic enclosures to help prevent against leakage of electromagnetic radiation. Typical shielded enclosure applications are metal, some plastic, or a combination of such. Conductive coatings applied to the inside of enclosures housing electronics are an effective, lightweight form of shielding. The conductive coatings applied to plastic panels consist of small (typically 30 to 150 microns) metal particles dispersed in a "paintable" binder. Typical metal fillers include nickel, silver, copper or silver plated materials (e.g., copper, aluminum). Typical binders include acrylic, urethane or epoxy coatings. The binder is highly loaded with the metal filler to provide low resistance.

3.2 This method is intended to provide a controlled test for comparison of different conductive coating shielding materials in a standardized test setup.

3.3 The shielding effectiveness is measured using a radiated field technique. This technique involves energizing an antenna which radiates through the 24 inch square opening in the shielded room wall (open reference). The transmitting antenna is connected to an RF amplifier and signal generator and the receiving antenna is connected to a spectrum analyzer (Figure 1). This open reference measurement is then compared to a coated panel in place over the opening (closed reference, Figure 2).

4.0 TEST PREPARATION

4.1 Test Plate

One test plate is required. The test plate is made of typical plastic materials.

The aluminum test plate (frame), illustrated in Drawing 1, adapts to the opening and bolt pattern on the shielded enclosure (test chamber). It is designed with a 24 inch square cutout in the center and is 0.250 inches thick. One set of bolt holes is for the hardware necessary to mount the frame to the 26 inch square conductive coated panel.

The test plate is used to hold the conductive coated panels against the MIL-DTL-83528 frame. The outer bolt pattern of this plate mates with the bolt pattern on the shielded room.

The frame is used to ensure the panel under test is uniformly compressed around its perimeter and uniform compression of the conductive gasket. The conductive gasket ensures that there is no signal leakage between the panel under test and the shielded room interface. The gasket is the same size and shape as the frame.

Metal fasteners (bolts) are used to fasten the aluminum frame and conductive coated panel to the shielded enclosure. A conductive gasket (CHO-Seal 1215 or 1212) shall be used on this interface to ensure the conductive coated panel is grounded to the enclosure and eliminate any signal leakage at this interface. The seam can also be bridged with copper tape.

4.2 Sample Conductive Coated Panel Preparation

The conductive coated panel should have a dimension that is specified in Drawing 2. The conductive coating is to be applied and cured to the 26” square panels in accordance with the manufacturer’s specification.

4.3 The EMI test chamber must meet or exceed the following specifications:

Minimum size: 16 feet long x 12 feet wide x 8 feet high. The use of either stirred mode or anechoic chambers is acceptable, although not required. Figure 1 is an example of a shielded enclosure designed with two sides opposite an isolation wall.

Attenuation tests must demonstrate that the shielded enclosure meets attenuation requirements in excess of 100dB from 20MHz to 10GHz.

The available AC power within the shielded enclosure is 115V AC, single phase, 60 cycle or 230V AC, single phase, 50 cycle for the test equipment operation. This power is required to be provided through line filters rated at 100 dB of attenuation from 10 kHz to 10 GHz.

Any unused aperture in the shielded enclosure should be covered with blank panels of aluminum or steel plate using metal fasteners, appropriate gaskets and copper foil tape. The technique used must ensure that no leakage from such panels will affect measurements made on the conductive coating material.

4.4 Support equipment, such as amplifiers (if needed) and signal generators 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 receiving and transmit antenna distances should be per the selected specification, unless they need to be closer to obtain a desired dynamic range.

4.5 Table 1 lists typical equipment that can be used for this type of test. Due to factors such as rotation within the calibration cycle, repairs, out of service equipment, and dynamic range considerations, any of the equipment listed within this table may be substituted for another piece of equipment of similar function. A detailed list of the exact equipment used and date of calibration shall be noted in the test report. If any signal attenuators are determined to be necessary at the time of test, the location within the test setup and value will be noted on the test data sheet and within the test report.

5.0 SHIELDING EFFECTIVENESS MEASUREMENTS

5.1 Each conductive coated panel under test should be mounted (one at a time) on to the MIL-DTL-83528 frame on the test plate after open reference measurement (through the open aperture or in free space).

5.2 The test should be performed at frequencies of 30 MHz, 40 MHz, 60 MHz, 80 MHz, 100 MHz, 200 MHz, 400 MHz, 600 MHz, 800 MHz, 1 GHz, 2 GHz, 4 GHz, 6 GHz, 8 GHz, and 10 GHz. Extension of the frequency range above and/or below what is specified is acceptable.

Swept frequency test techniques are acceptable.

The type of field (i.e., electric or plane wave) and the antenna polarization should be noted on the test data sheet for each frequency under investigation.

5.3 Due to the nature of the test setup, only one antenna polarization is required during testing.

5.4 Shielding effectiveness values are obtained based on the initial open reference measurement. The reference shall be taken as follows:

The open reference measurement shall be performed by transmitting a signal on the transmitting antenna through the 24” square opening on the shielded room wall (see Figure 3). The position of the transmit and receive antenna is to be in the same position as the final testing. As a secondary option, open reference measurements may also be performed in free-space outside of the chamber. This is not required.

5.5 Final signal measurements with the conductive coated panel in place are to be performed as illustrated on Figure 2.

5.6 The shielding effectiveness is calculated by taking the power level recorded during the reference measurement and subtracting from it the power level recorded during measurements made with the gasketed panel set covering the aperture. Below is a sample calculation.

5.7 Reference test - Panel test = Shielding Effectiveness

Reference Level   Test Level
+10 dBm - (-102 dBm) = 112 dB

6.0 OPTIONAL ENVIRONMENTAL EXPOSURE

6.1 After initial shielding effectiveness measurements, the test panels can be exposed in any environmental condition and then retested. Examples of environmental exposures are

1. Dry Heat Aging
2. Heat and Humidity Aging

7.0 TEST REPORT

7.1 Detailed test data sheets and associated graphs are to be inserted into the test report. The test data sheets will include the test results, the name of the person who performed the test, and the location and time of the test. Refer to Table 2 for an example of the test data sheet.

7.2 Any deviation from this procedure should be noted on the test data sheet and within the test report. A full explanation of the deviation and the corrective action taken should also be provided on the test data and in the test report.

7.3 The Test Report shall contain the list of test equipment used and date of calibration as well as photographs of the test setup.

TEST EQUIPMENT- EXAMPLE ONLY		
Manufacturer	Model #	Description
Agilent (Hewlett Packard)	8566B	Spectrum Analyzer
Agilent (Hewlett Packard)	85685A	RF Preselector
Agilent (Hewlett Packard)	8341B	Signal Generator
Amplifier Research	150L	Amplifier
Amplifier Research	30W1000M7	Amplifier
Agilent	4440A	Spectrum Analyzer
Agilent (Hewlett Packard)	8672A	Signal Generator
EMCO	3115	Horn Antenna
EMCO	3109	Biconical Antenna
Singer	CLS-105A	Log Spiral Antenna
ENI	603L	RF Amplifier
RF Power Labs	220-IK60L	RF Amplifier
Logimetrics	A300L	TWT RF Amplifier
Logimetrics	300U	TWT RF Amplifier
Logimetrics	A300/S-08	TWT RF Amplifier
Logimetrics	300/C-08	TWT RF Amplifier
Narda	768-20	Attenuator

Table 1 Test Equipment

SHIELDING EFFECTIVENESS TEST DATA

CUSTOMER: ____________________ DATE: ____________________

EQUIPMENT: ____________________ TEST NUMBER: ____________________

TESTED BY: ____________________ TEST SPEC: ____________________

R & D REFERENCE: ____________________

TYPE OF FIELD	FREQUENCY MHZ	ANTENNA POLARIZATION	OPEN REFERENCE dBm	CLOSED dBm	SHIELDING EFFECTIVENESS dB	LIMIT	REMARKS

Test Equipment (Model and Serial Number):

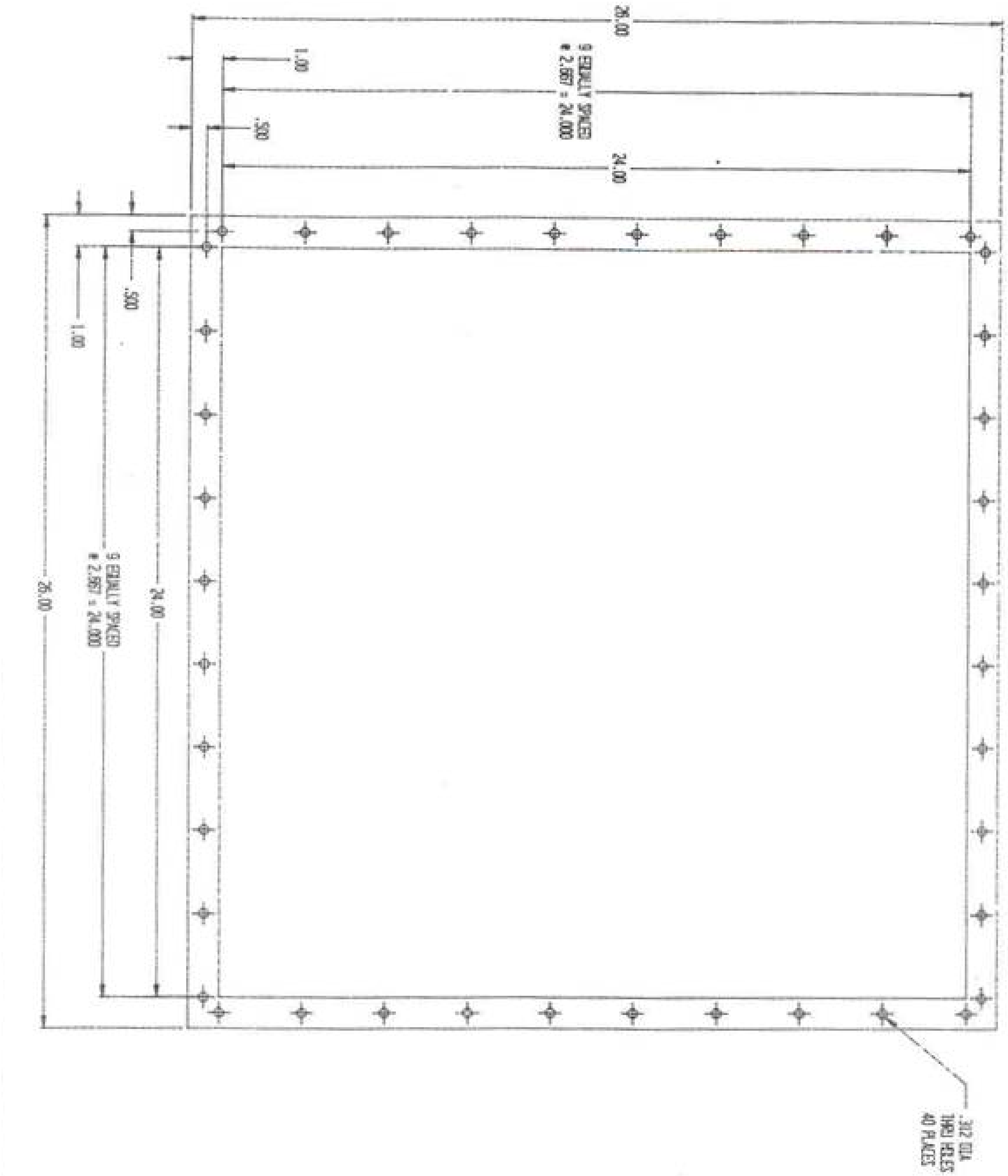
____

____

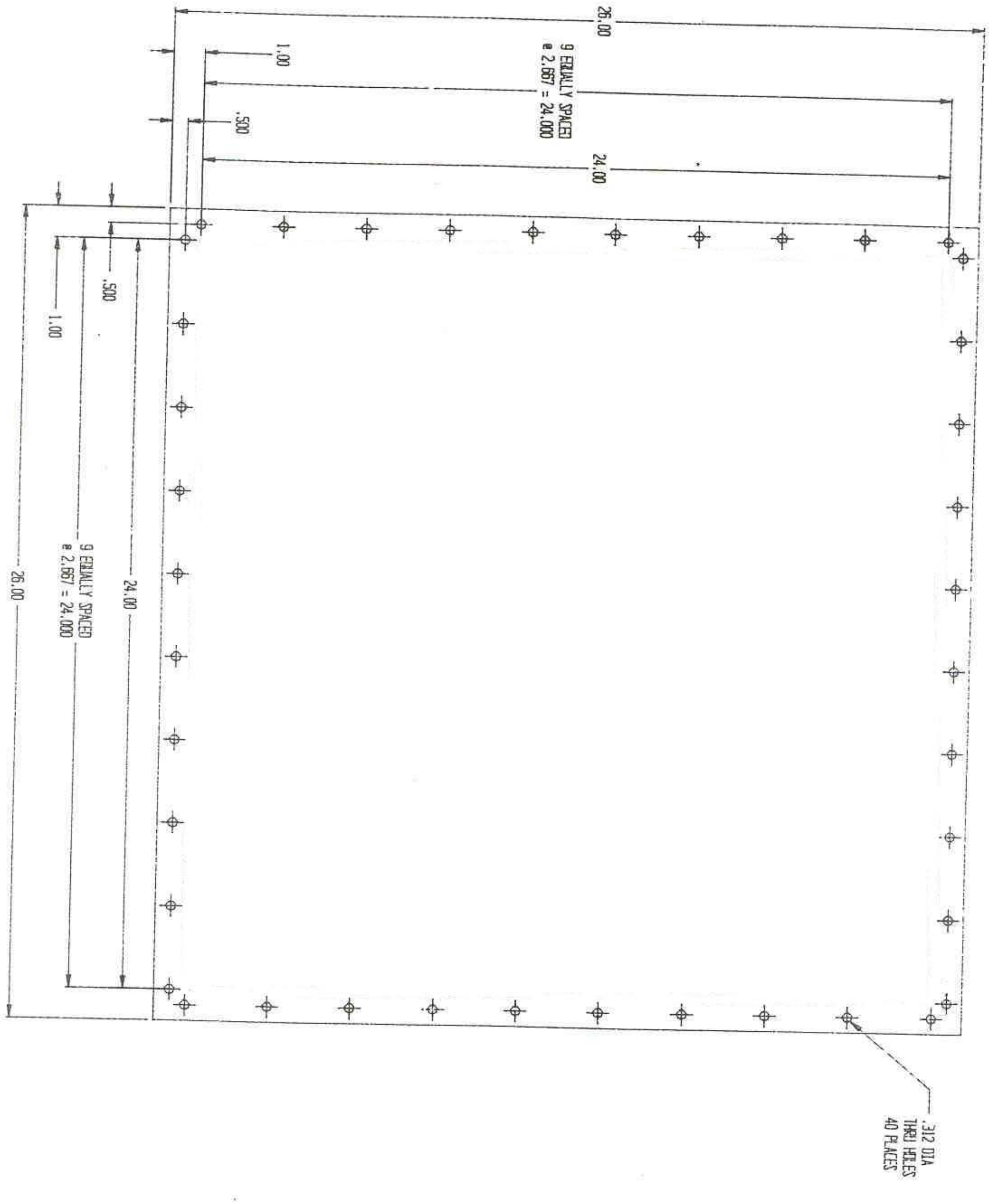
FORM CTSDS020

Table 2 Test Data Sheet Example

Chomerics, 77 Dragon Court, Woburn, MA 01801-4014 (781) 935-4850 FAX (781) 935-2758



Drawing 1 Shielded Room Access Panel



Drawing 2 Conductive Coated Panel Specification

Parker Chomerics

Coating Shielding Effectiveness Test Setup
Open Reference

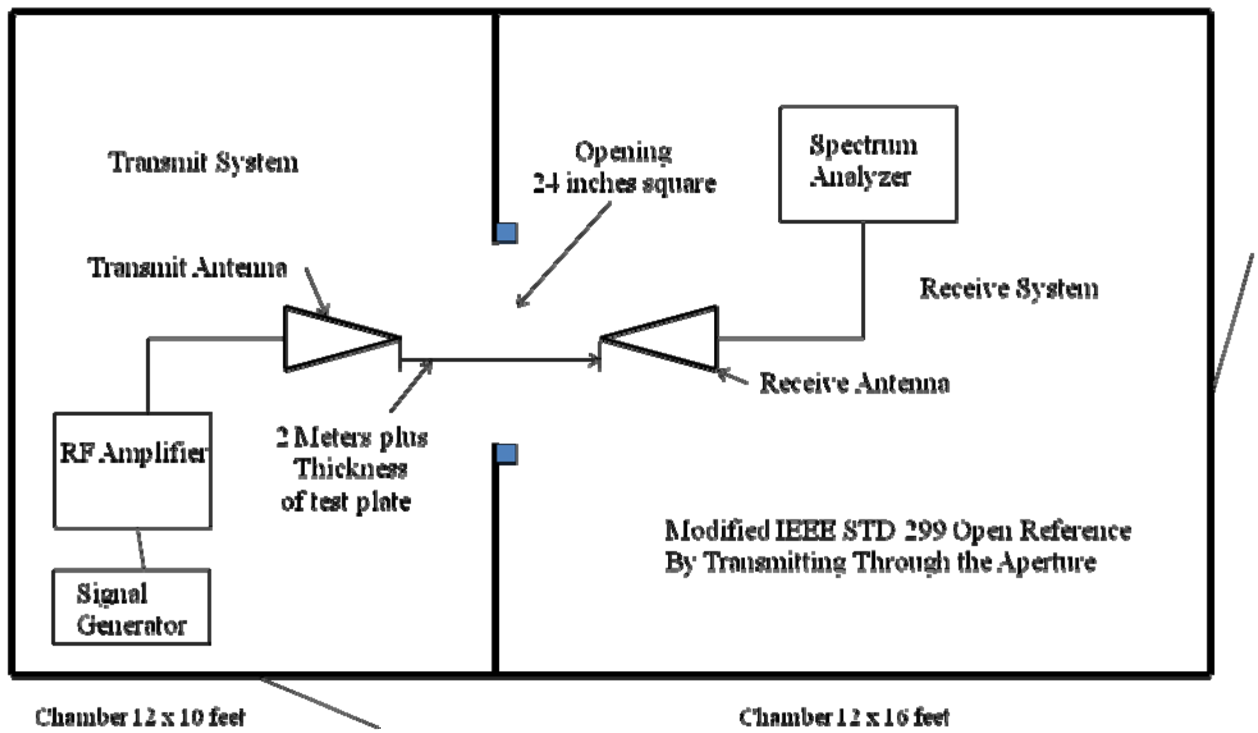


Figure 1 Test Enclosure – Open References

Coating Shielding Effectiveness Test Setup
Final Measurements

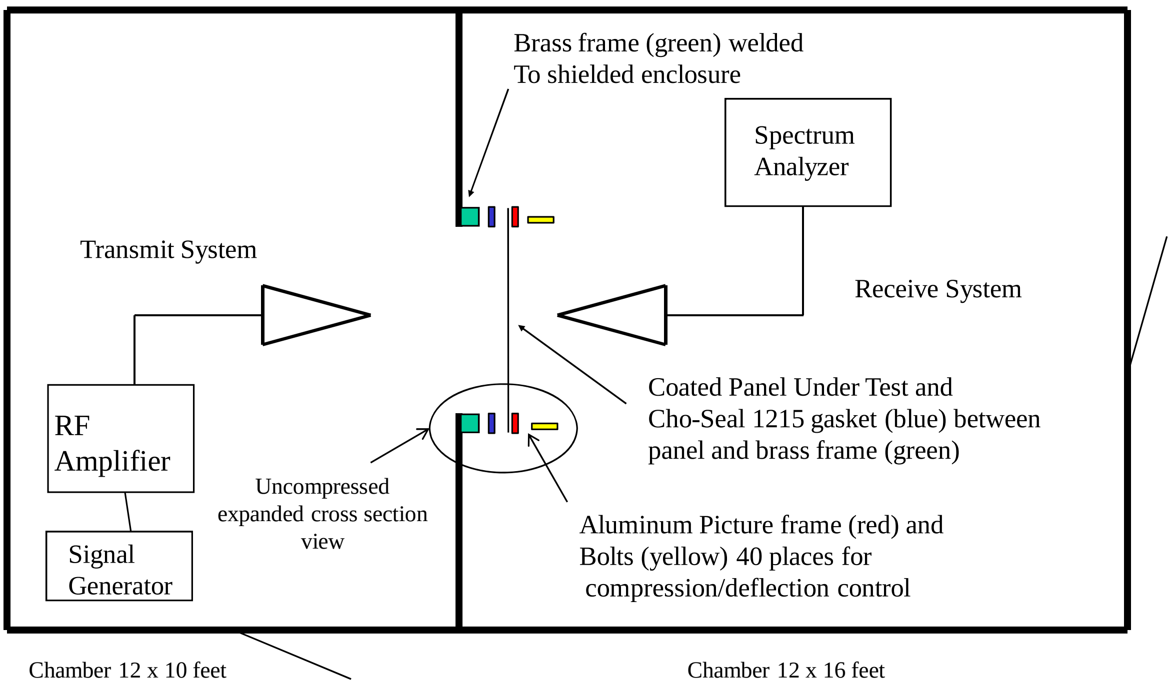


Figure 2 Conductive Coated Panel Measurement Setup