

Emerson & Cuming MWP'S

ELECTROMAGNETIC MEASUREMENT CAPABILITIES

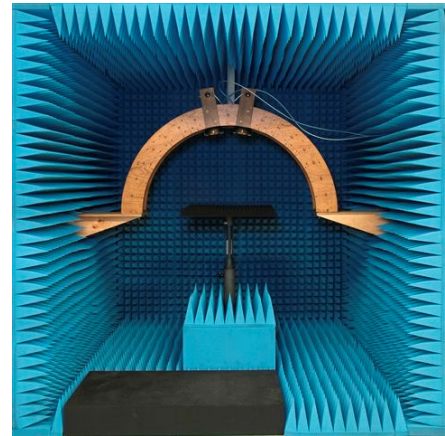
In order to keep its position as one of the market leaders for microwave products, Emerson & Cuming MWP has systematically built up an extensive capability to measure the electromagnetic parameters of microwave materials or the RF performance of microwave absorbers. In doing so, E&C ranks among the world's best equipped houses for electromagnetic characterisation.

Not only do these electromagnetic measurements form an essential part in keeping up with the company's will to constantly assure products with the highest quality, but with the available simulation software for both anechoic chambers and microwave materials, they are also a primary tool in R&D activities.

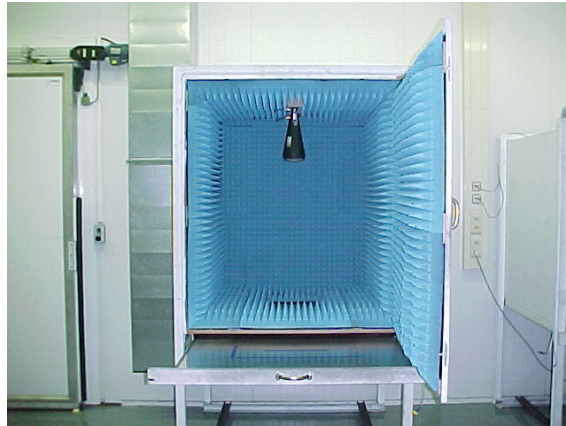
The following sections give an overview of the available set-ups for measurements of absorber characteristics, of material parameters and of anechoic chamber performance. Before proceeding to the technical details, it is however worth considering this :

- The measurement capability covers the **DC to 70GHz frequency range**, the extension of this range to 90GHz being one of E&C's current projects.
- As humidity is an important parameter in a material's electromagnetic performance, most set-ups are located in a **conditioned, dust free measurement room** (control of temperature and relative humidity).
- When no international standards exist the set-ups are designed and built by E&C. (see also technical note : "**Error-Corrected Wideband Reflectivity Measurement of Microwave Absorbing Materials Using the Arch Technique**" Mikrowellen Magazin, Vo. 14, No.6, 1988). Many **customer specifications therefore refer to E&C's measuring procedures**.
- In order to measure above 40 GHz E&C makes use of a Quasi Optical bench. (see also technical note : "Quasi-Optical Measurement Circuit for Agilent's VNA's").

http://www.terahertz.co.uk/index.php?option=com_content&view=article&id=135&Itemid=438



- All network analysers are integrated into a network environment. Repeatability and accuracy are moreover enhanced by software control of the measurements.
- All data are centrally stored on PC and thus form an **excellent tool for both QC and design purposes.**



Absorber measurements

When characterising convoluted or flat absorbers, the main interest goes to their reflectivity performance. The table below gives an overview of the available reflectivity set-ups, its bandwidth and the application they are mainly used for. For some of the set-ups a picture is shown. Absorber reflectivity data can be used to simulate and design anechoic chambers.

Equipment	Freq. Range (GHz)	Reflectivity	Insertion Loss
Arch	2 - 18	X	X
Arch	18 - 26	X	
Arch	26 - 40	X	
Quasi Optical bench	33 - 50	X	X
	50 - 70	X	X
	60 - 90	X	X
Coax Ø = 3 1/8"	0 - 2.4	X	X
Coax Ø = 7/8"	0 - 6.5	X	X
S-band Waveguide	2.6 - 4	X	X
X-band Waveguide	8 - 12.5	X	X
Ku-band Waveguide	12.5 - 18	X	X
J,K-band Waveguide	18 - 26	X	X
Square coaxial line	0 - 3	X	



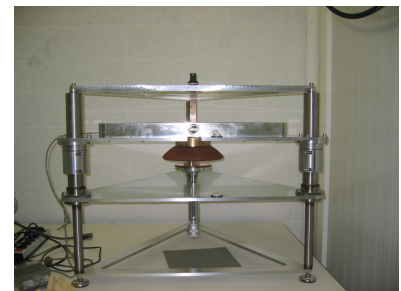
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For the flat sheet absorbers (foam type or elastomeric), there are moreover two insertion loss measurement set-ups available, one for the 2-18 GHz range and one for measurements between 8 and 12.5GHz.



Parameter measurements

For all types of materials, set-ups are available to measure the electromagnetic parameters in various frequency bands. Also these measurements can be used as a QC tool or as input data for various simulation programs. Obviously these parameter measurements are particularly meant for materials that do not come in the form of sheets, but rather as bulk material. Moreover they can be used to measure the intrinsic material properties of all types of absorbers, which can be used in the development of new types of microwave materials.



Set-up	Freq. Range (GHz)	Permittivity	Permeability
		ϵ	μ
Splitt posed cell	1.28	X	
Coax $\varnothing = 3 \frac{1}{8}$ "	0 – 2.4	X	X
Coax $\varnothing = 7/8$ "	0 – 6.5	X	X
S-band Waveguide	2.6 – 4	X	X
X-band Waveguide	8 - 12.5	X	X
Ku-band Waveguide	12.5 – 18	X	X
J/K-band Waveguide	18 - 26.5	X	X
Quasi Optical bench	33 - 50	X	X
	50 - 70	X	X
	60 - 90	X	
Open Resonator	8 - 12.5	X	
Free Space	2 – 18	X	
Free Space	18 – 26.5	X	
LCR	0 – 0.001	X	

