



CUMING MICROWAVE

AN INTRODUCTION TO ANECHOIC CHAMBERS **RoHS Compliant**

APPLICATION NOTE 300-1

There are three commonly encountered types of enclosures in the microwave industry:

1. **Anechoic Chambers:** “Non-echo” rooms lined with radar absorber to prevent undesirable reflections.
2. **Shielded Rooms:** Rooms lined with metal foil or plate to prevent entry of outside “noise” or escape of internal signals.
3. **Shielded Anechoic Chambers:** A combination of types 1 and 2, shielded against outside signals and lined with absorber to reduce internal reflections.

In addition, there are two very distinct types of anechoic rooms: those used for electromagnetic compatibility (EMC) testing; and those used for antenna and other high frequency applications.

EMC CHAMBERS

These are rooms used for measuring the emissions and susceptibility of electronic equipment to various international norms. Measurements are made down to low frequencies – as low as 27 MHz. Because the wavelengths are long, the entire room begins to act as a TEM resonant cavity. Absorber material is put on the walls to reduce reflections of waves, and also to dampen the low frequency resonances. Since very low power levels are being measured, the enclosure generally must be a well shielded room.

ANTENNA CHAMBERS

These are used for characterizing antenna patterns, measuring Radar Cross Section (RCS), and other applications, typically in the microwave and millimeter wave regions.

Since the wavelengths are shorter, smaller absorber material can generally be used, and shielding may or may not be a factor. One is generally interested in defining a quiet zone – an area within the chamber of a particular size and geometry -- within which the sum of the RF vectors bouncing singly or in multi-bounce off the walls, ceiling and floor, add to a power level which is a defined dB level below the direct path energy from the transmit antenna to the quiet zone.

Cuming Microwave Corporation makes a variety of radar absorbing materials (RAM) for the purpose of reducing reflections. Technical Bulletin 390-1 describes C-RAM SFC, a series of carbon loaded foam pyramidal absorbers specially designed for anechoic chambers. This material comes in a range of thicknesses from 4 to 72 inches, depending on the wavelength of principal interest. For example, if at least 40 dB of absorption is desired at a frequency of 1.0 GHz ($\lambda = 2$ inches), the absorber must be at least 24 inches thick. Naturally, cost is proportional to RAM thickness, so low-frequency chambers tend to be more expensive than moderate-frequency chambers.

Section 390 of the Cuming Microwave catalogue contains Technical Bulletins for various support products used in the anechoic design of a chamber, such as walkway absorbers, porous absorbers to cover air vents, etc.

Cuming Microwave Corporation also supplies products useful in shielded rooms. Technical Bulletin 240-6, for example, describes C-SHIELD WPS, stainless steel foil which is effective in shielding applications. However, Cuming Corporation *does not* supply complete shielded room packages. The reason for this is that the design and construction of shielded rooms is an art often requiring extensive custom engineering. For applications requiring “turnkey” design and construction of such facilities, Cuming Microwave Corporation prefers to team with other specialized firms--we have established good relations with several such organizations and can bring them in quickly when required.

As a minimum, the following questions should be addressed when starting an anechoic chamber project:

1. What is the frequency range of interest? The lowest frequency is likely to govern the selection of radar absorber.

2. How quiet must the room be? 30-40 dB is no problem, but 40-50 dB is more difficult. Isolation beyond 50 dB may be impossible.
3. How big is the room? Obviously, cost will be proportional to the surface area to be covered.
4. What are the special requirements? Will relatively inexpensive foil suffice, or will welded steel plate be necessary? What about shielded doors, air conditioning vents and other openings? Do the AC power outlets require filters? What about fire safety and sprinklers? Lighting? Does the floor require special “walk-on” radar absorber?

All of these questions demand expert attention.

Table 1 provides a very crude approximation of RAM cost for anechoic chambers of various sizes operating at a number of frequencies, assuming a typical absorption level of -40 dB. Needless to say, much more detailed study will be required to accurately price any specific application.

Table 1
Approximate Pricing of RAM for Anechoic Chambers
(\$ per Sq. Ft.) in year 2000 dollars

-40 dB at Following Frequencies:	SIZE OF ROOM (Total Sq. Ft. to be Covered)		
	Small (Under 1,000 Sq. Ft.)	Medium (1,000-3,000 Sq. Ft.)	Large (Over 3,000 Sq. Ft.)
Low (Below 1.0 Ghz)	\$30.00	\$28.00	\$25.00
Medium (1.0 - 3.0 Ghz)	\$17.00	\$15.00	\$14.00
High (Above 3.0 Ghz)	\$12.00	\$10.00	\$9.00

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