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Testing in a Reverberation Chamber

A Technical Guide

What is a Reverberation Testing Chamber?

A reverberation chamber, sometimes known as a mode tuned/mode stirred chamber, is a shielded enclosure or resonant cavity for RF testing. This chamber is statistically isotropic, random in polarity, having RF uniformity within specified limits. Typically a reverberation chamber has a paddle (or tuner) which stirs the field, randomizing the boundary conditions.

There are two types of Reverberation Testing methods. “Mode tuned” refers to when the paddle is stepped to a position and then RF is applied for a dwell time sufficient to exercise the equipment. At NTS, the test is software controlled driving the tuner, test equipment, and can also monitor key parameters of the device under test (DUT).

The second type, “Mode stirred”, is when the paddle is continually turned with RF energy applied for a full paddle revolution. Paddle speed is varied to meet the specific requirements of device under test.

In both methods, a single, full turn of the paddle applies RF energy to all sides of the device in one pass. This greatly simplifies the process compared to direct illumination testing.

What are the benefits to Reverberation Testing?

The benefits to reverberation testing are numerous. RF is applied to all exposed sides of the device under test (DUT) during a full 360° turn of the paddle, instead of a single side. For direct illumination testing, many standards require that all apertures of the DUT to be illuminated. On complex items this can be difficult – even impossible. Window effects testing, required when applying direct illumination, is not required during reverb testing because the field intensities are constantly changing in amplitude. Test repeatability is much easier to obtain in a reverb chamber. This is largely due to a simpler test methodology. Compared to direct illumination antenna distance, aim (focus), 3 dB beam width, location of the field probe, DUT layout (shading), and location of the DUT in the working volume are either less of a factor or not a factor in the repeatability of test.

When is a Reverberation Chamber used?

Reverb chambers are useful for radiated susceptibility, radiated emissions (total radiated power), shielding effectiveness, and many other troubleshooting scenarios for equipment to be utilized in the Aerospace, Defense, and Automotive sectors. In some cases, the reverb test method is called out as the preferred method such as in SAE ARP 5583 which states that reverb method testing is the recommended and preferred method to show compliance for large and/or complex Level A (flight critical) systems.

The FAA, AEROCAE, RTCA, and major airframe manufacturers (i.e., Boeing, Airbus, etc..) are "preferring" reverb over anechoic chamber due to the time and cost savings, as well as the robustness of the reverb test method over the direct illumination technique.

You should know if reverberation testing is right for your program. Reverb chambers are random in polarity, which makes it challenging in determining directivity of RF energy. Testing multiple field levels on a system, such as outside the pressure vessel level and inside the pressure vessel level, can be difficult; all equipment in the chamber is exposed to the same field. There are limitations on pulse width due to a high Q (efficient) chamber having a large amount of stored energy. If you have small, simple devise, single aspect angle testing may be faster and sufficient for test coverage. There are ways to compensate for each difficulty, and an NTS engineer can help with suggestions or assist you with a test plan.

Both direct illumination and reverberation test methods are acceptable paths to certification. They both have benefits and drawbacks that champion each as a test method. Fortunately, NTS has the ability to test in both methods and the engineering expertise to support your path to certification.