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Design and Development of Anechoic Chamber

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***Abstract*: RF anechoic chamber is a completely shielded room whose walls are covered with materials absorbing or scattering the energy. Ferrite tiles have helped in enhancing the performance of such chambers. The concept behind reflection-less chamber is the sending of a signal down the transmission line without it getting reflected back. Due to the metal covering on the shell of the chamber, there will be a circuit shorted at the end of the transmission model. Due to the shorted circuit, the signals which are sent down the transmission line will reflect back. The design is considered only after simulating, adjusting and measuring the system and for accurate measurement of the performance of the chamber. It is important to know if the energy is radiated properly and in the direction which is desired as per the design. We also need to know the amount of energy travelling in the undesired directions. There is a need to have an antenna which is unaffected by its environment. Hence the anechoic chamber becomes an answer to the problem. The anechoic chamber is echo-free and it reduces the effects of the undesirable signals. There are many applications of anechoic chambers like recording auditory signals, testing, emissions and immunity which are radiated, RF antenna testing and rate of absorption testing.**

***Keywords*: Anechoic, shielded, measurement, simulating**

1. Introduction

Anechoic chambers are the rooms which are designed to absorb the reflections of electromagnetic radiation and also to minimize the interfering energy disturbances coming from different sources. It helps in measuring antenna efficiency and pattern-gain characteristics. The chamber wall acts like a cage which prevents interference due to external signals which may have an effect on measurements. This prevents the test signals from escaping out of the chamber which interferes with different external devices and can also be a potential health risk. It has an interior which is covered with an absorbent material which helps in absorbing the RF signal in the required frequency band.

Anechoic chamber is the test site to carry out the measurement of antenna, radar and electronic warfare test measurement. During the measurement, it provides a non-reflection, quiet and full-time test space, preventing the leakage of test information that disturbs the electronic equipment or environment surrounding it, and also isolates the outside electromagnetic signals that may affect the experiment. Therefore, the performance of the anechoic chamber will have a directive influence on the accuracy of measurement inside of the chamber.

The key characteristic of an anechoic chamber is that it absorbs the wave reflections rather than causing an echo. On proper designing and assembling, they have the ability to stop waves from entering the chamber by providing shielding from outside interference. This prevents the test signals from escaping out of the chamber which interferes with different external devices and can also be a potential health risk. It has an interior which is covered with an absorbent material which helps in absorbing the RF signal in the required frequency band.

The chamber minimizes the impact on health and also ensures safety due to involvement of high power radiation. Anechoic chambers reduce the reflections and help in simulation thereby improving the performance of the chamber. To accurately evaluate the chamber's performance index on the whole band, the work of measurement and data analysis is huge. Therefore, we must design an anechoic chamber automatic measurement system to improve the measurement and data analysis efficiency, and at the same time reduce the manual measurement error.

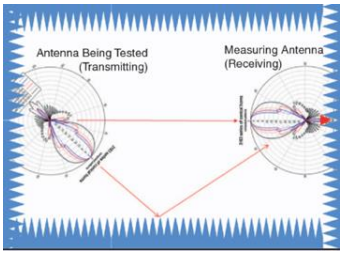

Fig. 1. Antenna

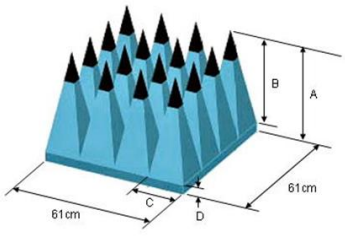

Fig. 2. Measurements

2. Methodology

A. Measurements

Antenna radiation pattern can be implemented in two different plots 2D and 3D. Anechoic chamber is used for measurement of antenna in frequency between 100 MHz to 40

GHz. This frequency covers many communication services such as mobile, satellite etc.

B. Different methods

1) 10m method

- Qualified for various registrations (FCC filling, VCCI registration, DAR, NVLAP, A2LA, and NATA authorizations.
- Mainly composed by ferrite radio wave absorber (TFA).
- Wide range radio wave absorbency in combination with radio wave matching devices is available.
- Barrier free doors allowing for easy transportation of large sized devices.
- Standard equipped storage room for amplifiers for the use in the immunity test.
- Applicable to large sized devices.

2) 3m Method

- It is qualified for various registrations.
- Using TFA only this allows for various standard certifications.
- Additional radio wave matching device is available for frequency ranges from 30 MHz to 18 GHz.
- Easy transportation of large sized devices by adoption of barrier free type doors.

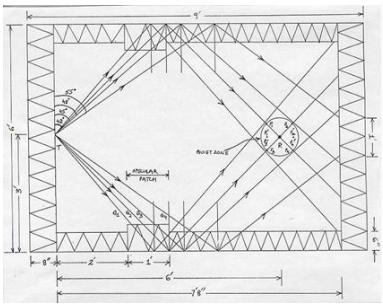

Fig. 3. 3M method

C. Application of project

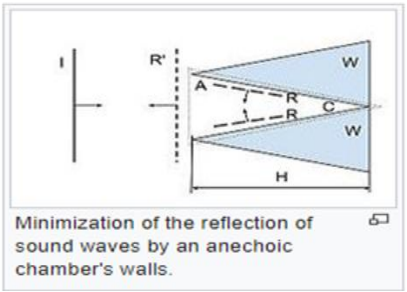

Fig. 4. Minimization of the reflection of sound waves by an anechoic chamber wall

Anechoic chambers are used for the measurement purposes like Radar cross section patterns: mono and bi-static, Bore-sight error, Antenna patterns of primary as well as secondary antenna. These chambers are used for measurement of characteristics such as comparability, susceptibility, sensitivity, and effective radiated power, tracking power, vulnerability and sight accuracy in satellites, radars, aircrafts, missiles, vehicles and electronic devices. Chambers produce an environment for the measurement of electronic devices to match requirements regarding spurious, harmonic and noise emissions. Devices such as microwaves, typewriters, motor generators, lights, computers, T.V sets etc. get their sampling measured in such chambers.

3. Results and discussion

By using the anechoic chamber, we can find out the gain and pattern characteristics of the antenna chamber minimizes the impact on health and also ensures safety due to involvement of high-power radiation. It is important to know if the energy is radiated properly and in the direction, which is desired as per the design. We also need to know the amount of energy travelling in the undesired directions. There is a need to have an antenna which is unaffected by its environment. Hence the anechoic chamber becomes an answer to the problem. The anechoic chamber is effective as it produces an environment which is echo-free and it also reduces the effects of the undesirable signals.

4. Conclusion

The performance of the anechoic chamber is very effective and similar to the results of different tests which have been published. Due to the presence of a number of frequencies which are close together in frequency, indicate that this area can be explored further. As the interference and reflections are minimal therefore there is much confidence in testing. The individual component analysis can be done next. The pyramidal absorbers were tested and they resulted in increased absorption with increase in incident angle. There is still potential for work to be done to optimize the usability of the room and hence come close to matching standards set for the design of the chamber.

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