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MINIATURE ANECHOIC TEST FACILITY AND AUDIOMETRIC TEST CHAMBERS

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As a result of recent legislation and more environmental consciousness particularly associated with small prime movers, domestic appliances and the performance characteristics of Electro Acoustic Transducers, the Industrial Acoustics Company was approached to design and build a small anechoic chamber which in some cases could also double as a production test facility.

These design constraints, together with ease of operation and vastly differing background conditions, i.e. laboratory or factory floor, were thought initially to require a large and cumbersome structure, however, after a little research and design evaluation a twin skin structure was found to produce optimum results. For ease of access to the measurement plane which should be situated across the central horizontal axis of the chamber, it was decided that the whole hood assembly should be removed. Moving the roof assembly vertically was clearly impractical and therefore it was decided that this should be hinged along the rear face, thus giving full unrestricted access on three sides for the setting up of intricate items prior to closing of the unit and commencement of testing. This approach, however, produced several problems since the roof assembly had to produce a good acoustic seal and be easily moved, and because it's weight was approximately 150 kg, it was not the sort of item that would be easily handled by female laboratory technicians without some sort of counterbalancing. This counterbalance took the form of a hydropneumatic gas filled damper which balanced the unit and would enable almost anyone to operate the hood with only one arm.

The body of the structure was constructed from twin skins of heavy gauge galvanised sheet steel with a mineral wool infill to the void between the sheets forming an overall skin of 50 mm thick. The internal void was then lined with a sculptured block of mineral wool of density 30 kg/m^3 to a depth of 200 mm, thus producing a measurement void of 400 mm x 400 mm x 400 mm. This mineral wool was then covered on all external surfaces by an acoustically transparent cloth which was tensioned and bonded to the fibreglass and also formed part of the anechoic chamber measurement plane support mechanism. The main support for the measurement plane equivalent to an anechoic chamber cable floor was derived from a thin steel mesh, over which was tensioned another acoustically transparent fabric tensioned and supported on a special frame supported from the main chamber case.

Special attention was then applied to the sealing mechanism where a special 'Z' shaped tortuous path was utilised together with two sets of acoustic compression seals, separated by an air gap. The whole assembly was then compressed for further sealing by over centre clamps. The whole box assembly was then vibration isolated by using soft neoprene AVM's as feet.

Thus an easy to use, balanced and very high acoustic integrity unit was produced equally suitable for laboratory and production line use.

As additional options, a sound source may be mounted in the hood with the speakers focused on the position of the test object.

We have carried out several such exercises using these techniques for many and varied applications and have found that there is a definite need for this type of equipment with it's ease of use and small space constraints. However, care must be taken in the design of such chambers and we have found that these units must usually be tailored to the end users requirements. We have also found that once this unit reaches a size proportion of 1.8 m x 1.8 m x 1.8 m it will be necessary to consider conventional chambers for the larger sizes. Typical characteristics are free field to 400 Hz. Measurements may be made accurately from 100 Hz - 10k Hz with correction techniques.

Basic Design Parameters for Medical Facilities

The design parameters governing medical and audiometric facilities in the UK is governed by the DHSS. This takes the form of (a) A Design Guide for Hospital ENT Services, with (b) A Standard Procedure for Testing and Qualification of Audiology Test Rooms (this is for field applications, not a chamber that may be built to meet the standard in laboratory conditions).

For most applications, the DHSS is also involved in the purchase of these chambers and as such has an engineering division that amongst it's duties checks that all DHSS facilities conform to their standards and issues a certificate stating that the rooms have conformed in the following areas of performance:-

(1) Room internal noise levels
(2) No discrete frequencies
(3) Impact sound transmission
(4) Reverberation times

Medical chambers fall into what may be called a half-way house between scientific test chambers and ordinary rooms, and have a similarity of concept to recording, dubbing and broadcasting studios but without the refinement that is associated with these other facilities.

Medical audiometric rooms are usually twin walled structures with an internal room that is structurally isolated from the building fabric with all services flexibly coupled and attenuated such as H & V, air conditioning, mechanical services, pipework, electrical supplies etc. This sometimes includes R.F. shielding as well for electrocochleography and evoked response.

The main dictates as to whether a room is single or twin skin is the local environment as to where the chamber is to be located. The internal environment usually specified is less than 30 dBA which has a spectrum assumed to be:-

Hz	63	125	250	500	1k	2k	4k
dB	51	41	33	28	25	23	24

with all services in operation and normal operational ambient external to the chamber. (Note - acceptance is only gained if levels more than 6 dB lower are given for quiet surroundings and 3 dB lower for normal usage). These services include ventilation at between 3-10 air changes per hour and an ambient temperature of 18-21^{o}C for an outside temperature of -1^{o}C. With such

installation it is therefore important to exclude cross talk between installations through the H & V system and mechanical services.

The lighting levels within the chambers is usually 200 lux and may be either incandescent fitting or fluorescent. If fluorescent fittings are utilised this normally takes the form of units with remote chokes, starters and other ancillary gear.

The reverberation times of these chambers should be between 0.2 and 0.25 of a second. This is qualified to 0.25 of a second below 1000Hz and 0.2 above 100 Hz (these are maximum levels). As these rooms are usually twin skinned, it should not be forgotten that connection points with isolation should also be made for the following electrical services: jack connectors, instrumentation, intercom for patient to operative, electrical power, fire alarm etc.

The layout of the rooms should also bear in mind local fire regulations and in the types of door openings as you will probably have double doors in single or multiple wall constructions. This means doors opening through doors or doors mounted on and isolated from the doors on which they are mounted.

It is also becoming an increasing requirement to provide these rooms with larger windows and as such the problem of reverberation time must be borne in mind when assessing the effect of the windows on the overall acoustic performance of a room, i.e. thickness and type of construction to maintain acoustic transmission loss of the structure and the effect of large areas of plate glass on internal reverberation time.