XL Risk Consulting

Property Risk Consulting Guidelines

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ANECHOIC CHAMBERS & SCREEN ROOMS

INTRODUCTION

Anechoic means “neither having nor producing echoes.” Anechoic chambers are chambers that are echo free. Historically, these chambers have been used for sound measurement and research. Many musical instrument manufacturing, speaker manufacturing or other sound-related industries have used anechoic chambers to measure musical parameters such as pitch, tone and frequency without echo interference.

In the age of electronic devices, anechoic chambers have become indispensable for the testing, development and calibration of various electronic devices, such as radios, radar, microwave transmitters and receivers, computer equipment and copying equipment. Devices being tested in the chamber are either emitting or receiving signals, or generating signals. Interference from electromagnetic echoes or stray electromagnetic signals must be prevented. This is accomplished by using special absorbing foam cones or wedges to stop wave echoes. Anechoic chambers ensure that this is done without interference from or to the surroundings.

Screen rooms prevent electromagnetic radiation from escaping or entering. They are most commonly used as a calibration area for fine tuned electronic devices. They usually deal with low levels of emission or transmission, which allow the omission of the absorbing cones in the anechoic chambers. These rooms are generally a metallic screen or solid wall and ceiling, totally enclosing the work area. Everything entering the room with the exception of shielded signal or power cables must go through a dielectric connection to prevent stray current from entering. Generally, these rooms are much smaller than anechoic chambers and can be used as production areas for such processes as the ultrasonic sealing of plastic parts, the ultrasonic inspection of various types of nonmetallic parts, and the ultrasonic or microwave curing of materials. Screen rooms are also used for security of classified project areas to prevent radio frequency (RF) signals from being intercepted.

Anechoic chambers and screen rooms are usually individual structures, however, their individual technologies can be incorporated into a single structure.

In some cases, the device being tested is more expensive than the anechoic chamber. In addition, test projects are scheduled for a particular “window” in time. Delays and incidents that damage or contaminate of the chamber cannot be tolerated.

POSITION

Build the structure forming an anechoic chamber with noncombustible or fire-resistive materials. If the structure is directly attached to an existing building, provide a minimum 2 hr cutoff between the chamber and the existing building. This is especially important when the building contains large control rooms with important computer equipment.

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Keep electric ignition sources to a minimum. Limit the number of power lines entering the chamber. Design the power system in accordance with NFPA 70. In addition, keep hydraulic oil systems to a minimum, and limit the capacity of oil reservoirs.

Do not allow hot work of any kind in the chamber once combustible construction materials have been introduced.

Use only absorbing cones and wedges within the chamber that are listed as passing Test 1, Test 2, and Test 3 of the Naval Research Laboratory's Report 8093. Foams meeting these specifications are commonly referred to as NRL foams.

Halon 1301 total flooding systems were previously the form of primary protection for the interior of many chambers. Because of AXA XL Risk Consulting's position not to recommend halon due to its environmental impact on stratospheric ozone, provide sprinkler protection as the primary protection feature in all new installations. Design sprinkler protection in accordance with Table 1. Where perimeter wall protection is used, the parameters for vertical and horizontal spacing, minimum head pressures, and the number of heads per level in the design calculations must be adhered to.

Use of approved telescoping heads is an acceptable means of protection where standard sprinklers are inappropriate due to transmission interference. Provide drainage for anticipated water flow from sprinklers and hose streams.

The thermodynamics of the agent should be considered. Carbon dioxide is discharged at 50% solids, which may not vaporize quickly without the presence of a sufficient heat source in the well insulated anechoic chamber. This could result in poor mixing and a lower than expected concentration.

When a gaseous agent is used, it is important that the agent's extinguishing ability be demonstrated with the specific absorbing material. Since every batch of foam used for absorbing materials has different burning characteristics, samples of actual batches should be tested by the extinguishing system manufacturer to prove that the agent is adequate for extinguishment. Submit data from such tests to AXA XL Risk Consulting's local Plan Review Office for review.

Install gaseous agent extinguishing systems with a connected reserve and interlock the system to shut down power to the object and calibration equipment, to shut down power to all hydraulics and positioning equipment, and to shut off air conditioning and close dampers, as needed. During the installation or removal of objects, or reconfiguration of the interior of the chamber, doors for entry and exit may be open and agent could be lost. Additional gas or extended discharge periods may be necessary to replace lost agent. Back up the gaseous extinguishing system with sprinkler protection.

Provide detection for gaseous agent extinguishing systems installed in accordance with NFPA 72, PRC.11.1.1.1.0 and PRC.13.0.1. Use one of the following methods:

- Air-sampling type smoke detection systems arranged to cover all areas of the chamber;
- Standard ionization type detectors throughout the chamber;
- Multiple beam type detectors arranged to cover all areas of the chamber.

Install hose connections equipped with standard adjustable spray nozzles at each access point to the chamber. Provide enough hose appliances to adequately reach any point within the chamber with two hose streams. Where hose lengths are excessive, use larger feeds with "wye" connections. In addition, provide ladders so vertical access can be gained for manual fire fighting along the walls or at the test pedestal.

TABLE 1
Anechoic Chamber Sprinkler Protection Wall and Ceiling Requirements

			Sprinkler Density	
Cone Type	Size (in.)	Room Height (ft)	Wet or Pre-action	Deluge (*)
non-NRL	=12	=15	0.35 entire area or 5000 ft^2	0.30 entire area
non-NRL	=12	>15 = 25	0.45 entire area or 5000 ft^2	0.40 entire area
non-NRL	=12	> 25 = 50	0.60 entire area or 5000 ft^2 **or** 0.30 entire or area 5000 ft^2 **and** 15 ft vertical 10 ft horizontal 15 psi/head 8 heads/ 3 levels	0.60 entire area **or** 0.30 entire area **and** 10 ft vertical 15 ft horizontal 15 psi/head
non-NRL	=12	> 50	0.60 entire area or 5000 ft^2 **or** 0.30 entire or area 5000 ft^2 **and** 15 ft vertical 10 ft horizontal 30 psi/head 4 heads/every level	0.60 entire area **or** 0.30 entire area **and** 10 ft vertical 15 ft horizontal 30 psi/head
non-NRL	>12 = 36	=15	0.45 entire area or 5000 ft^2	0.40 entire area
non-NRL	>12 = 36	> 15 = 25	0.60 entire area or 5000 ft^2	0.60 entire area
non-NRL	>12 = 36	> 25 = 50	0.45 entire area or 5000 ft^2 **and** 15 ft vertical 10 ft horizontal 30 psi/head 8 heads/3 levels	0.60 entire area **or** 0.40 entire area **and** 15 ft vertical 10 ft horizontal 30 psi/ head
non-NRL	>12 = 36	> 50	0.45 entire area or 5000 ft^2 **and** 15 ft vertical 10 ft horizontal 30 psi/head 8 heads/3 levels	0.60 entire area **or** 0.40 entire area **and** 15 ft vertical 10 ft horizontal 30 psi/ head
non-NRL	> 36	= 15	0.60 entire area or 5000 ft^2	0.60 entire area
non-NRL	> 36	> 15 = 25	0.60 entire area or 5000 ft^2 **and** 15 ft vertical 10 ft horizontal 15 psi/head 8 heads/3 levels	0.60 entire area **and** 15 ft vertical 10 ft horizontal 15 psi/head
non-NRL	> 36	> 25 = 50	0.60 entire area or 5000 ft^2 **and** 15 ft vertical 10 ft horizontal 15 psi/head 8 heads/3 levels	0.60 entire area **and** 15 ft vertical 10 ft horizontal 15 psi/head
non-NRL	> 36	> 50	0.60 entire area or 5000 ft^2 **and** 15 ft vertical 10 ft horizontal 15 psi/head 8 heads/3 levels	0.60 entire area **and** 15 ft vertical 10 ft horizontal 15 psi/head
NRL	=12	= 25	0.25 entire area or 3000 ft^2	0.25 entire area
NRL	=12	> 25 = 50	0.35 entire area or 5000 ft^2 **or** 0.25 entire area or 3000 ft^2 **and** 15 ft vertical 15 ft horizontal 15 psi/head 8 heads/3 levels	0.35 entire area **or** 0.25 entire area 15 ft vertical 15 ft horizontal 15 psi/head
NRL	=12	> 50	0.35 entire area or 5000 ft^2 **or** 0.25 entire area or 3000 ft^2 **and** 15 ft vertical 15 ft horizontal 30 psi/head 4 heads/every level	0.35 entire area **or** 0.25 entire area **and** 15 ft vertical 15 ft horizontal 30 psi/head
NRL	>12	= 25	0.30 entire area or 5000 ft^2	0.30 entire area
NRL	>12	> 25 = 50	0.35 entire area or 5000 ft^2 **or** 0.30 entire area or 3000 ft^2 **and** 15 ft vertical 15 ft horizontal 15 psi/head 8 heads/3 level	0.35 entire area **or** 0.25 entire area **and** 15 ft vertical 15 ft horizontal 15 psi/head
NRL	>12	> 50	0.35 entire area or 5000 ft^2 **or** 0.30 entire area or 3000 ft^2 **and** 15 ft vertical 15 ft horizontal 30 psi/head 4 heads/every level	0.35 entire area **or** 0.25 entire area **and** 15 ft vertical 15 ft horizontal 30 psi/head

SI Units: 1 ft^2 = 0.09 m^2; 1 gpm/ft^2 = 40.74 L/min/m^2

1. Maximum ceiling head spacing 80 ft^2 (Horizontal wall spacing exceeding 10 ft must be staggered.)
2. Ceiling heads located ⅔ the distance from ceiling to tip of cone. Use telescoping heads where exposed piping is a problem. Use air sampling detectors.
3. *Deluge system should not be used unless used for exposure protection.

Provide smoke and heat venting, using the existing air conditioning system, and arranged to provide 6 cfm of venting for each ft^2 (0.03 m^3/sec/m^2) of floor area in the chamber.

Anechoic chambers containing fueled vehicles pose special problems because sprinkler protection must also control the flammable liquids fire. If there is a possibility of a sizable spill, investigate the need for a foam-water system. In addition, low level ventilation and explosion relief are needed. Provide Class I, Group D electrical equipment for all pits and up to 18 in. (45.7 cm) above the floor. Environmentally controlled chambers provide another challenge because the temperatures inside the chamber can range from -40°F – 140°F (-40°C – 60°C). In those cases, continuous low level ventilation is not practical. Provide vapor detection interlocked to start ventilation at 25% of the lower explosive limit (LEL).

Provide sprinkler protection inside the crane pockets.

DISCUSSION

There are three general types of chambers: the electromagnetic compatible chambers (EMC); the free space chambers (FS); and the radar cross section chambers (RCS). The EMC chambers operate in the 30 - 1000 MHz range. The FS chambers generally use microwaves and frequencies of 100 MHz – 100 GHz. The RCS chambers operate in the 100 Hz – 100 GHz range.

These chambers can range in size from the typical small room for a radio set of 1500 ft^3 (42.5 m^3) or less to one capable of holding large military aircraft.

These structures present a number of fire protection challenges. Anechoic chambers can be constructed inside a building. By their very nature, they must be secured and screened or secluded from the rest of the facility. This makes access difficult at best and can also present possible blind spaces at walls and ceilings where the two structures abut. Many times there are cranes at the ceiling level hidden by cones.

The current form of absorbing material used in anechoic chambers is a urethane foam plastic in various shapes. The most common are cones or pyramids (wedges) of various heights and dimensions. This absorbing material covers all surfaces of the chamber as well as main interiors and exteriors of air conditioning duct work and test stands within the chamber. The maximum cone length reported to date has been 12 ft (3.6 m). Within the chamber, hydraulically powered material handling equipment positions the object being calibrated or tested. This equipment can be similar in configuration to a cherry picker and may have three dimensional movement at the end of the arm.

It is also possible to have fixed pedestals of plastic or other nonmetallic construction to support the object being evaluated. The object itself may also be supplied with electric power, cooling arrangements and instrumentation wiring. The chamber is air conditioned or ventilated to remove waste heat from the emitting or receiving object. Air conditioning equipment should be properly maintained to ensure longevity.

During the calibration or testing period, these chambers are not occupied because of the electromagnetic radiation hazard to personnel. In some cases, there may not be direct observation capability. Some long-term testing is done unattended, a practice which should be discouraged.

Because of their high energy input or output, the hydraulics involved and the nature of the absorbing material, a fire in the chamber can present an extremely difficult fire fighting challenge. The large volume of modern chambers make detection in the early stages of a fire difficult. Because of the configuration of the cones or wedges, fires can become involved above the sprinkler system at the ceiling levels. Access to the chamber can also be very difficult because of the multiple sealing effect of the doors or other access points to prevent radiation from escaping the chamber. Some occupancies also have a high level of security with restricted access that would not allow fire fighting crews into the chamber.

The value of an anechoic chamber can be quite high. The absorbing material can account for up to 25% of the total value of the chamber. The material or objects being tested can also be high in value or critical to the continued operation of a facility. Since the test objects are generally of open configuration, they are very susceptible to smoke, heat, water and contamination damage.