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TECHNICAL NOTE

AN EFFECTIVE AND ECONOMICAL SOUND-ATTENUATION CHAMBER[1]

Effective sound-attenuation chambers serve several functions. They keep extraneous environmental noise from the experimental space, raise the quality of auditory stimulus presentations because their interior surfaces usually reduce sound reflection with its resulting distortions, and confine sound stimuli to their intended experimental space. If several experiments employing auditory stimuli are conducted in close proximity to each other, attenuation chambers are absolutely essential to eliminate interference among discriminative stimuli of the various experiments. The aim of the present design was primarily to keep an auditory stimulus from escaping the chamber in which it was generated. Chambers built to the specifications described allowed the author to conduct three experiments, each employing 2000-Hz 95-db tones as discriminative stimuli, simultaneously in the same small room without interference among them. The loud tones are barely perceptible directly outside the attenuation chambers.

This article describes an effective sound-attenuation chamber for small animals; its construction requires few tools that are not available in most laboratories. The cost of materials, including an exhaust fan, is approximately $70 per chamber. The attenuation chamber, with a training compartment inside, is shown in Fig. 1. Its outside shell, measuring 31½ by 27⅝ by 5⅝ in. (80 by 70 by 65 cm), is made of ¾ in. (1.90 cm) plywood. (This can be precut at most lumber yards.) The chamber's wall is shown schematically in Fig. 2A. The ⅝ in. (1.59 cm) National Gypsum Gold Bond sheetrock is held to the plywood, and to the adacent sheetrock, by Industrial Contact Adhesive #7004. The Owens-Corning ¾ in. 1.90 cm) Textured Glass Acoustitile is held to is held to the plywood, and to the adjacent sheetrock, by Acoustigum.[2] (Sound absorption characteristics of this acoustitile are available from the manufacturer.) Adjacent wall layers have staggered joints. The resilient adhesive between these layers serves further to attenuate sound transmission.

The design and quality of the door seal and air ventilation sound baffle determine the limits of sound attenuation. Figure 1 shows that the chamber's door is so constructed that complementary wall and door layers interlock in a stepwise fashion. Tolerances are determined to insure that these "steps" press firmly against one another when the door is closed. The exposed edges of the door and walls are covered with polyethlene-coated weatherproof tape. The door is pulled tightly shut by window locks with retracting clasps.

The sound baffle, one over the air intake and another over the exhaust duct, is seen in Fig. 2. These baffles transmit air while absorbing the sound that normally escapes through conventional air vents. The baffle, constructed of the same materials as the chamber itself is an open ½ in. (1.27 cm) plywood box, 6⅞ by 9⅞ by 4¼ in. (43 by 25 by 11 cm) lined with sheetrock and filled with five sheets of acoustitile. The air path through the baffle is shown in Fig. 2A, while Fig. 2B presents its interior design. An air intake or exhaust fan is necessary for an adequate air supply. Fan capacity would be determined by the amount of heat generated in the chamber. Vibration transmission is eliminated if the fan is connected to the chamber with flexible tubing. For additional air transmission capacity, the air path in each sheet can be widened by approximately 50% without appreciably affecting the sound transmission characteristics of the baffle. Placing the chamber on foam rubber or felt pads helps to isolate it from other sources of vibration. To allow normal air convection currents to assist in ventilation, the air intake should be located near the floor of the chamber and the exhaust near the ceiling.

A 4 in. by 7 in. (10.2 by 17.8 cm) observation window was cut through the side wall. Three ¼ in. (0.64 cm) panes of clear Plexiglas impede sound transmission through this avenue. One pane is glued to the exterior plywood wall, another to the interior acoustitile wall, and the third intermediate between them. Connection cables travel through a 1 in. (2.54 cm) fiberglass-filled hole in the side wall.

The sound-attenuation characteristics of the chamber were tested, with the ventilation fan off, by measuring the sound pressure level (SPL) inside and directly outside the chamber when several sound stimuli were generated at 105 db inside the chamber. (The fan was off during these tests to reduce the ambient noise level outside the chest, so that the full attenuation capacity of the chamber could be appreciated.) These stimuli

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[2]These standard items are available from most dealers in acoustical materials.

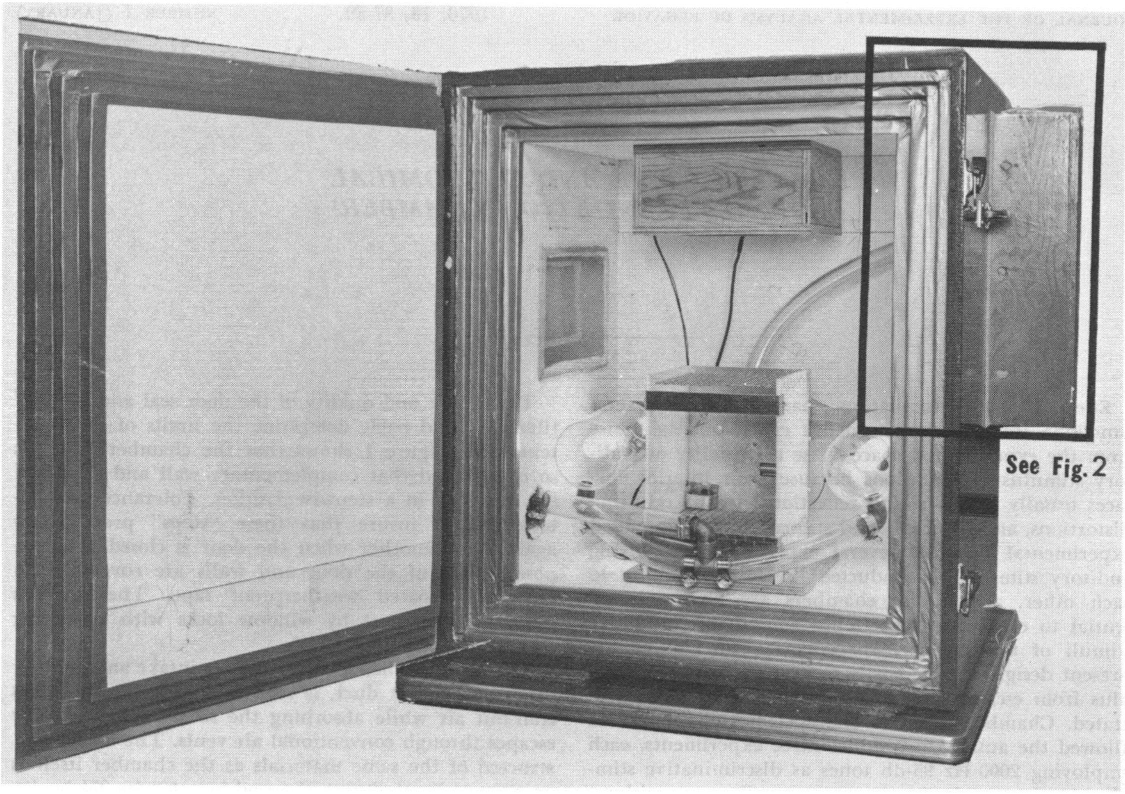

Fig. 1. The sound-attenuation chamber. Its interior dimensions are 61 by 51 by 46 cm. It is shown with a training compartment enclosed because an animal could not be allowed access to the fiberglass walls. The clear plastic cylinders over the bulbs and the plastic tubing travelling from the air intake to the exhaust duct merely augment heat dissipation from the bulbs and are not an integral part of the attenuation chamber. The corner of the chamber outlined, with the sound baffle, is shown in construction detail in Fig. 2.

are shown in the first column of Table 1. The tones were generated by an Eico 377 oscillator and amplified by an Eico ST-70 amplifier. The white noise was produced by a Grayson-Stadler 901B noise generator. An 8 in. (20.3 cm) Quam 8C12X-8 speaker was mounted in a wooden enclosure on the ceiling of the chamber. SPL was taken with a General Radio Sound Level Meter 1565-A, Scale C. SPL was measured in the chamber with the microphone approximately at chamber center, directly under and parallel to the speaker. The complementary SPL measurement outside the chamber represents an average of five readings taken with the microphone adjacent and parallel to the sides, top, bottom, and front of the chamber.

Table 1

Attenuation Characteristics

Hz at 105 db inside Chamber	*SPL Reduction in Decibels**
50	33
200	29
500	45
1000	47
2000	49
5000	50
10,000	50
White Noise	37

*Difference between 105 db generated inside chamber and average reading taken outside chamber. Ambient outside noise level 54 db. All readings to nearest db.

Table 1 gives the attenuation characteristics of the chamber for each of the test stimuli. Attenuation was substantial for all stimuli tested. With 105-db tones of 1000 Hz and higher in the chamber, SPL outside the chamber was only slightly above ambient noise level, the tones being just faintly audible. Audio equipment was unavailable that would produce the homogeneous sound field outside the chamber necessary to measure adequately SPL reduction in the reverse direction to that reported.

Unfortunately, the animal chests available from most manufacturers of behavioral research equipment serve almost no sound-attenuation function, and the commercially produced acoustical chambers that do are often too expensive for many laboratories. This situation has

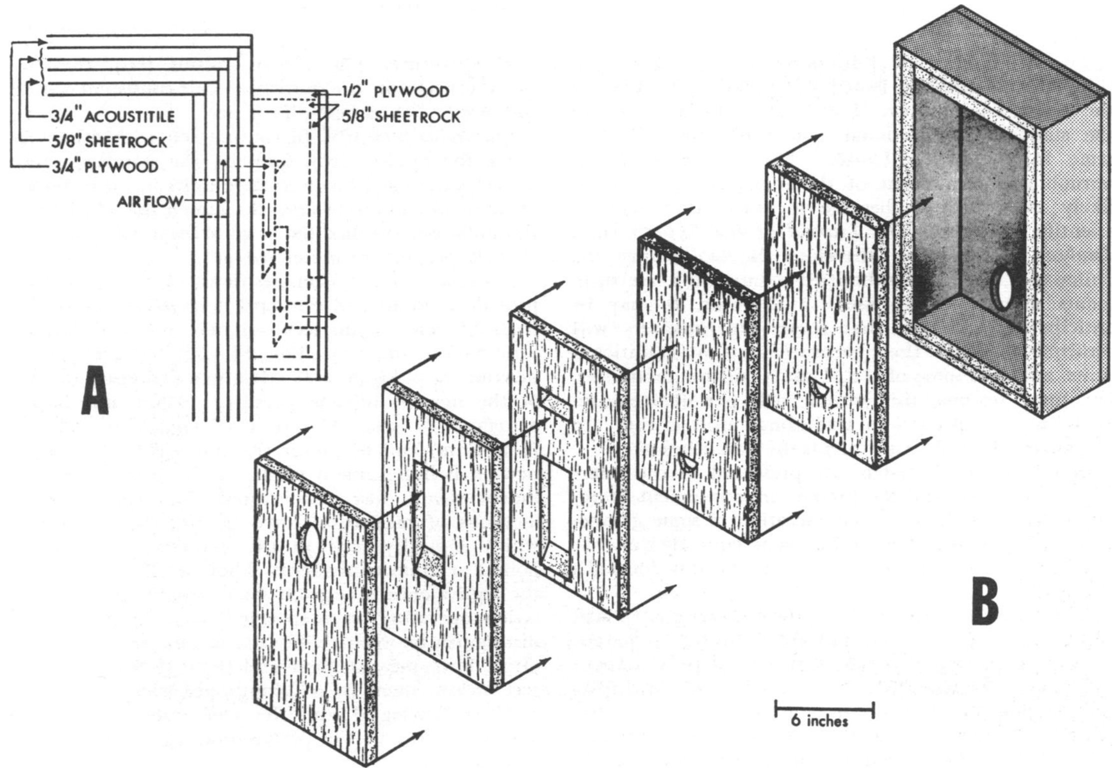

Fig. 2. Figure 2A presents a schematic rendering of the chamber's walls, the staggered corner joints, and the air flow through the wall and sound baffle. The five layers of fiberglass are not detailed in the baffle in order to present more clearly the air flow path. Figure 2B is a projection drawing of the sound baffle that displays how the pattern cut from each fiberglass sheet creates the air duct.

frequently led investigators to be somewhat insensitive to possible auditory interactions between simultaneously run experiments, and even interference from unintended "cues" of scheduling equipment with intended discriminative stimulus control. The design reported here indicates that most investigators plagued with these problems have the capacity within their own laboratories at least to partially overcome them.

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