stereophile

EQUIPMENT REPORTS

ASC TUBE TRAPS

J. Gordon Holt

Low and high frequency acoustic absorbers. Dimensions: 3' and 2' high; 9", 11", 16", and 20" diameter. Semi-cylindrical versions of all sizes available. Prices: $59 to $299, depending on size. MANUFACTURER: Acoustic Sciences Corp., PO Box 11156, Eugene, OR 97440. (800)-ASC-TUBE.

In my rather jaded report on the Winter CES (Vol. 29, No. 2), I remarked that there was nothing really new in the field of high end audio. Well, I was wrong. I overlooked the ASC Tube Traps, a patented new acoustic device designed by Arthur Noxon (president of ASC). The Traps represent the first practical and effective solution to a perennial audiophile problem: standing waves in the listening room.

While most audiophiles today know that proper acoustical treatment of the listening room is essential for good sound reproduction, few are aware that the usual wall treatments have practically no effect at low frequencies. A treated room can be almost completely dead at middle and high frequencies and yet suffer from severe standing-wave interference at low frequencies[1].

Recording studios use wall "traps"[2] to control low-frequency reflections, but, since these must be built in to the walls during construction, they're of only academic interest to the majority of audiophiles. Most of us have had to accept the inevitability of standing waves, and, by judicious placement of the loudspeakers, try to minimize their detrimental effects. Now at last, there's a better solution.

In order to understand how the ingenious devices from Acoustic Sciences Corp. work, it's necessary to understand a little bit about how sound waves behave in an enclosed space. We all know that sound waves are created by any vibrating object, be it a violin or a shrieking infant. Less generally known is that sound waves produce only slight changes in pressure in the surrounding air.

As the vibrating object moves, it presses against the surrounding air and causes a pressure rise at the surface of the object. Because the surrounding air molecules are unconfined, they immediately relieve the pressure by simply moving away from the sound source. Likewise, as the source produces a surface rarefaction by moving away from the surrounding air, the air molecules are drawn towards it, again maintaining the air pressure at a relatively constant level.

As each of these molecular shifts occurs, it is passed on to adjacent air molecules; the shift travels outwards in all directions from the vibrating object at a speed of about 1100 feet per second--the velocity of sound in air. It is important to note that these air-molecule shifts do *not* cause a wind (which is the acoustical equivalent of direct current). The shifts are only temporary, with all molecules returning more or less to their original positions in space, after the sound wave has passed.

The easiest way to visualize sound transmission through air is to think of a falling row of dominoes. When the first one falls, it knocks over the next, which in turn knocks over the next, and so on. Each individual domino moves only an inch or so, but the state of fallen-ness traverses the entire line of dominoes. Each domino behaves like an air molecule, while the "fallen-ness" is analagous to the sound wave.

Because sound transmission in open air consists of molecular shifts and pressure changes, when sound waves impinge on a boundary like a room wall, the air molecules cannot move any further; they pile up on one another, causing a pressure rise at the boundary surface. If the surface has no absorptive qualities, the pressure rise will have no place to go except back out into the room, as a reflection. It will then cross the room as an acoustic wave until it encounters another surface, which may reflect it once again. This will continue until the wave dissipates as a result of friction in the air.

A room's reverberation is the result of multiple reflections between opposite boundary surfaces. The time it takes for the reverberation to die out is considered to be the room's reverberation time or RT (For measurement purposes, "dying out" is defined as the point where the strength of the reverberation has fallen to 60 dB below the strength of the original sound; hence the term RT60.)

If it weren't for friction acting upon air motions of the wave, and sound transmission through the walls, the sound wave would be trapped in the room almost forever. Such is the case in marble-faced reverberation chambers.

When a room dimension equals half the wavelength of a sound, the reverb does not die out smoothly and predictably, because the wave acts to reinforce its own reflections. When the boundary zone at one wall surface is pressurized, the opposite one is subjected to a rarefaction, and when these reflect back into the room, they just exchange ends. Each reflection feeds the other, and the result is a storage of energy between the opposite wall surfaces. The reverb therefore takes longer to dissipate than it normally would. This is what we call a standing wave; its effect on reproduced sound is to emphasize a certain frequency, and add hangover to it, impairing both the smoothness and the detail of LF reproduction (not to mention the spectral balance).

Further aggravating the situation, every standing wave also supports lesser standing waves at multiples of the lowest one's frequency. Thus, a 24-Hz standing wave will also cause weaker room resonances at 48, 72, and 96 Hz, each of which will he stimulated by any of those frequencies in the program material.

And that's only a third of the problem. Standing waves occur between *all* parallel room boundaries, and every room has three such pairs (defining height, width, and length). If any of these dimensions are the same, or multiples of each other (such as an 8-foot ceiling in a 16-foot-long room), the harmonic progressions will coincide across the board, and the standing-wave problems will be at, least twice as bad. It is not difficult to see how this can can wreak havoc with an audio system's LF performance.

When sound strikes a flat-surface boundary, the resulting pressure buildup may be dissipated in two ways: by molecular motion parallel to the boundary surface, and by reflection off the boundary surface. Where two boundaries meet as in a room corner, one avenue of pressure relief is cut off, and more energy must then be reradiated by reflection. Thus, pressure buildups are greater in a corner. Where three surfaces abut, as with floor and ceiling corners, pressure changes are even higher still. This is why loudspeakers placed in room corners will excite every standing wave the room is capable of supporting, at maximum efficiency, and why audible bass response is usually greatest in the other room corners. The result is the most bass you can get, but also the most irregular LF response.

Traditionally, standing waves have been considered an inescapable evil in home

1 Only very thick panels--3" or 4" --have significant absorption down to 500 Hz. The thinner, more commonly available stuff doesn't help until 900 Hz, which is pretty well up in the midrange. **-LA**

2 Wall traps are cavities filled with absorptive material and faced with irregularly spaced slats which serve to pass low frequencies and reflect high frequencies. The low frequency energy is then dissipated in the absorptive filler of the cavity.

sound reproduction, to be worked around as best one could. (The "ideal" room dimension ratio of 1 to 1.25 to 1.6 does not reduce the severity of standing waves; it merely puts them as far from one another as possible, to minimize augmentations and cancellations. By spreading out the irregularities, it also creates the illusion of smooth response.) ASC's Tube Traps now provide a means for actually suppressing standing waves.

Each Trap is a hollow tube with a solid cap on each end. The walls of the tube consist of a l"-thick layer of dense, fene-stration Fiberglas, surrounded by a rigid wire frame to prevent its collapse. The outer surface is a decorative fabric material available in a variety of colors.

Placed in a room corner, the tube is subjected to air-pressure variations from standing-wave activity; these create pressure differentials between the room and the cylinder. The porous fiberglas allows air to flow in and out of the hollow cylinder in order to equalize the pressures; because the fiberglas is quite dense, friction between the air molecules and the fiberglas strands tends to impede air flow. The friction results in heat, which draws energy from the moving--air energy that would otherwise have been re-radiated as a standing wave.

Because it takes a certain period of time for the inside and outside pressures to equalize, the LF absorption characteristic of the ASC tubes depends on their internal volume. The larger the volume, the more time required for pressure equalization, and the lower the absorption frequency. The smallest tube, 9" in diameter, works down to around 90 Hz. A 11-incher is good down to 45 Hz, while a 16-incher is claimed to be effective to 10 Hz--not that anyone is likely to care.

The end caps on each tube are threaded, and metal studs are provided to stack several tubes together, allowing for the assembly of a stable floor-to-ceiling column. The tubes are light enough so that an 8-foot stack could fall on your head without causing much more than acute surprise; nevertheless, .if you have small children, or cats with a penchant for climbing, I would suggest anchoring the columns to the wall or ceiling with a length of picture wire.

I should mention here another interesting feature of the Tube Traps. Suspended just under the surface of each tube and wrapped around about 180° of its circumference, is a thin sheet of soft plastic that is reflective at frequencies above 400 Hz. (It has little effect below 300 Hz.) Thus, each tube can be "tuned" by rotating it for the optimum balance between low- and upper-frequency absorption, to compensate for differences in the absorption coefficients of wall surfaces behind it. One can tell at a glance which way the tube is oriented by the placement of a seam that runs up and down the tube, so this tuning process is not too difficult.

Like all great inventions, the Tubes are a masterpiece of elegant simplicity. What is most remarkable about them, though, is how *well* they work. Just two of these tubes, in the corners behind the loudspeakers, make a clearly audible difference in LF smoothness and detail. Floor-to-ceiling columns in all four room corners produce an improvement that can only be described as dramatic. Additional ones, along the walls, can make the room as acoustically dead as you want it to be.

While it *is* possible to overdamp a room with Traps (according to the manufacturer-I was not able to confirm this), their not inconsiderable cost--particularly in the larger diameters--and their tendency to eat up room space will generally dictate using them efficiently rather than going for overkill. Even a minimally efficient room treatment may cost-close to $1000, but the onus is partly offset by the fact that you can do the treatment in stages, starting with two of the large Traps in the most critical locations, then adding more as finances permit--which is fortunate, considering how expensive complete room treatment is (the cost of doing my room *thoroughly* was about $8200 at retail).

Because the cost of each ASC Trap depends on its size, you should use the smallest ones you can get away with. The 11" tubes will usually be ideal in three surface corners, with 9-inchers suitable for two-surface junctions and midwall locations. In listening rooms of average size, you should not try to suppress all of the lowest frequency standing waves, as they will usually be near the speaker's low-end limit, where output level is somewhat down to begin with. It is pointless, for example, to use 20-inch tubes in a system with loudspeakers whose bottom range doesn't extend below 50 Hz.

You might build the treatment of a typical room as follows:

• Single 11-inchers in lower room comers-first behind the speakers, then 16-inchers behind the listening area.

• Go up to the ceiling in the corners with 11 -inchers behind the speakers, then more 16-inchers behind the listening area.

•Single 11-inchers at mid-points along the lower side walls.

•Single 9-inchers at one-quarter points along the lower side walls.

• Go up to the ceiling at mid- and quarter points (you're venturing into the realm of no-holds-barred).

• 9-inchers at all boundary edges, with tubes parallel to the edges. Now you're a complete Tube addict!

My listening room was Tube-treated by ASC's Field Rep Sandy Hawkins, who really did the whole number--no holds barred. The room now contains 60 Tubes, 9" to 16" in diameter; to say that it has been transformed would understate the case~ With only 1 -inch-thick fiberglass panels on the walls and carpeting on the floor, this used to be a good listening room. It is now superb! Everything about the sound except high end quality has improved, and dramatically in some areas: bass performance, imaging, soundstaging, and overall detail.

The only real problem with Tubes is the space they take up, particularly when they're out of the corners. Ideally, they should be located symmetrically in the room, which may mean blocking off windows and record cabinets--or worse, doorways[3]. The ideal Trap configuration for my room left no space for the work desk, computer printer, and 14 boxes of LPs, not to mention the piles of 14-year accumulated junk. The room sounds great and looks very impressive, but is now useful *only* as a listening space. For me, it's still a worthwhile sacrifice, but you may not want (or be allowed) to sacrifice your living room so wholeheartedly.

Speaking from experience, I would advise the following compromise for those who cannot dedicate an entire room to listening. Use conventional acoustical materials like Fiberglas and Sonex--the thicker, the better--on wall and ceiling surfaces, and heavy wall-to-wall carpeting on the floor, to control mid- and upper range reflections. Then use the Tube Traps in the corners and, perhaps, the half-way points, to control LF standing waves.

There are few "accessories" I can think of that I would consider tube absolutely necessary for good audio system performance, but the ASC Tube Trap is one of them. I cannot recommend them too strongly!

LA Comments:

I don't qualify as an evaluator of Tube Traps, more as a witness. The effect on JGH's room has been practically breathtaking. The only characteristic perhaps not emphasized enough by JGH is *articulate-ness.* You notice it as soon as you go into the room, even without music playing: speech is much easier to understand; you can speak more softly and still retain perfect intelligibility. This, of course, extends to the music: particularly low end, but midrange as well, is *much* better defined.

There aren't many products that I think make an astonishing difference, but Tubes are definitely one of them.

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3 Just before this issue went off to the printer, JGH and I were attempting some critical listening in his "tubed" listening room--he always has been a rabid tube fan-when he pointed out a surfeit of low end at the back wall right in front of the door. Moving a good-sized tube column in front of the door (thereby blocking off the room's only mode of egress) eliminated the problem. These tubes can really change your life! **-LA**

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