

Audio Speaker Enclosures

Construction tips

For do-it-yourself (DIY) audio hobbyist.

You can design a system that looks and sounds the way you choose. Audio speakers with non-parallel walls have fewer problems with internal reflections but most builders prefer the box-like enclosures because construction is easier and they look like audio speakers. The preferred ratio of dimensions is 0.62 : 1 : 1.62. This ratio is referred as the "golden ratio" since the days of the Egyptian pyramids. It insures the resonance will be spread over the frequency spectrum. This ratio is prevalent in several engineering applications.

Driver placement

The first rule is to place the high frequency tweeters above the low frequency woofers. This places the tweeters near ear level and the directional sound will not be lost. The woofers then are nearer the floor for good bass reinforcement. The second rule is to place the audio drivers in a vertical line. This will keep frequencies in-phase with the listeners ear. If for some reason the drivers are place off line or off center, mirror the audio speaker front face so that the drivers are not at different distances from the ideal listening chair.

Materials

The most commonly used speaker material is 3/4" plywood or particle board. Thickness should be chosen to match enclosure size. If the box is under 1/2 cubic foot in volume, it can be made from 1/2" or even 3/8 material. Use 3/4" material in enclosure made for woofers with a diameter of 8" or greater. If you use plywood, choose a good grade. Hardwood plywood such as birch or walnut works well. Cheap grades of fir plywood will have many voids and poorly glued layers. Voids and loose layers can cause rattles. For a fine wood furniture appearance you can use 3/4" hardwood plywood with beveled corner joints. One can also use particle board with butt joints. Wood veneer can be applied for appearance. Any kind of material will work from cloth to wallpaper for appearance. Particle board is especially desirable because of its high density, lack of voids or loose layers, and is less expensive. When buying it, choose an industrial grade. Counter top particle board works very well. You can identify the best particle board by examining the particle size. The best selection has small particles and smooth edges. Avoid particle board that is flaky with large particles.

Make the audio speaker enclosure rattle-free

The best way to avoid rattles is to do a good job gluing the joints. Experienced carpenters use just enough glue to hold, but not enough to squeeze out onto raw wood spoiling the appearance. This works well for furniture but can cause problems in speaker enclosures. The skimpy use of glue can leave air leaks as well as rattles. Spread the glue thicker near the interior side of the joint. Then remove excess glue with a damp cloth. If you make one panel removable, use carefully installed foam weather stripping material to seal the box and prevent rattles. Such panels should be held in place with wood screws, size #8 x 1 1/4 " works well. Position the weather stripping so the screws will not catch and damage it. When installing removable panels, place the screws no farther than

about 4 or 5 inches apart. For speaker systems with crossover networks, the crossover components and screw terminals can be installed on a piece of 1/4" hardboard which can be glued to the interior of the back.

Make the audio speaker enclosure airtight

Small gaps between joints can cause air noises. If the air leak is significant, it can unload the woofer in a sealed enclosure. To insure against leaks, caulk every joint with latex caulking compound. If you are building a box with no removable panels, you can start by assembling the sides, top, bottom and the front speaker board. Caulk every inner joint, then install the back. You can reach through the speaker holes to caulk the joints around the back. Make sure you fill the terminal holes on the inside of the panel with latex caulking compound.

Do not forget damping material

Audio speakers that don't have enough damping material sound "loud", even at low volume. Damping material is necessary to absorb sound from the rear of the cone, sound that would otherwise be bounced around the box and reflected out through the cone. Damping material suppresses mid-range peaks, making the response curve smoother. If you are building a port, keep the port free of damping material. Put damping material on the interior of the back panel, one side, and either the top or bottom. The idea is one layer of material in each dimension will absorb reflections. Some builders will put damping material on all the interior walls. Make sure the walls near the woofer are heavily covered. In addition to absorbing reflections, damping material can be used to increase the effective cubic volume of the speaker enclosure. A 20% effective volume increase can be achieved by stuffing the enclosure with material. Don't compress the material. For adjustment of how much material to use, judge by your ear. Add more material to the enclosure that sounds "loud" at modest volume levels. Fiber glass is the most widely used material. Acoustical grade fiber glass can be bought for this purpose. You can also substitute other materials such as polyester batting, rug underlayment, even old rags. Don't use dense materials that would significantly change the enclosure volume.

Install drivers from the outside of the enclosure

If the driver is bolted to the rear of the front speaker board, the panel produces a cavity at the front of the speaker that can change the "color" of the sound. The edge of the wood at the edge of the driver will diffract the sound waves. Front mounting permits a more vibration-proof box because there is no need for a removable panel. If there is no rubber mounting gasket for the back of the driver, a bead of silicone rubber compound will work. For very large woofers, 15" or greater, install T-nuts to secure the driver.

Choose an open grille cloth

Don't cover tweeters with a thick drapery material. Use a grille cloth made for the purpose. You can test any cloth that you may use by holding it up to a light. If you can see through it, it will probably be suitable. You can also test the cloth by hanging it front of the audio speakers. If it changes the sound, find a different material. Speaker grills work great for music instrument and PA systems. They provide better protection for transportation. For a professional look use cloth-backed vinyl or "tolex" for the finish. Metal corners will also provide adding protection.

Ports

Finding a round port tube might prove difficult to find. Some hardware stores will carry different size prefabricated wood "tubes". They will work fine. You can use a paperboard tube for a port. Such tubes are used by rug manufacturers for shipping cores. You can get a tube from a local furniture store or carpet installer. Cut the tube to the proper duct length. Make sure that it is securely glued when building the enclosure.

Audio speaker wire

Ordinary lamp cord with #18 gauge conductors is a good choice for most audio speaker systems. If you have long runs, more than 30 feet from amplifier to the audio speaker, get at least #16 gauge cable.

Polarity test

It is essential the audio speakers be connected so they are in phase with each other. So many times people will connect their audio speakers out of phase and wonder why there is no bottom end bass response. When audio speaker enclosures are out of phase low frequencies will cancel each other. If you are not sure the audio speakers are in phase, there is a simple test. Find a good CD with a lot of "bass" in the recording. Turn up the bass control on your amplifier and listen at a loud volume. Turn the volume completely down. Reverse the leads to one speaker. Turn up the volume and listen again. The correct hook-up is the one with the greater bass response.

Have fun building!