The Table Tuba

This author's latest horn design offers subwoofer capability, but also fits nicely in the living room.

By Bill Fitzmaurice

PHOTO 1: The Table Tuba as a coffee table.

This project is in response to numerous requests for a Tuba folded horn for stereo and home theater capable of reaching down to 30Hz or lower. A 30Hz horn is easy; having space left for anything else in the room isn't. Then there's the matter of the WAF: Wife Acceptance Factor. The Table Tuba (**Photo 1**) gives you the sub that you want, cleverly disguised as a living room table to keep your wife happy. Or at least a little less unhappy when she demands to know why you need to have that "great big speaker thing" in her home.

FEATURES

This design is very driver tolerant. I tested it with a $35 MCM 55-2421 eight (www.mcminone), as well as an Eminence HL10a ten that goes for four times that price, and there was very little difference between them. Target T/S specs are fs 30Hz, Qts 0.35, Xmax 8mm or more, Bl at least 12, Vas 30-60l. Most drivers with specs reasonably close to these will work fine in this box.

If you wish, you can widen the cabinet more than the original 15.75″. I chose the dimensions so that there would be minimal waste when building from standard 5 × 5′ Baltic birch plywood. Widening the cabinet will increase the mouth area for higher SPL and deeper extension, but not by much; you'd get only an additional 3dB by doubling it. I'd only widen it if I wanted to be able to fit dual drivers for higher power handling or lower impedance.

The throat impedance of this box is very high and can nearly double the driver impedance (**Fig. 1**). If you want a 4Ω load, you must use a pair of 4Ω drivers parallel wired, or a dual 4Ω coil driver with the coils parallel wired. However, it is so efficient that you don't need to worry about maximizing your amp's output. An amp rated 100W into 4Ω will put at least 50W into 8, and with the sensitivity of this speaker that's plenty for most home-theater setups (**Fig. 2**).

CONSTRUCTION

The entire cabinet is constructed from ½″ material, either plywood, MDF, or particleboard. If you plan on a natural

FIGURE 1: Impedance chart.

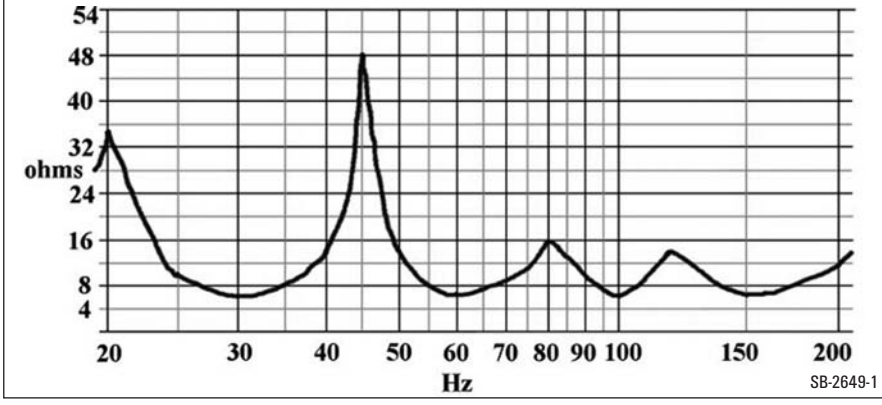
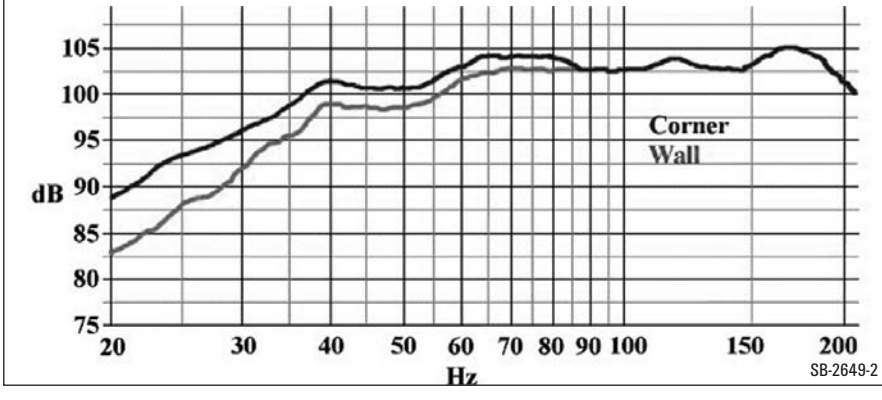


FIGURE 2: SPL response.



finish, Baltic birch is the better choice. With a veneer finish softwood plywood is quite adequate as a substrate. Heavier materials are not necessary, as this box simply does not vibrate. You really can use it as a table, and I can assure that a glass will not scurry across it during the chase scenes of *Terminator 3*. Whether you use 5′ × 5′ or 4′ × 8′ materials, you'll need two sheets.

There are many jointing methods possible—from dado to biscuit to glue and screw. If you're an expert woodworker, I'll leave the decision on which jointing method to you. If you aren't, you can build your Table Tuba the same way I made the original: with a hammer and nails.

I used 1 ⅝″ ribbed panel nails, which are intended for putting up pre-finished wall paneling. They aren't very strong, but they don't need to be. The only purpose of the nails is to hold the parts in place while the adhesive that keeps the cabinet together cures.

Because the joints in the cab must be airtight, I highly recommended that you use a polyurethane-based adhesive, which expands when curing to fill any gaps. I use "PL Pro" construction adhesive, applied with a caulking gun, which works great and is inexpensive. Urethane woodworking glues are fine as well, but can be very pricey.

Construction starts by cutting out the two sides, both measuring 29.75″ square. While the "sides" may technically end up being the top and bottom if you set the cabinet up as a lowboy table, I'll refer to the two largest pieces as the sides, and the cutaways as side views. Draw the locations of all the joints onto one side, as shown in **Fig. 3**. These dimensions show the actual clearances of the horn pathway, surface to surface.

First draw the joints with the top, back, bottom, and front. Then draw the internal joints, starting at the mouth of the horn, working backwards to the driver chamber.

Figure 4 shows the angles of the various intersections and the numerical

FIGURE 3: Parts dimensions. SB-2649-3

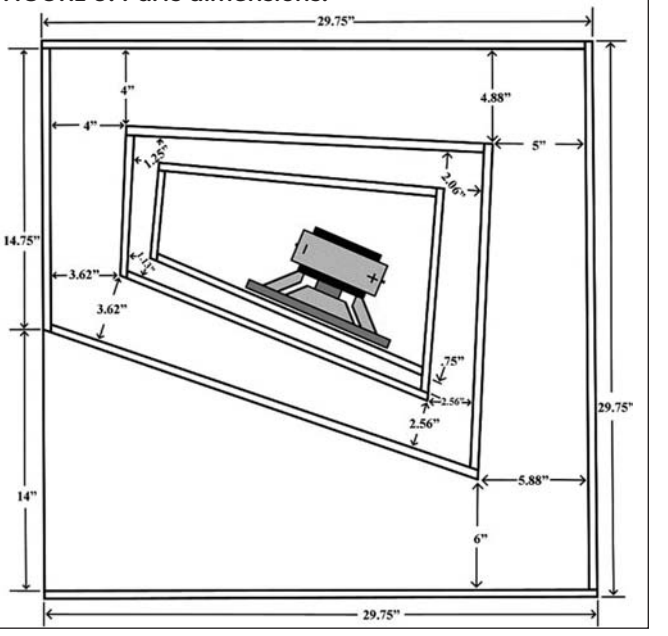


FIGURE 4: Parts angles. SB-2649-4

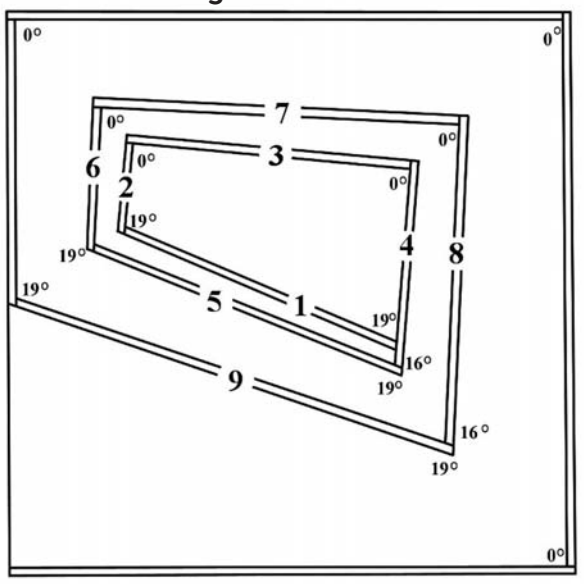
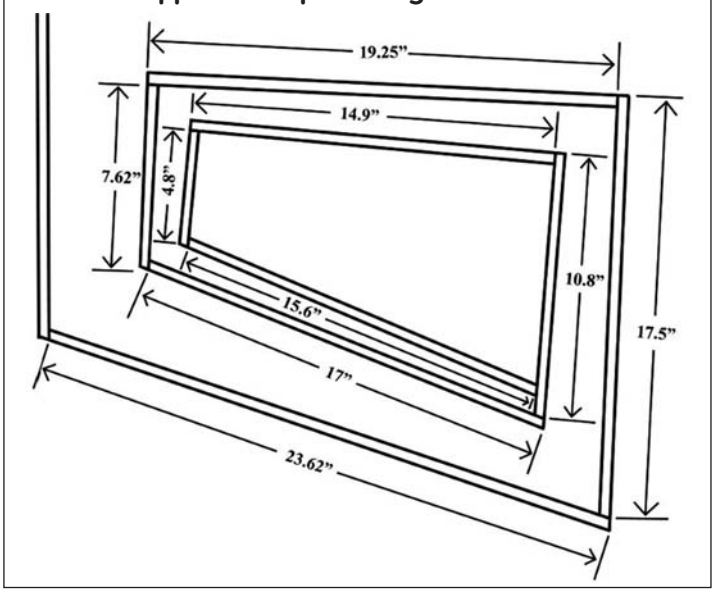


FIGURE 5: Approximate panel lengths. SB-2649-5



designations of the internal panels. You don't need to utilize these angles in the layout, but notice that where the angle is 0°, such as at the junction of plates 7 and 8, the two parts are at right angles to each other. You will want to refer to these angles when cutting the panels, so write them on the side and they'll be there when you need them.

Figure 5 shows the nominal lengths of the internal panels. These are approximate dimensions only and depend on the actual thickness of the material you're building with. You must confirm all these sizes by measuring and/or dead reckoning during the construction process.

After you've drawn the joints on one side, put the two sides back to back and clamp them together. Drill pilot holes through the middle of each joint, using a drill bit the same diameter or slightly smaller than that of the nails you're using. Do not drill closer than 2″ or so from the end of the joint, with the holes spaced 6–8″ apart.

Drill the holes entirely through both sides, even if you plan on using screws instead of nails. Unclamp the two sides and put aside the second. Using either a circular saw or saber saw, cut out a driver access hole in the side as framed by panels 1-4.

The remaining parts are all cut to the same 14.75″ width. If you're using a table saw, it's best to cut them all to width at the same time so that the rip fence can stay in the same place and all the parts will be identically cut.

ASSEMBLY

Cut out panel 1, which is also the driver mounting baffle. Draw a line across the baffle 1½″ from one end. Place the driver on the baffle, centered with one edge on the line. Mark the bolt locations through the frame holes. Put the driver aside. Drill the baffle for T-nuts for the driver mounting bolts. I suggest you use 3/16 × 32 Allen head bolts, as the clearance inside the box is tight and you must drive some of the bolts primarily by feel.

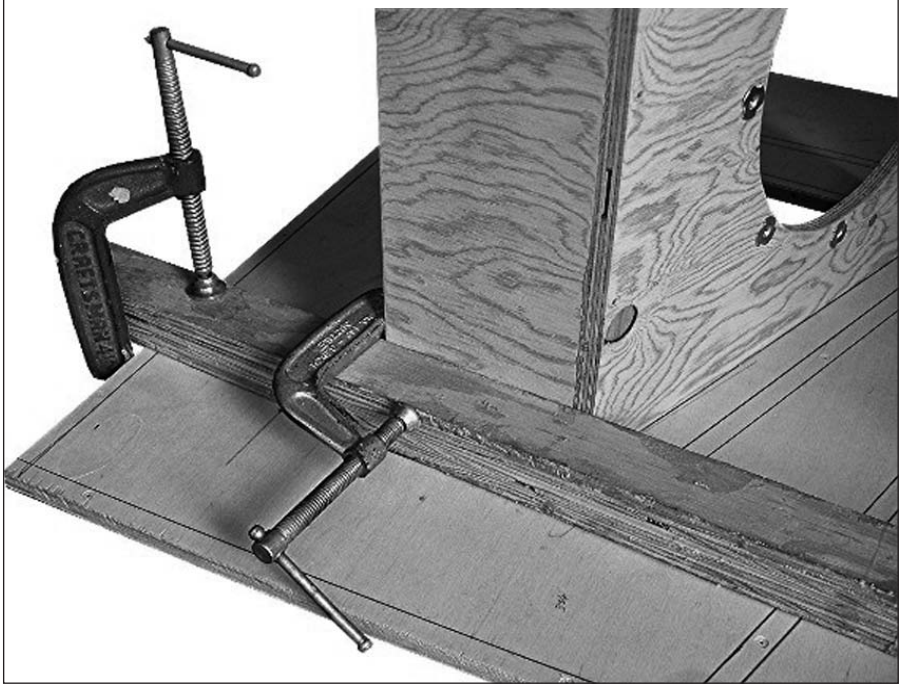
Draw two intersecting lines connecting opposing boltholes to determine the center of the driver and use a compass to draw the appropriate size hole on the baffle. Then cut this hole with a saber saw. Drive the T-nuts in place with a hammer, ensuring that they are located on the bottom of the baffle. Trial-fit the driver to the baffle to be sure that all the nuts are properly installed, then remove it and put it aside.

Attach the baffle to the side. The best

PHOTO 2: Attaching panel 1.

way to do this is to clamp a 2″ × 2″ guide board along the joint edge, apply adhesive to the joint, clamp the panel to the guideboard, and when you're sure all is right nail it in place (**Photo 2**). To prevent splitting, drill through the pre-drilled pilot holes about ½″ or so into the panel. Use a nail set to drive the head of the nail below the face of the side. If you choose to use screws, follow the same steps, using a pilot/countersink bit to prepare the hole before driving the screw.

PHOTO 3: Attaching panel 2.



Double-check the length and cut angles against the cabinet and cut out panel two. Attach it to the side using the same guideboard technique (**Photo 3**). Use a clamp at the end of the joint of the two panels and a scrap piece of plywood to hold the parts together while you first drill pilots and then drive two or three nails or screws along the joint, checking the alignment with a framing square to be sure that everything is square. Using the same technique continue with panels 3, 4, 5, and 6, checking alignment with a framing square as you add each new panel, holding things together with clamps until after you have driven the nails/screws (**Photo 4**).

Starting with panel 7, bracing is added between the panels (**Fig. 6**). Note that the braces don't touch each other and don't need to extend fully across the entire length of the panels. The braces are spaced midway across the cabinet. You figure their dimensions by dead reckoning (**Photo 5**). Place a piece of plywood

PHOTO 4: Use clamps and a framing square for perfect alignment.

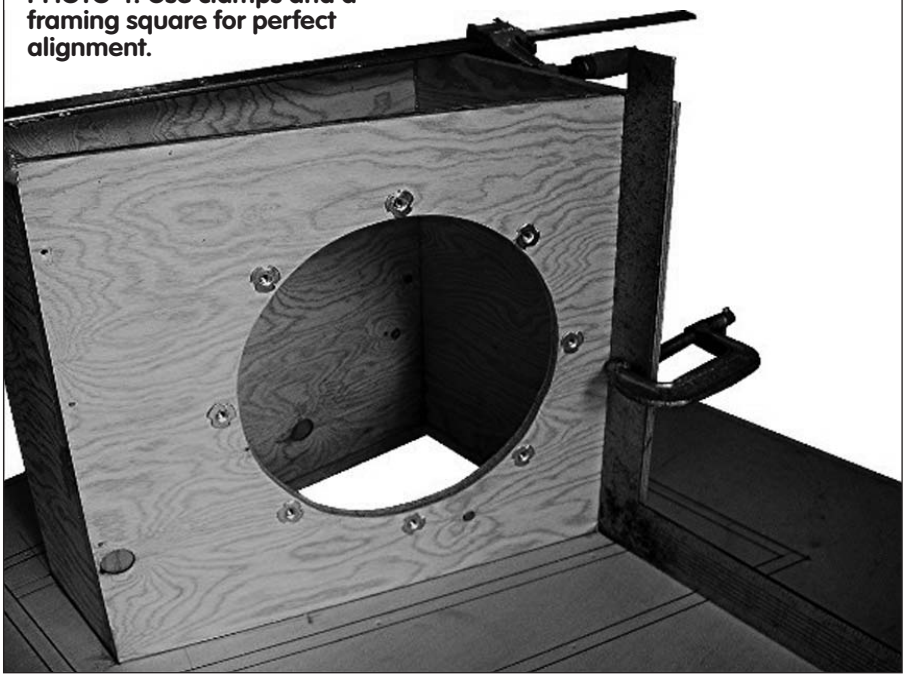


FIGURE 6: Braces (shaded).

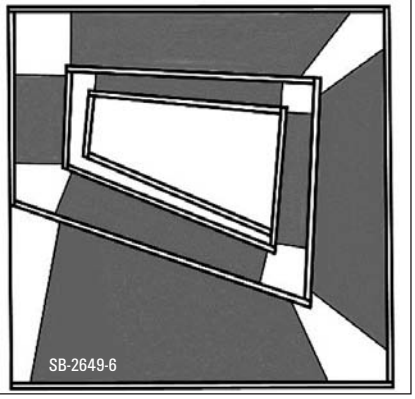


PHOTO 5: Dead-reckoning a brace.

PHOTO 6: Keep it square.

of sufficient size against the inner panel to which it attaches, in this case panel 3. Then set a straightedge across it where the next panel will joint to it, in this case panel 7, and draw the cut line.

After sawing, lay the brace in place again to check the accuracy of its sizing. Also draw on the panel where the installed brace will join to it. After cutting the brace that spans panels 3 and 7, install panel 7. Liberally apply adhesive to the edges of the brace and slide it into place, pushing it far enough to just be snug. Secure it in place with nails or screws driven through panel 7.

Continue the assembly process. When installing the braces joined to the front, top, and rear panels, use a framing square to check their alignment, pushing the brace in only as far as required to square the panels (**Photo 6**). When you install the cabinet bottom, do not install the brace between it and panel 9.

After installing the bottom, lay the cabinet on its side and apply a generous bead of adhesive on all the panel edges. Put the second side atop the assembly, making sure that it is oriented so that the pilot holes line up with the panels. Nail or screw it into place. If required, use a long pipe clamp to pull it into alignment with the rest of the cabinet.

After installing the side, go back and install the brace that goes between panel 9 and the bottom. Use a router with a pattern following bit or a sander to make flush the outer joints and those of the panels surrounding the access hole. Fill the holes over the nail or screw heads before sanding and finishing the box. After your finish is complete, install your driver.

SETUP

If you're using a ten, things are rather tight, so tight that reaching the far lower corner bolt isn't easy. Install that bolt first (**Photo 7**), with the driver offset so that you can reach it, and then swing the driver into place. Don't fully tighten any of the bolts until all are installed, then go around the frame easing them in until all are firmly set. This is a job made much easier with a small ratchet screwdriver.

Eight-inch drivers, on the other hand, have room to spare, even when mounted on a plywood reducer to fit over a

PHOTO 7: Tens are a tight squeeze.

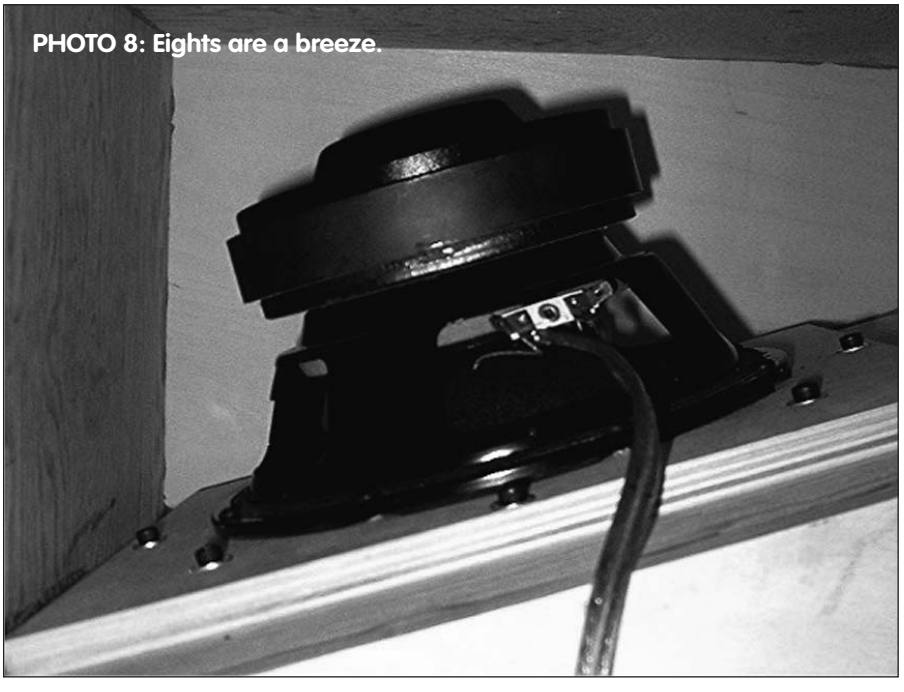


PHOTO 8: Eights are a breeze.

hole for a ten as I did in the prototype (**Photo 8**).

Finally, there is the driver access cover. Surprise! There isn't any. Just wire up your driver and plug it in.

Most bass horns have a sealed rear chamber that is employed to both tune the cabinet response and apply restorative force to limit the excursion of the driver. However, if the horn is long enough, and has sufficient throat impedance, the air mass of the horn alone will tune the driver response and limit excursion. That is the case with the Table Tuba, and as a bonus the rear wave of the driver also adds to the low-frequency output of the cabinet in much the same fashion as a bass reflex cabinet. Computer simulation predictions show the excursion of the driver at 15Hz unaffected by rear chamber size, while at 10Hz the excursion differential between a 10-liter chamber and no chamber is only 10%.

As to placement, like all subs the Table Tuba (TT) benefits greatly from placement near walls or room corners, though you will still get very good results without corner loading. With upright wall placement (**Photo 9**) put the horn mouth at the floor, the access hole facing the wall, the cabinet 1″ away from the wall. With corner placement the mouth is at the floor facing into the corner, the end of the cabinet 6–10″ from the corner, the access hole again facing the wall from 1″ away.

You may also place the TT in the corner on the floor, with the mouth in the corner and the box on 1″ legs. If you use middle of the room placement, also use 1″ legs, so that the rear wave is not blocked.

PHOTO 9: Upright for wall or corner placement.

Using more than one cabinet will enhance sensitivity via mutual coupling, but there is a finite limit. In the case of the Table Tuba, that limit is about 106dB/watt. As you can see in **Fig. 6**, a single cab reaches that limit only at 160Hz. With every doubling of the sum total mouth size, another 3dB of sensitivity is gained, but only where that 106dB limit has not already been achieved. In theory enough cabinets would allow 106dB sensitivity right down to the horn flare frequency.

Because the length of the horn in the Table Tuba is some 13′, 106dB sensitivity could extend to 20Hz. The bad news is that it would take perhaps 32 Table Tubas to do so. No matter. Furniture or not, I can guarantee that my wife will draw the line at two. *aX*