Subwoofer Box Building 101
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Custom subwoofer enclosures can be a profitable part of any installation. Knowing how to sell it and being able to build it quickly demonstrates your skills and knowledge as a certified installation technician.

Before starting any fabrication, it’s vitally important that you have a strong understanding and respect for power tools like the table saw, panel saw, and router. It’s also important that you have the appropriate support for large sheets of medium density fiberboard, or MDF, and the correct safety items (e.g., push sticks) when dealing with smaller cuts.

Subwoofer Box Design
For this tutorial, we designed a vented enclosure (also called a ported enclosure) for two JBL P1224 woofers. We wanted a performance envelope that would be loud on the street where people will hear you coming. After taking measurements in the vehicle to see what kind of room we had, we used computer aided design software for the enclosure volume and vent tuning analysis to save the time of manual calculations. This type of software is great and there are many choices. The best part is we can get an accurate estimate of how it will perform before ever cutting one single sheet of material!

Box Volume (includes Port and Speaker Displacement) **3.03 Cubic Feet**
FB (Tuning Frequency) **41Hz**
F3 (-3db roll-off) **23.7Hz**
Ripple (Frequency Response Curve) **1.91**

External Dimensions
32” Wide x 15.5” High x 13.76” Deep

Vent Dimensions
2.5” Wide x 14” High x 17.65” Deep

**Step 1**
Determine the volume of your enclosure. Go out and measure the car to get the max dimensions (or preferred dimensions) you can use. Remember, the simple calculations for volume are width (W) x height (H) x length (L) – in inches – divided by 1,728. This formula will give you the cubic feet measurement. Remember to subtract the thickness of the material for each end so you have the internal, not external, dimension.
**Example** – External Dimensions of 32”(W) x 15.5”(H) x 13.76”(L) using ¾” material

This would be an internal dimension of 30.5”(W) x 14”(H) x 12.26”(L) = **5235.02 cubic inches**. Since there are 1,728 cubic inches in one cubic foot, dividing the total volume by 1,728 will give you the total internal volume in cubic feet.

In this case, **5,235.02 divided by 1,728 = 3.03 cubic feet (rounded off)**. Knowing the correct internal volume is very important, especially in vented (ported) enclosures.

After you have the dimensions, you can finalize the vent dimensions and tuning analysis by using the enclosure design software. There are several great choices out there. Give us a call if you need help on that.

**Step 2**

*Lay out your cuts.* When starting from a full sheet of MDF, lay out the dimensions so you make the most efficient use of your material with the least waste. You can do this easily on graph paper or just by drawing lines right on the MDF. Make the largest cuts from a panel saw or large table saw. This allows simple rip and crosscuts against a square reference point. From there, you can trim all of the pieces to the final dimensions on a table saw.

**Step 3**

*Use a panel saw for the precutting of basic panel sizes.*

This tool allows you to slide a full sheet of ¾” MDF (Medium Density Fiberboard) directly onto the saw with out any type of heavy lifting. It also allows for a much smaller table saw. As we all know wood working space is very valuable in a shop.
Step 4
Make the final panel cuts on the table saw.

The table saw can be very dangerous. Be sure you have a guard on the saw and use a push stick when ever working with small or thin pieces of material. Never use the miter gauge and a bare rip fence together when pushing wood through the table saw.

Step 5
Put a 1/8” rabbeted edge on the side panels of the enclosure.

The router should remove about 1/8” of MDF and should leave a lip all the way around the outside of the side pieces. This lip will give us an area to tuck our carpet in once the enclosure is built.
Step 6
Assemble the panels. Begin with the top, bottom and sides.

At Installer Institute, we recommend attaching the top and bottom to the sides of the enclosure first. This will allow you to adjust edges to match up perfectly with the front and back of the enclosure. Please note that the routed lip must face toward the outside edge. We recommend using a pneumatic crown stapler or brad nailer with the appropriate length fasteners and wood glue. The wood glue provides strength to the joint and the fasteners simply hold it in place while the glue dries. If you are liberal with the glue, the seams will be strong and not leak any air!

Step 7
Determine the vent size and length. We choose to do a rectangular (slotted) vent rather than standard round PVC pipe vents. When you have designed a vent that is square or rectangular, it must be installed before the box is completely built.

One of the advantages to a slotted port is you can design the port to match the internal height of the enclosure. You must make sure that the surface area of the round port equals the surface area of the slot port to
maintain the same tuning frequency. Below are the equations to convert slot ports to round and round to a slot.

**Square to Round Port Conversions**

Internal Width x Internal Height = Port Surface area

\[ 2 \left( \sqrt{\frac{\text{Surface area}}{3.14}} \right) \]

Example: 2.5” Width x 14” height = 35” squared (Surface Area)

\[ 2 \left( \sqrt{\frac{35}{3.14}} \right) = 6.67” \text{ Port} \]

**If the round port does not match available sizes on the market you would need to recalculate the port length based on what is available.**

**Round to Square Port Conversions**

\[ 3.14 \times \text{Radius}^2 \]

Example: Round Port = 6.67” would have a radius of half (3.335”)

\[ 3.14 \times 3.335^2 = 34.923 \text{ in}^2 \]

Divide 34.923 by internal height of box 14” = 2.4945 or 2.5”

**Step 8**

*Construct and round over the vent section of the enclosure.*

Assemble the panels for the rectangular vent. Before it is installed into the enclosure you should round over all the sharp edges, this helps reduce air turbulence inside the port.
Step 9
Install the port into the enclosure.

When installing the port into the enclosure we used two 2.5” spacers made from MDF which were the exact width of our port. This is a quick and easy way to ensure your port is the same distance away from the walls of the enclosure all the way down. With the spacers in place a square was used to transfer the lines of the port to the outside of the enclosure. The port was then glued and stapled into place.

Step 10
Add any bracing before attaching the final panel.

Braces were added to the box to help prevent unwanted vibrations, the more an enclosure vibrates the less output it will have. After bracing, the final panel of the enclosure was glued and nailed into place.
Step 11
Mark the location of the port opening and the woofer holes.

An easy and quick way to find the center of any square or rectangle is to line up a straight edge on opposite corners and drawing a line, duplicate that line on the other corners, where the two lines intersect is the center of the shape. Then a straight edge was used to draw a line down the center of the enclosure, you can then use the same technique to find the location of the center pin for the router circle guide.

Step 12
Cut the woofer holes with a router.

Use an 1/8” drill bit and drill out the center of the two mounting locations. The 1/8” bit is used for the pin on the router circle guide. The router circle guide is an attachment that is mounted on to the base of a router and can cut perfect circular holes. When using a router circle guide you must find the mounting diameter of the woofer and divide it by two to find the radius. Then measure from the outside of the straight cut router bit to the center of the 1/8” pin. You should always double check your math at this step by making a small pass first then measuring before going all the way with the cut. Remember, measure twice, cut once!
Step 13
Cut the opening for the port.

Now that the holes of the subs are cut and they fit, we can cut out the port. Find the center of the port and use a drill bit larger than ½” and small enough not to come close to the walls of the port. We will be using flush trim bit to route out the inside of the port, so it is very important that the walls of the port are not damaged. To avoid any unnecessary wear and tear on your router bits, you can rough cut the vent opening with a jig saw so that the router only has to take away a small amount of material.

Step 14
Round over the vent opening and the outside edges.

Next the entire box was rounded over using a ¾” round over bit. This helps the overall look of the box and takes almost no time at all. A ½” round over is used on the inside of the port and set a little higher than normal so it will leave a 1/8” groove around the edge of the port to tuck the carpet and provide a clean transition between the face of the enclosure and the vent opening.
Step 15
Paint the inside of the port.

For cosmetics we used flat black spray paint and painted the inside of the port. Once the paint dries tape up the port and trim the tape flush with the routed lip on the edge of the port. The whole reason you leave the tape in place is so no upholstery glue gets in the freshly painted vent opening!

Step 16
Measure and cut the carpet for the enclosure.

When measuring for carpet you can take a tape measure and wrap it around the box. Then transfer the measurement to the carpet needed to cover the enclosure. You should always give yourself a few extra inches just in case.
Step 17
Prepare the carpet and enclosure with spray adhesive.

The glue used to attach carpet to the box is Dap Weldwood upholstery glue. This glue can be found at just about any local upholstery supply store. The box and carpet should be well sprayed, be sure not to build up puddles of glue because it can take a long time to dry and even soak though the carpet. It is a good idea to spray the box while on the carpet it helps control over spray. Once the box is sprayed you should remove the tape that is covering the port, so it will not stick to the carpet when you lay it down.

Step 18
Carpet the enclosure.

Wrapping the carpet is fairly easy. When the box is fully wrapped you have the carpet edges over lapping each other. Use a straight edge and cut though both pieces of carpet then remove the scrap pieces. When you lay the carpet back down on to the box you will have a perfect seam. Be careful not to pull and stretch the carpet or your seams will no longer match.
Step 19
Tuck the carpet into the sides of the enclosure.

Now, remember the lip that is in the sides of the enclosure, we are now going to glue and tuck the carpet into it. A quick and easy way to push the carpet into the seam is to use a piece of ABS plastic about 3” wide and a light weight mallet. Make sure to pull and stretch the carpet to remove any wrinkles. Once all the carpet is tucked into the edge cut off excess carpet with razor blade.

Step 20
Carpet the end panels of the enclosure.

We can now cover the side of the box with a different color carpet using the same technique. To remove the extra carpet, run the razor blade down the center of the routed lip, to avoid any MDF showing through the carpet. The lip gives you a nice guide for the razor blade so the cut will be straight!
Step 21
Finish the port edge.

We can use a plastic upholstery tucking tool to seat the carpet into the side of the port seam and then trim off the extra carpet. Take your time at this stage, you want to use a new razor blade so the cuts look straight and perfect. Then a heat gun can be used to remove (melt) the frays in the carpet. Don’t get the heat gun too close to the carpet it will bum and melt very easily. This technique provides a clean transition between the carpet and the port opening.

So far this looks pretty good and we are only a little over 1 hour into the construction!
Step 22
Wire the enclosure.

When running the wires out of the box, drill a hole just large enough for the speaker wire to fit and apply strip-calk into the hole and around the wire. This will create a perfect seal.

Step 23
Wire and mount the subwoofers.

Wiring and mounting is next. Make sure that the speakers are wired properly to match the impedance rating on your amplifier. Set them into the box, use a 1/8” drill bit to pre-drill mounting holes of woofers. Be careful not to punch through the cone or surround when doing this. Pre-drilling will keep you from slipping off of the screw and damaging the woofer after all this work. When screwing the sub into place it is good practice to tighten the woofer down like you would tighten the lug-nut of a tire – alternating sides in a star pattern.

The Final Installation
The enclosure is now ready to be installed in to the customer’s vehicle. Subwoofer enclosures should always be mounted with large washers and
bolted to the vehicle’s floor. A properly mounted enclosure will ensure that it stays in place if the vehicle is ever involved in an accident. Taking the proper steps when doing any type of install with help raise the overall quality of work that comes out of your shop it will also help build a solid customer base. Remember to help sell your skills as a installer, educate the customer.

The total design and build took 90 minutes. Materials cost about $50.00 not including the labor cost. A shop built enclosure like this in the southeast region would sell for approximately $220.00, perhaps more if you choose different upholstery material or other finishing techniques. The main point you should take away is that once you have done this the first time, repeating it again is even more profitable.

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