Part 2, Attachment 4. Revision 1. <u>Chassis Top Panel Drilling</u>

Wall of Sound.ca Tubelab DIY EL84 Amp

Tools Required:

-2-speed, variable speed electric drill

-Centre Punch

-Centre Drills: ~1/8” and ~1/4”

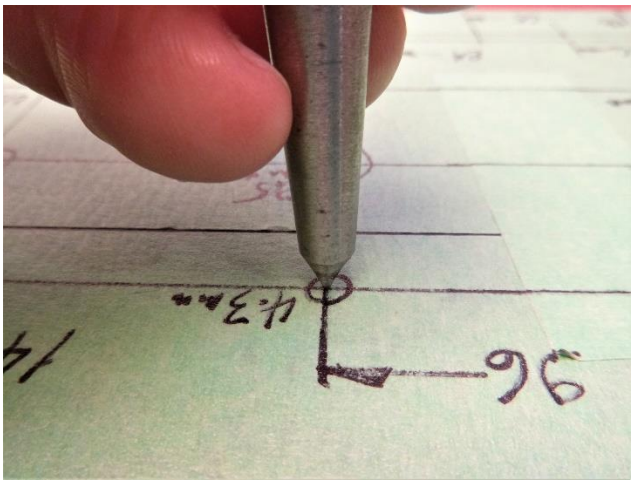
-Drill Bits: 1.7mm (or 5/64”), 4.3mm (or 11/64”), 6.2mm (or 1/4”), 6.5mm (or inch “F” size), 9.5mm (or 3/8”), 12 to 12.5mm (or ½”)

-Countersinks: ~1/4” and ~ 1/2”

-Small half round file. See picture on a later page.

-Hole saw arbour, 1 3/8” and 2” metal cutting hole saws. See pictures on a later page.

<u>Centre Punching:</u>



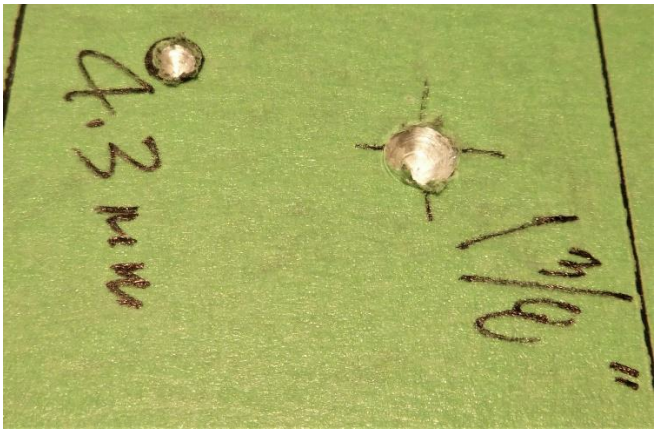
Centre punch all marked hole positions. Be especially diligent with getting accurate positioning on the large holes for tubes. You’ll see why later. Be as accurate as possible with binding post holes too.

Set the punch in the desired position. Give it a light tap, check the position and if OK give it a heaver tap or two.

If you don’t use a centre punch and centre drills your drill bits will wander, and you’ll hate yourself.

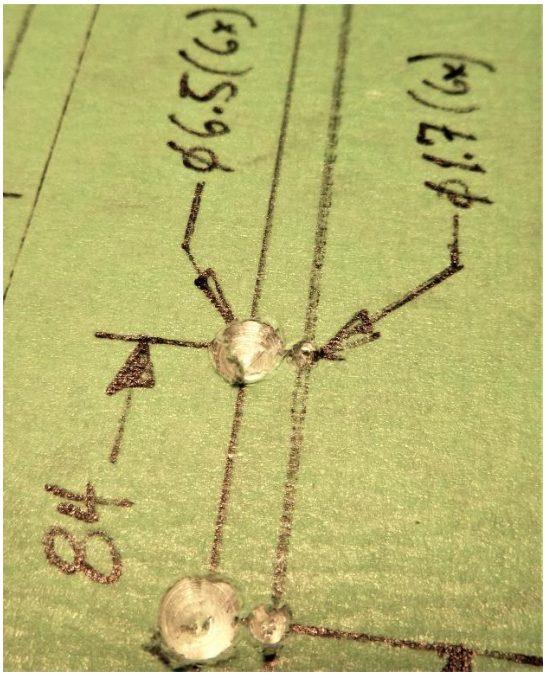
Centre Drilling:

Note: Use the low speed on your drill and keep the variable speed fairly low.



Using a **¼"** centre bit, drill the **five** board spacer holes to no more than **4mm (5/32")** in diameter.

Using a **¼"** centre bit, drill the **seven** tube holes to the full **1/4"** diameter.



Using a **1/8"** centre bit, drill the **six** output binding post holes **on the 18mm line** to no more **1.5mm (1/16")** diameter.

Using a **¼"** centre bit, drill the **six** output binding post holes **on the 22mm line** to no more than **5mm (3/16")** diameter. Be careful not to intrude on the drill spot for the 1.7mm hole.

Using a **¼”** centre bit, drill the **eight** output transformer attaching holes (4.3mm) to no more than **4mm (5/32”)** in diameter.

Using a **¼”** centre bit, drill the **four** output transformer wire holes (9.5mm) to the full **1/4”** diameter.

Using a **¼”** centre bit, drill the **four** power transformer attaching holes (4.3mm) to no more than **4mm (5/32”)** in diameter.

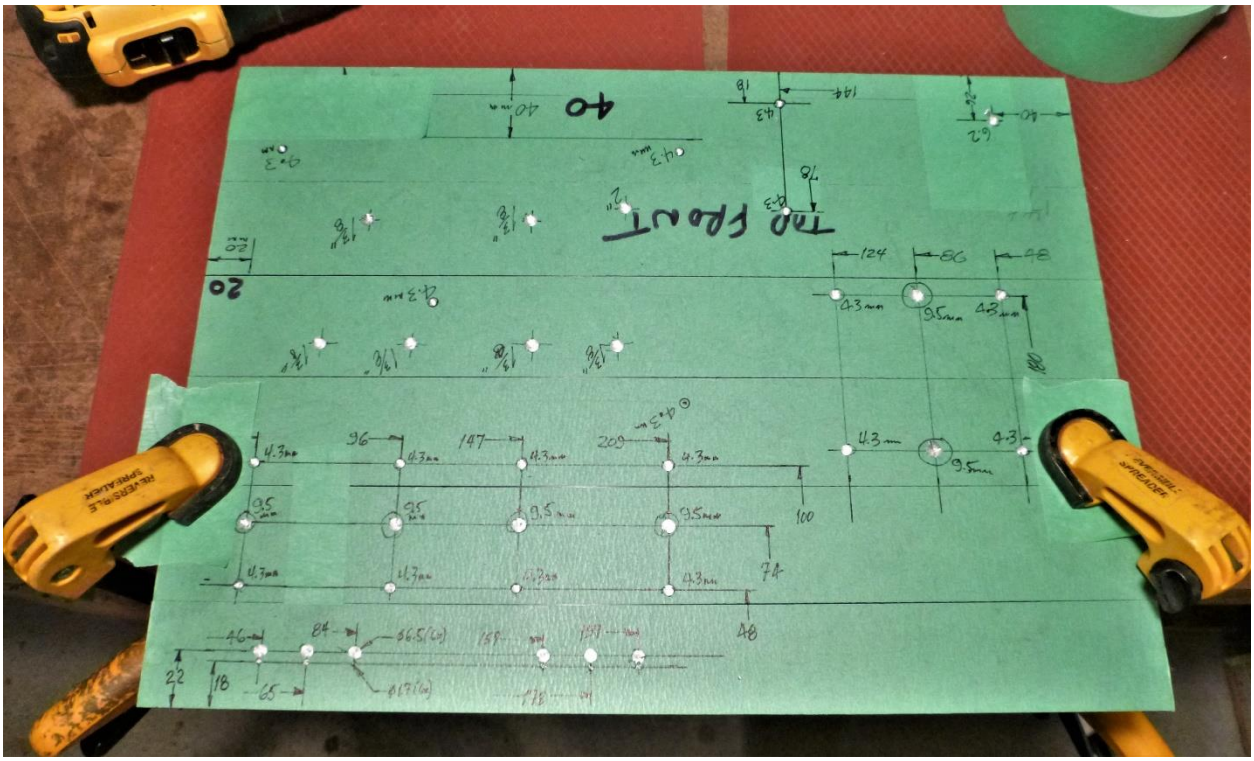
Using a **¼”** centre bit, drill the **two** power transformer wire holes (12mm) to the full **1/4”** diameter.

Using a **¼”** centre bit, drill the power switch hole (6.2mm) to no more **5mm (3/16”)** diameter.

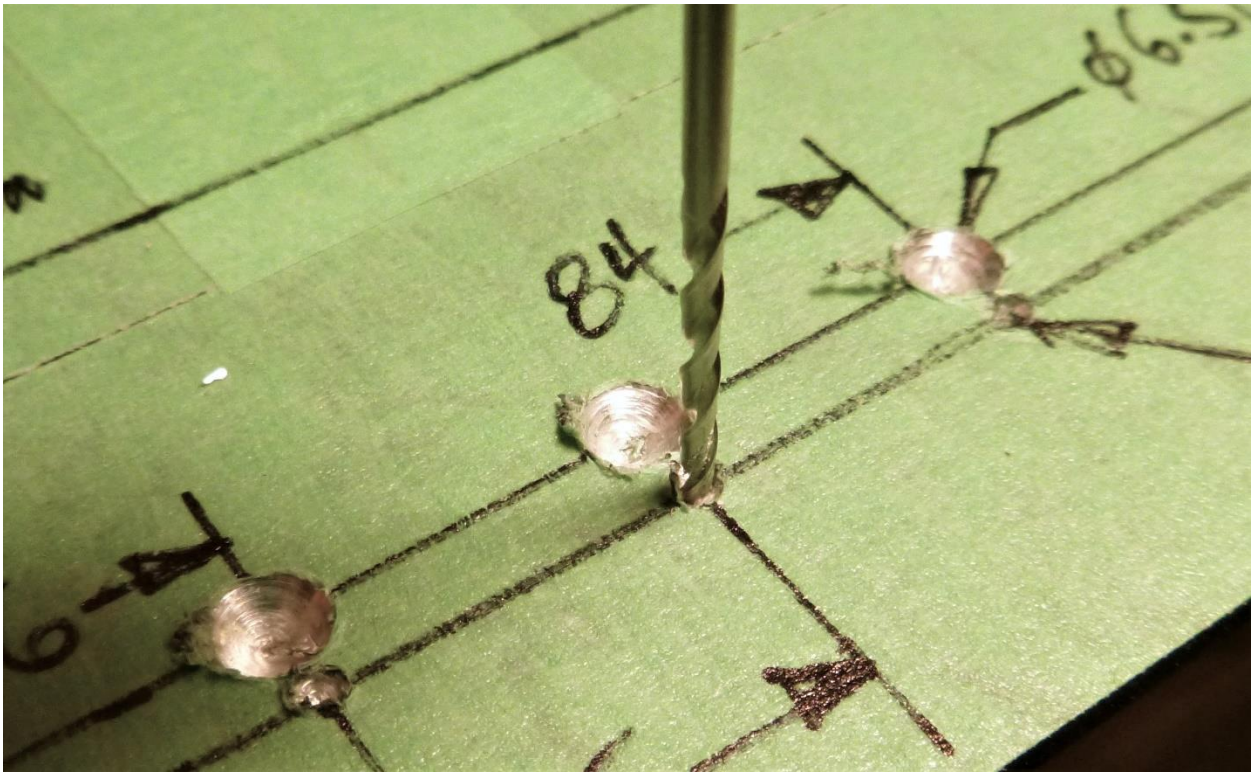
Using a **¼”** centre bit, drill the **two** filter choke mounting holes (4.3mm) to no more than **4mm (5/32”)** in diameter.

If installing the optional dual input switch, use a **¼”** centre bit and drill the power switch hole (6.2mm) to no more 5mm **(3/16”)** in diameter.

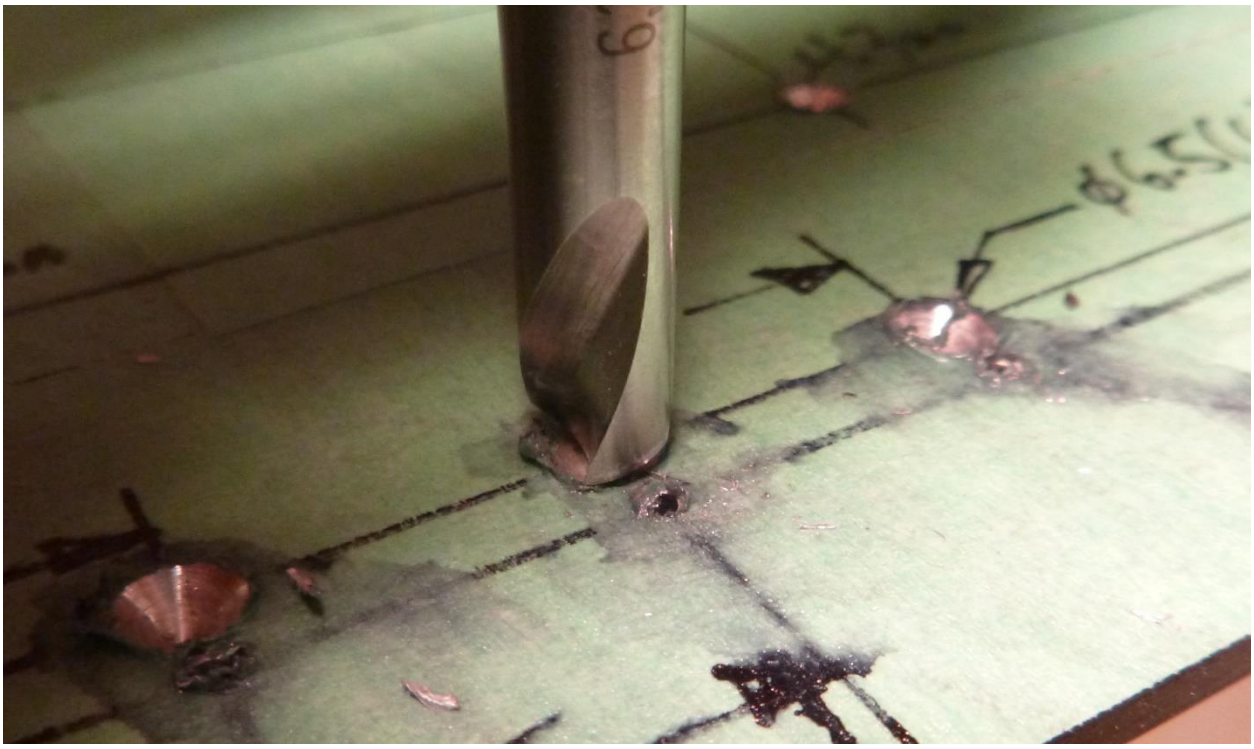
Hole Drilling:



Clamp the top plate to a bench or table letting it overhang the edge. I use silicone mats to keep the plate from sliding and an extra layer of masking tape under the clamps as added protection for the plate.



Drill with the **six** small holes for the output binding posts. Chuck up a **1.7mm (inch size F or 5/64”)** bit in your drill. Using a drop or two of methyl hydrate alcohol will cool and partially lubricate the drill bit. It makes a bit of a mess of the pen markings as you’ll see in the next picture.



Now that the 1.7mm holes have been drilled you may enlarge the centre drill hole for 6.5mm adjacent holes if you wish.

A note about drilling thin sheet metal:

When the diameter of a standard twist drill is larger than the thickness of the metal, it's more difficult to drill a clean hole. And the larger the drill the progressively more difficult it becomes.

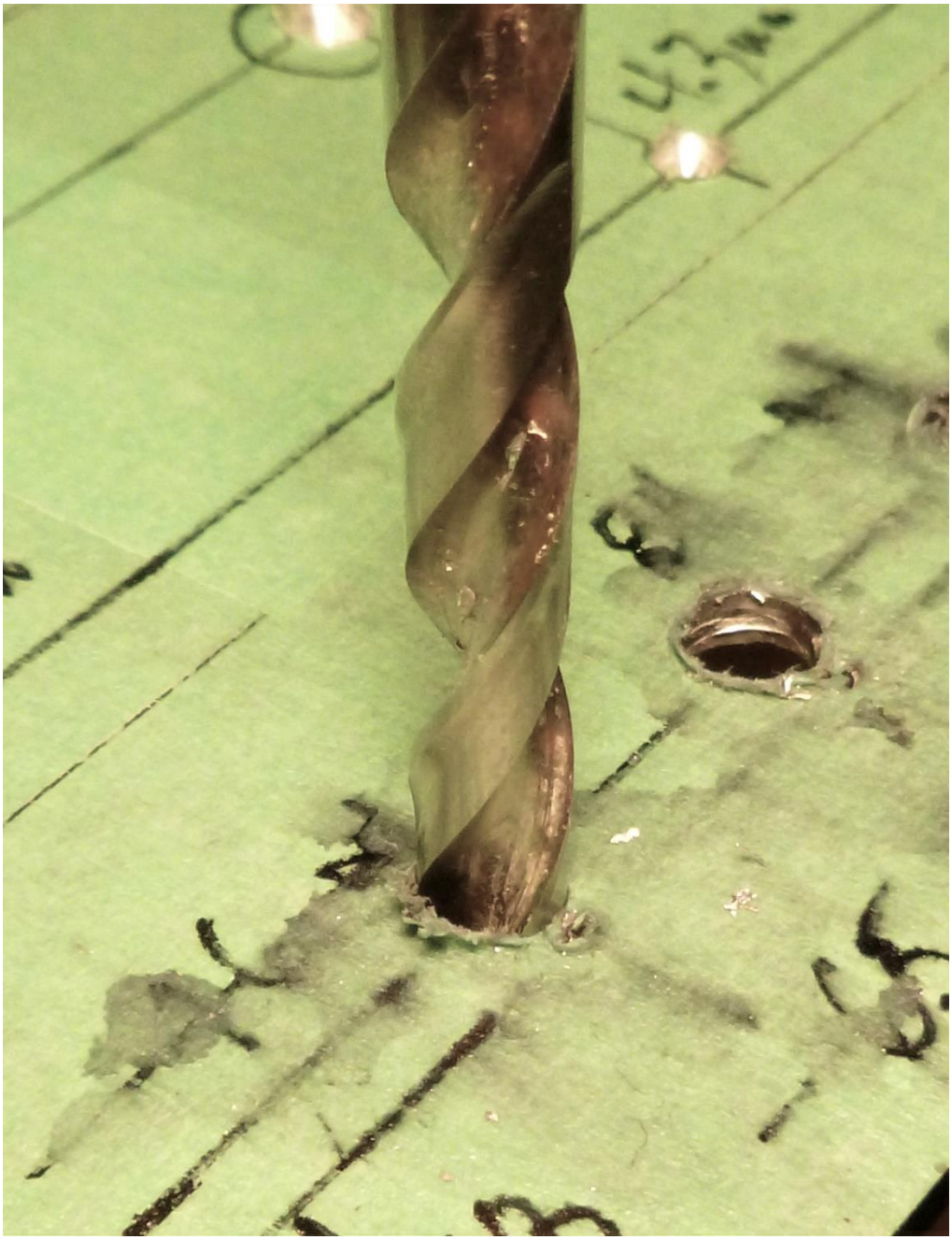
A few tips:

-Securely clamp the piece you are drilling.

-Shift your drill to the highest speed.

-Pressing down firmly on the drill before pulling the trigger will reduce drill bit chatter.

-Be prepared to remove downward pressure once the bit breaks through. The bit will tend to "suck" the drill chuck right down to the work piece.



Drill the six **6.5mm** (inch size **F** or use a ¼” bit and file the hole out a little).

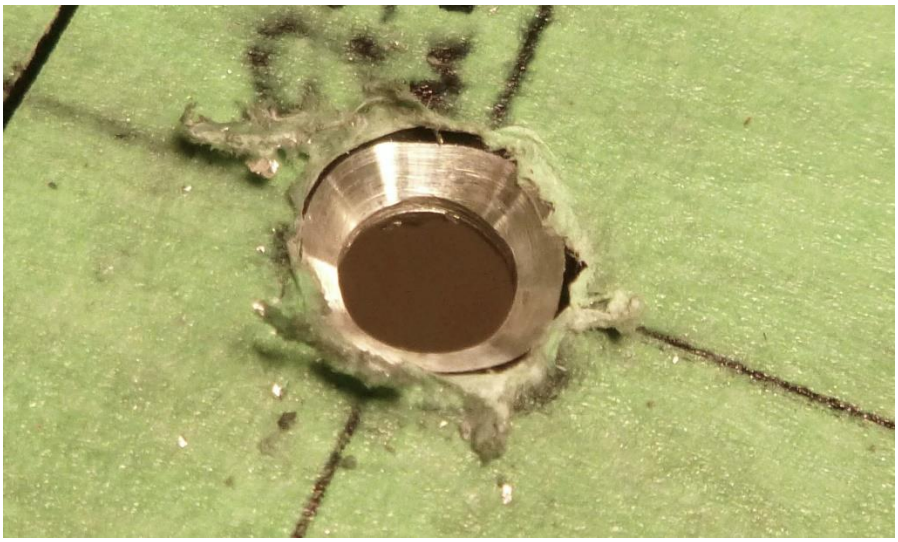
Drill all of the **4.3mm (or 11/64")** holes, shifting clamping on the plate as required.

Drill the hole for the power switch using a **6.2mm (or ¼" bit)**.

Drill the four **9.5mm (or 3/8")** holes for the output transformer wires. As mentioned earlier the larger the hole the progressively more difficult it is to drill. If desired you may "creep" up on the final hole size as described below.

Drill the holes with a smaller bit (~6.3mm or ¼").

Using a counter sink, put a large chamfer on the hole, see below.



Now drill with the specified bit. The large chamfer will act as a drill guide.

REVISION: The two wire holes for the power transformer have changed in location and size. See the Attachment 3 revision. Drilling a **12mm or ½"** hole in a panel of this thickness is tricky.

It is nearly essential that you employ the method shown just above using a countersink to enlarge the hole lead-in and working up incrementally to the final size.

Alternatively, you may use a sheet metal step drill. See attachment 5 for details.

Once all of the holes have been drilled remove the burrs with countersinks.

Notes on burr removal:

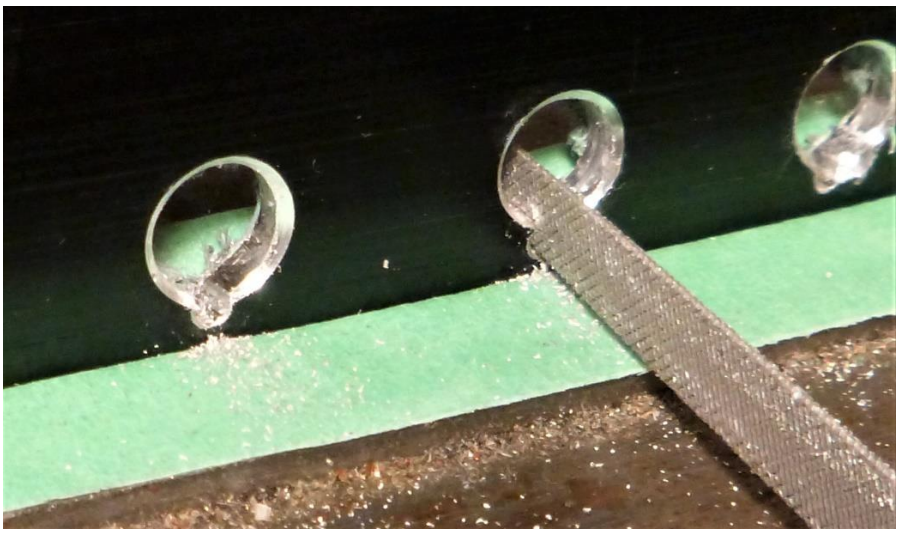
-Choose a countersink about 1.5 to 2 times larger than the hole to be deburred. Too small and the hole won't be deburred properly, the same with too large.

-When deburring, shift your drill to the lowest speed and even then, as slow as it will turn on variable speed.

-Heavy burrs on the back side of a panel are more difficult to remove. By pivoting the drill in a circular motion as the countersink is turning often helps.

Deburr all of the holes <u>except</u> for the **six** 1.7mm at the output binding post locations.

Apply 2 or 3 layers of masking tape to the jaws of a vise.



Clamp the front plate and file out the remaining "web" of material between the **six** 1.7mm and 6.5mm holes. Remove the plate from the vise and using the file remove any burrs around the 1.7 and 6.5mm holes.

Drilling the Tube Clearance Holes:

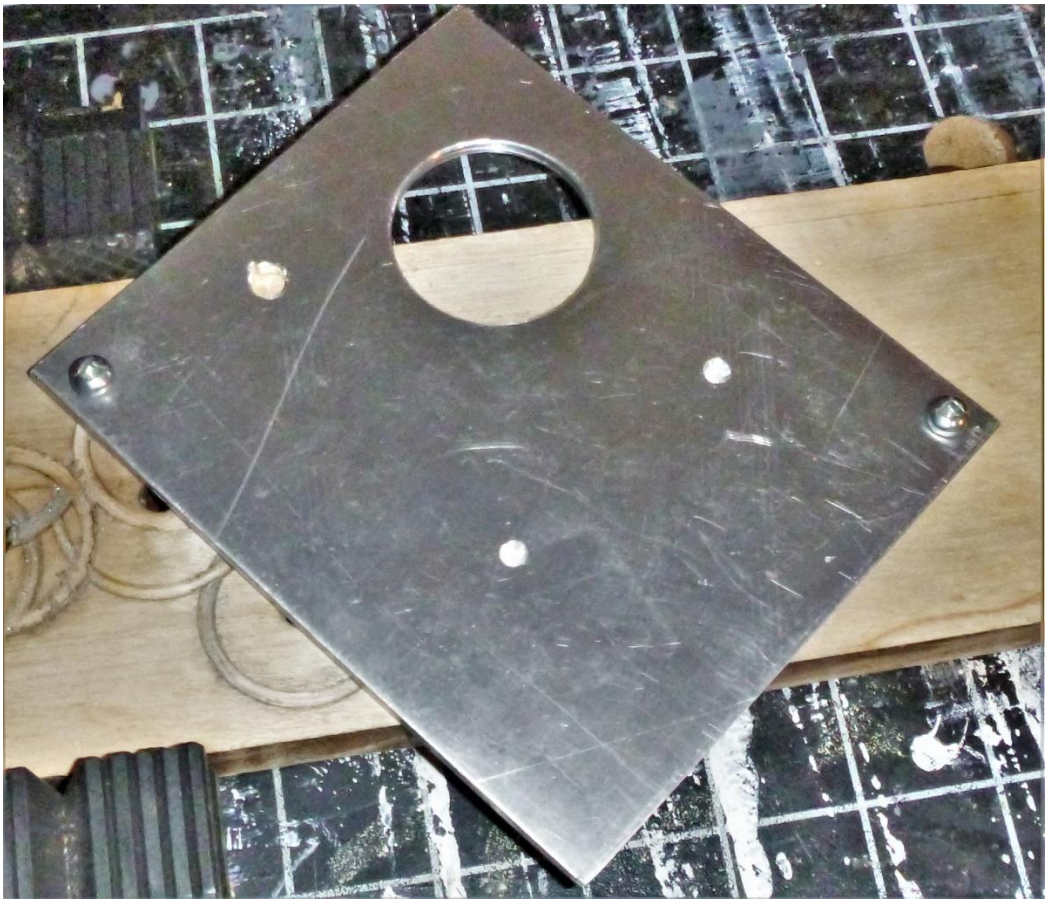
I've saved the trickiest bit for last. We are going to use hole saws to make the one **2"** and six **13/8"** holes.

This going to get kind of wordy but I want to pass along some tips I have learned working with sheet aluminum. I don't wish to scare anyone off. If you work slowly, patiently and follow these instructions an acceptable result is likely.

The best advice I can give is what an older German fellow I once worked with used to say, "Take your time, make a nice job."

Please, take the time to read this as one "oops" can spoil the top plate of your amplifier.

Practice Piece:



If possible, obtain a scrap or small off-cut of 3mm or 1/8" aluminum plate. My local Metal Supermarket often has off-cuts that can be purchased for a buck or two. Tell them what you a looking for and they might let you peruse the off-cut cart yourself.

I drilled two 4.3mm (11/64”) holes through my practice piece. I then used these holes and two #8 sheet metal screws to anchor it to a scrap piece of wood. I also drilled two centre drill spots for my sawing experiment.

The metal sheets being drilled are attached to the wood to keep the hole saw from wandering. A piece of hardwood is best - it can be a piece from a discarded skid or pallet. A scrap piece of ¾” plywood could work as well. Once the ¼” drill in the hole saw arbour pierces the metal plate it can wander **without** the piece of wood to constrain it. Clamp the board to a bench or in a work-mate.

One of the problems with sawing aluminum is that it galls. The easiest way I can explain galling is that it is like sawing wet wood. The chips don’t come away cleanly and want to stick to the piece being sawn and the saw itself.

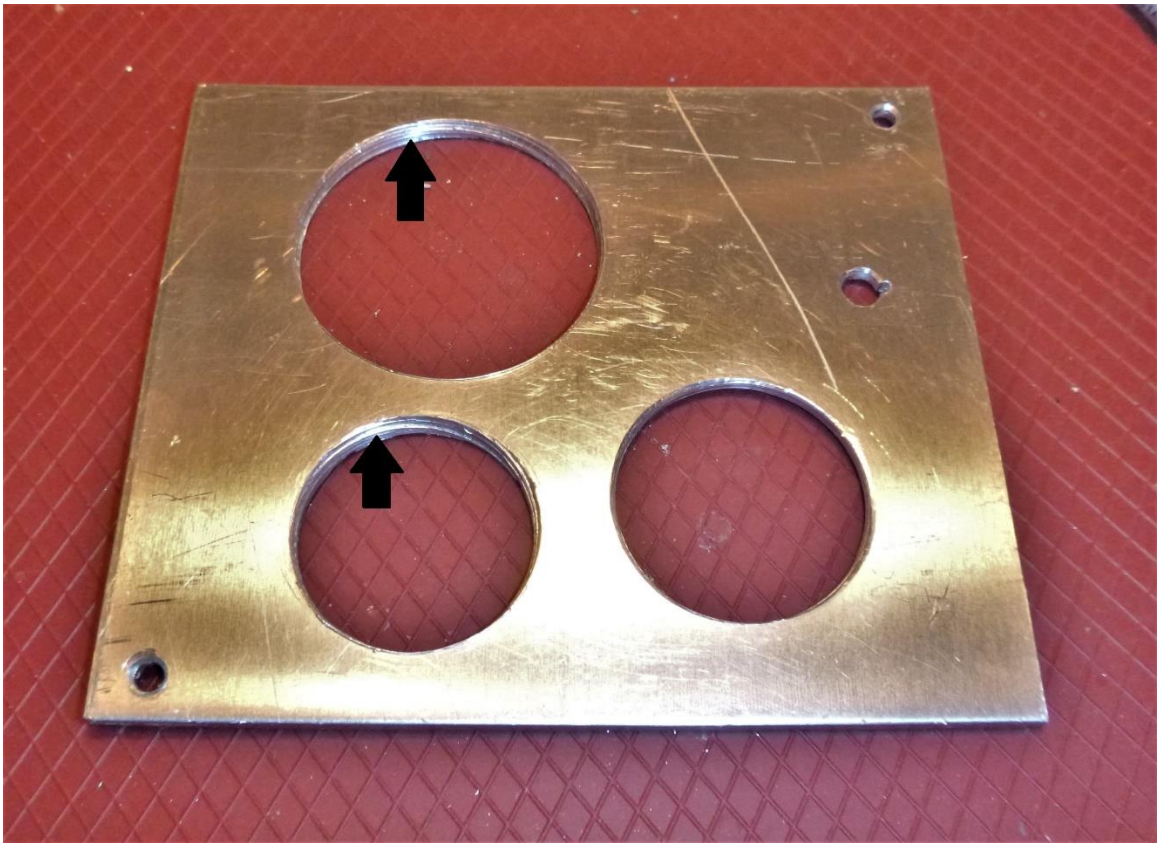
Add a bit of lubricant in the centre hole and around where the saw will cut.

Start the ¼” pilot drill into the plate but stop before the saw contacts the metal. check to make sure that it is square to the metal surface.

Set your drill to the low speed. Grip the drill firmly as it will buck and grab once the saw teeth contact the plate.

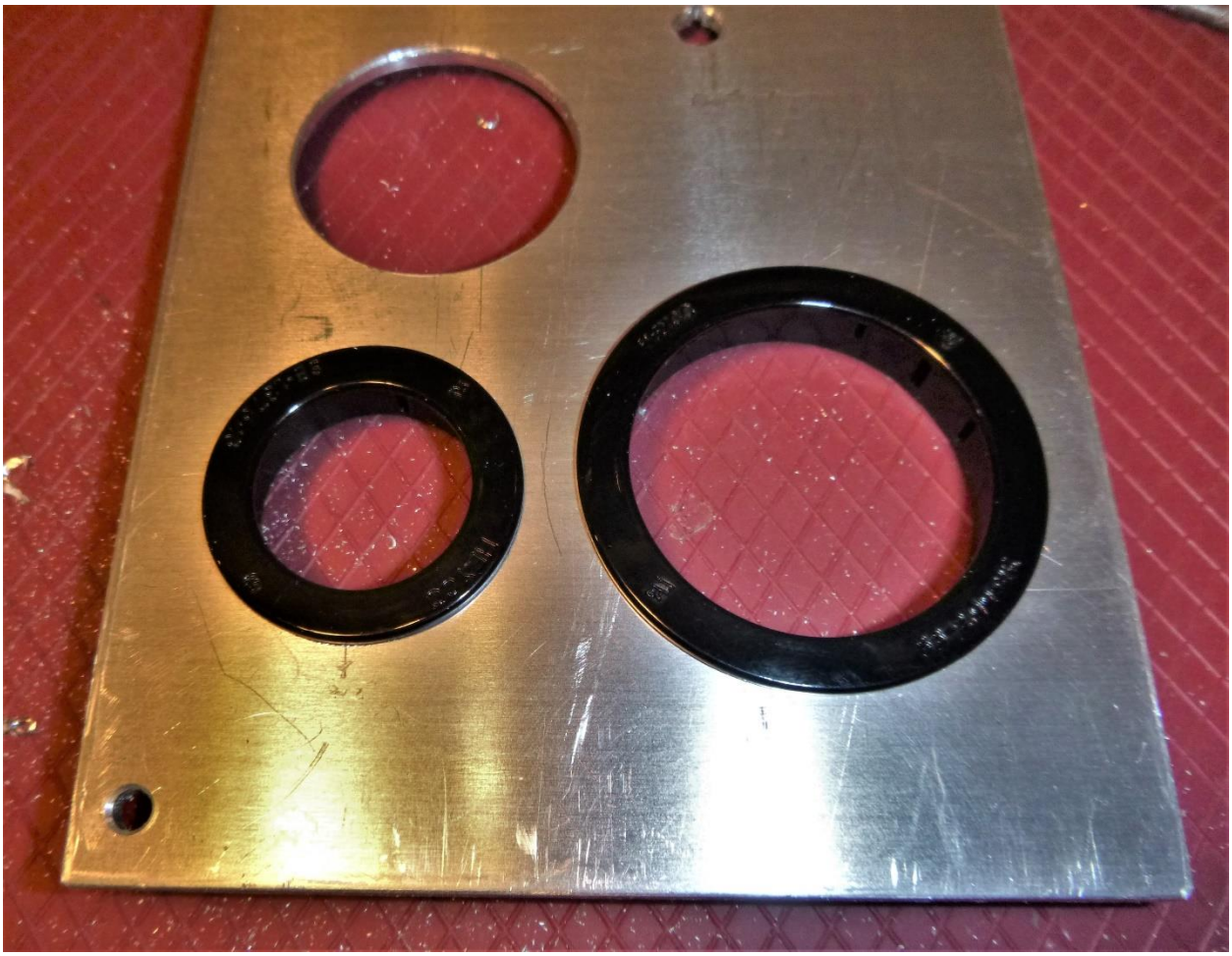
Run the drill slowly and after every three or four revolutions withdraw it, clean away the chips from the saw and the plate and add more lubricant to the plate.

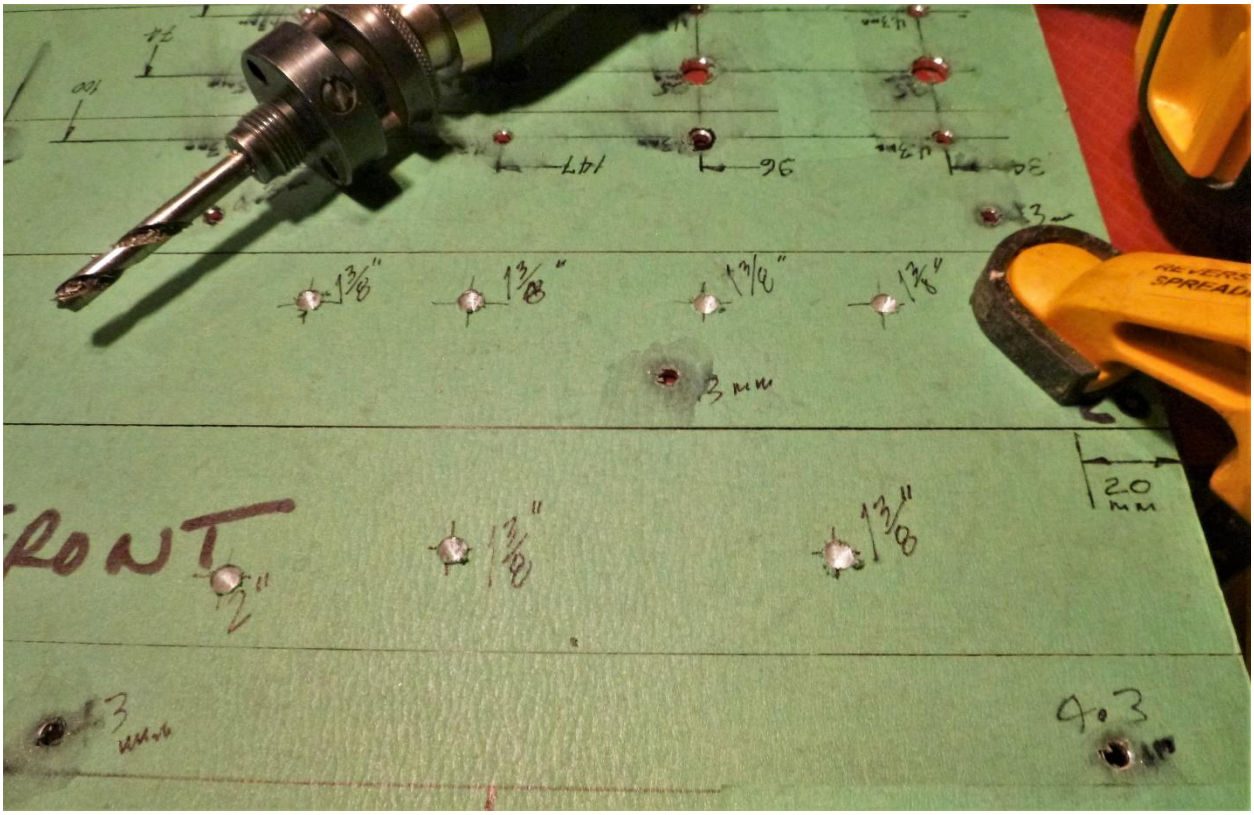
Once the hole(s) have been drilled, remove the screws securing the plate to the board. It will be messy with lubricant and chips. Wipe it off and if desired use a bit of alcohol on a paper towel to clean it further.



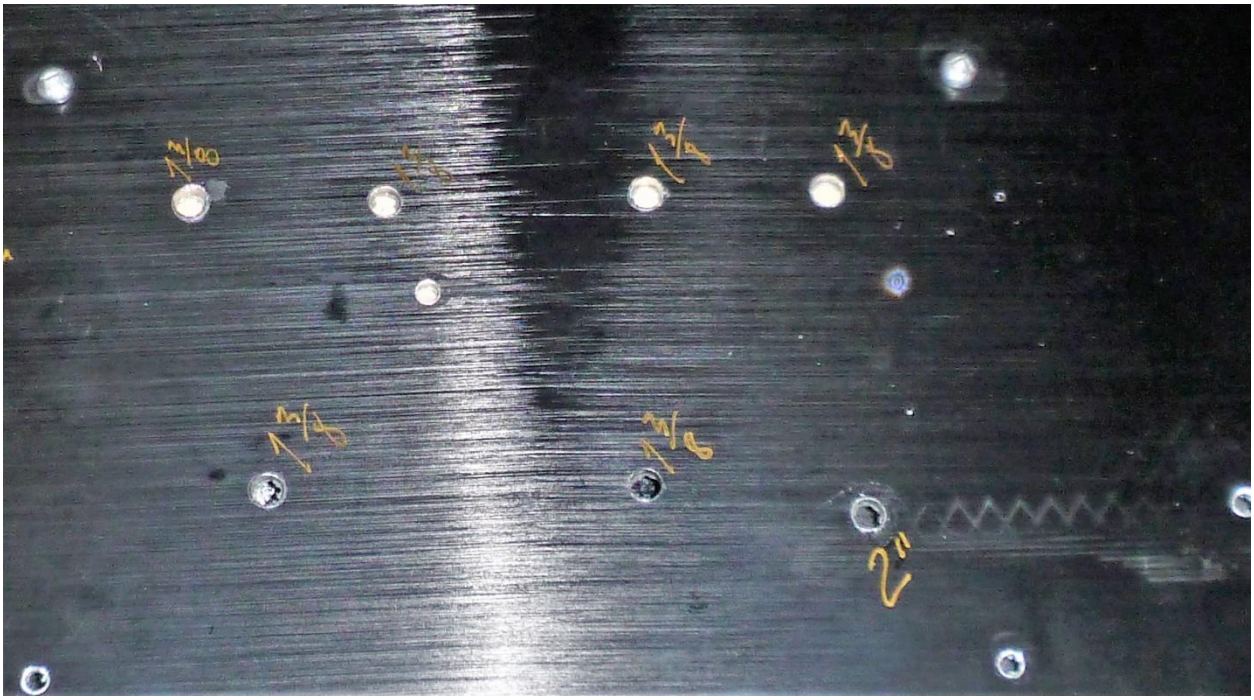
As indicated in the picture above, the holes are a little ragged. This can be seen on the side that was facing <u>up</u> when we drilled the holes. The grommets we will use later will only cover so many sins. **SO**, we will drill the holes in our amplifier's top plate **from the under-side.**

Using a half-round file remove the burrs around the hole(s). **Don't put too large a chamfer on the holes as the grommets may not cover them.** Test fit the gromets if you wish.





Since we will be drilling the top panel from the underside, the centre-drilled holes will need to be drilled through. Clamp the plate to a bench, remove the hole saw on the drill arbour and drill the holes through.



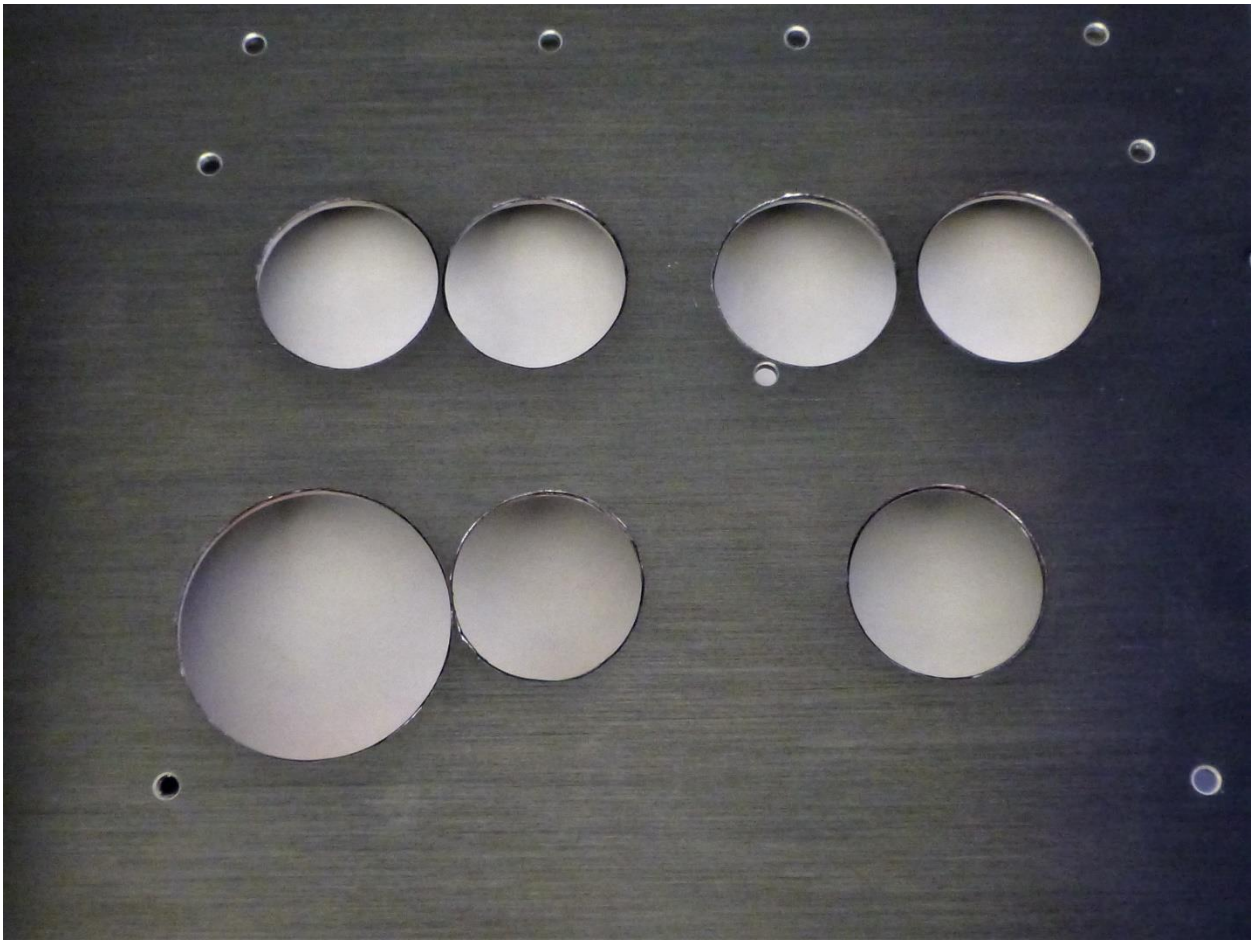
To avoid drilling the wrong hole size, write the required size on the underside of the plate.

To avoid potential damage to the top of the plate, as the top it will be screwed against the drilling board, wipe the board free of any metal chips before proceeding.

Attach the plate to the board using the 4.3mm holes already in the plate. If using a narrow board like mine, you might need to reposition the plate a few times. Always choose a "clean" spot on the board for the holes to be drilled.

Drill the six **1 3/8"** and one **2"** hole in the same manner as was done on the practice piece.

When finished remove the tape on the top side and clean away the lubricant.



As you can see in the picture above, two pairs of the holes are very close to each other! This is to be expected. We will trim the grommets as needed when they are installed later.

Carefully file away the burrs from around the holes. Clean the plate thoroughly with alcohol or acetone. You may darken the edges of the holes with a Sharpie marker, if desired.

Retrieve one of the board spacers and an 8-32 screw from your kit of parts. Attach the spacer in the position show above I.E. the 4.3mm hole that is close one of the 1 3/8” holes.

To prevent interference with the grommet installed later, remove the spacer and file or sand away 2 to 2.5mm (.080 to .100”) about half way along one of the flats.

Return the spacer and screw to your parts kit.

Congratulations! You have just finished what is, in my estimation, the most arduous part of the whole amplifier build. There is just a bit more metalworking left but it is easy and less demanding, compared to what's been done above.

Proceed to Part 2, Attachment 5 to layout and drill the remaining chassis parts.