



Building an Acrylic Aquarium

by Brad Newton

Building your own Acrylic tank is a rewarding, cost saving, and enjoyable project. If you have basic carpentry & power tool skills you should have no trouble building your own beautiful Acrylic tank.



The tools required are as follows:

- A fixed base router (preferably one with at least 1.75 HP & 1/2" collet)
- A 2-flute, straight cut router bit (1/2" or larger diameter, and 1.25" cutting length or more is preferred) 1/2" shank is also a plus, since these bits get very hot when cutting acrylic.
- A fixed straight edge (at least 2" longer than your longest Acrylic piece)
- 2-C Clamps
- 2 PVC holding jigs (these will be detailed in the article)
- Door panel or similar flat work surface
- Syringe or solvent bottle (get a couple, they can fail at a bad time)
- WeldOn 4 Solvent cement (get a pint, better to have too much than not enough)

Optional as per application:

- A 2-flute straight cut router bit with flush cut bearing (for trimming down tank edges for a more finished look)
- Holesaws (if drilling for plumbing is required)
- Jigsaw & plastic jigsaw blades (for larger cutouts)
- Circular saw with laminate blade (for cutting down stock)

- Drill with bits (for smaller holes, or starting a path for a jigsaw run)

Before we begin...

This is a rather time consuming project as far as locating a plastic source, getting the seaming process down and assembling the tank. Plan on at least a weekend to practice with Acrylic edge routing and seaming, and more time if you're not satisfied with the results.

The first thing to do when deciding to attempt this project is coming up with the desired tank size. This will determine the amount & thickness of material required.

Keep in mind, a taller tank will require thicker (and much more expensive) material, and keeping waste to a minimum is a major concern. Try and design your tank to accommodate full 4'x8' sheets. You should get a graph tablet and try and see how much tank you can get into two or three sheets. I can get a 190 gallon tank, including two overflow boxes out of 2 sheets, it just takes some planning. If time permits, I can give you measurements to maximize your sheets, just email.

Finding a plastic supplier can be a rather challenging event. Unfortunately, pricing can fluctuate dramatically from one source to another. You really need to call around, and a large city with several suppliers usually yields the best results. Be sure to have them include the cutting in their prices. Again, a well thought out plan will also keep the cuts to a minimum.

All Acrylic used for Aquariums should be Cell-Cast. Do not use Extruded for anything taller than 12" tanks

Basic thickness guidelines are as follows and only applies to tanks 8 feet or less in length:

Aquarium Height	Sheet Thickness
1 to 12 inches	1/4 inch
12 - 18 inches	3/8 inch
18 - 24 inches	1/2 inch
24 - 30 inches	3/4 inch

These are just guidelines and have been used by most of the commercial tank builders, the Acrylic manufacturers

recommend thicker sheet, but the above recommendations have been "field-tested" over time and have proved reliable. Obviously, if money isn't an issue get the next thickest size, it surely won't hurt.

This article will only apply to square or rectangle tanks to keep things as simple as possible. The basic tank layout is as follows:

The side panels are sandwiched between the front and back panels and the four panels rest on the bottom piece. The top section is typically one piece resting on the four panels with cutouts for the lids. It can also consist of a center brace and perimeter bracing (although this is best left to more experienced builders).

When getting your cut sheet together to submit to your plastic shop, keep these things in mind:

- All cuts made at the acrylic shop will remove aprox. 1/8" from the piece (the width of their saw blade), take this into account when getting your cutsheet together.
- The front, back, and side panels will all be the same height. Keep in mind, the final height will include the top & bottom sheet thickness added to the height of the vertical panels.
- The bottom and top panels should be 1/4" longer than the length of the front & back panels (to allow for seaming)
- The bottom & top piece should be also be a 1/4" longer than the width.
- The desired tank width minus 2 x the sheet thickness will give you the length for the side panels.
- **You MUST allow 1/16" extra on each side that will be edge routed. This will give you the desired final dimension after your edge prep.**

The following edges need to be router prepped for seaming:

Sheet	Action
Top & Bottom	No router prep
Front & Back	Router prep top & bottom edges only
Sides	Router prep all 4 edges

To keep it simple, a tank 70" long, 18" high, and 15" wide would require the following:

- 3/8" Acrylic Cell-Cast sheet
- The front, back and side panels will all be 17.25" high + 1/8" (for router prep on both edges). This makes the final height 18", since you add 2 x the sheet thickness (2 x 3/8" = .75") for the top & bottom panels.
- The bottom and top panels will be 70.25" long and 15.25" wide
- The side panels will be 2 x 3/8" (.75") minus 15" = 14.25" + 1/8" (for router prep on remaining two edges)

Hopefully this makes sense. Once you lay it on paper and see the following pictures it should become clear.

When you order your plastic, let them know you're building a fish tank and need the cuts to be very accurate. Like pieces should be within 1/16" of each other. Bring a tape measure with you to the shop and verify the cuts. Don't accept short cuts. If the piece is a bit long that's OK; you can router it down later. All shops have a scrap bin. you MUST get scrap to practice with. They may charge for scrap but it's still money well spent. If it's free, get as much as they'll let you take.

The key to successful tank building is seam preparation & solvent application. If you have wavy, uneven edges you won't get a quality build. The best way for an occasional tank builder to achieve quality edges is with a reliable straight edge and a quality router. If you have access to a router table or more professional equipment, even better.

Let's get started.

Preparing your individual sheets:

Here's the router with the straight-cut flush bit installed. I used this for all my edge prep and to "flush-cut" the finished product.



I use a straight edge and measure from my router cut point to shave off between $1/32$ - $1/16$ ". If you have a combo square you can save this measurement for quick reference. I clamp the straight edge down and make an initial pass with the router, you want to run the router in the direction that the blade will go against the direction of travel, otherwise the router will take off and run. Try and use a quicker router speed (18,000 RPM +) and a steady pass speed. Practice a bit with this. You should get a clean edge. If you run your nail across the edge and it has a bit of small ridges (like a nail file) then you need to increase your bit speed and possibly make a quicker pass. Here's the difference between a shop cut edge (right) and a routed edge



Once you feel confident with your routing skills then you can move on to your REAL pieces. When making the initial pass be sure to only take off a minimal amount ($1/32$ " is good). If your pieces aren't quite true you may have to make several passes to get a solid straight edge. This is where most of your time is spent.

If you have two like pieces, stack them and route them together as in the photo below, you'll get a much closer fit that way. You should keep the protective paper on the sheets until the seaming process.



When routing a long piece it's a good idea to brace your straight edge in the middle as shown to prevent any bowing along the way.



Once you get all your pieces edge routed you can perform any additional cuts/holes that may be required. When cutting holes or other cutouts, you need to keep the cutting blades, holesaws or bits water-cooled as you go. Here's a typical bulkhead cutting procedure:

First, mark your cutout with the bulkhead washer as a guide.



For larger holes you can use a jigsaw (with blades made for cutting plastic). You can start the jigsaw run with a few small holes then wiggle the drill back and forth to cut a path between the holes to make a slot for the jigsaw blade to fit into.



Once you start your jigsaw cut, be sure to have a spray bottle handy and keep the blade wet as you go.



When using a holesaw, drill into the plastic about 1/16" and then flip the sheet over and drill out the hole from this side. If you drill from one side only you may get some chipping when the holesaw breaks through, giving you a tough surface for a water tight bulkhead. You should make the cuts in several tries letting the bit cool down & spray away the plastic shaving then start again. The holesaw gets extremely hot and trying to cut too much will cause the holesaw to melt into the plastic creating big problems, trust me on this one. Be sure to spray plenty of water as you drill to keep the holesaw as cool as possible.



Make sure the bulkhead fits without any binding.



When cutting out lids and other openings for your top, it's best to use a router and a straight edge. You can also use a jigsaw as shown below. Acrylic isn't a very good choice as a lid, they tend to warp and sag, especially with the added heat from tank lighting. 1/4" glass is a good choice for a lid, if you want it to hinge, just run a bead of silicone between two panes of glass.



If you have any internal integrated overflows, here's a good way to make your overflow teeth. I use a 1/4" straight cut router bit and a couple straight edges. Here's the setup. It allows for exact depth control and I like to keep 1/2" of acrylic between each notch and go down 1.25" into the sheet.



Solvent seaming:

Now, let's address the issue of solvent seaming. It's a bit tricky, but once you get the hang of it it's a very efficient and strong way to bond all but the very largest of aquaria. In fact, solvent seaming is

used for acrylic as thick as 1.5" in the industry!

The basics of solvent seaming are this:

- The solvent needs to be applied on a horizontal plane to insure proper flow of the thin solvent into the seam.
- The solvent actually pulls into the seam through capillary action and will melt or weld the pieces of plastic together, the solvent evaporates leaving a very strong and clear seam, if performed properly.
- The edges and the space between the pieces to be bonded need to be very even. If the edges are poorly prepped or the gap between pieces isn't consistent you'll end up with a lot of bubbles and gaps, not at all acceptable for a water tight fixture.

The following tools are needed for solvent seaming:

- A can of WeldOn 4
- A solvent bottle with needle
- A tube of WeldOn 16

I don't recommend using the WO16; it's not very strong and is hard to apply without making a mess. Also, I prefer using a plastic syringe with a 25 gauge needle. They're very cheap at a vet supply and I usually get about 4 syringes and 8 needles at a time (< \$5 US). They're easier for me to control and also easier to extract the WeldOn4 from the can. You'll see me using the syringes for this article.



I use the "pins method" for seaming my tanks, it's a great way to get flawless seams, and with some practice you should get good results. The "pins" method is as follows:

1. You insert pins between the panels to be seamed at even intervals, this keeps a fairly even gap between your two pieces, very important for good joints.
2. The gap needs to be large enough to allow good solvent flow

but not too large as to cause the solvent to flow out of the joint and create wasteful & harmful puddling.

3. I use ball head pins from WalMart size 17 - 1 1/16", they work well for this application.
4. You may also need to add shims under the lower acrylic piece to keep all the pins snugged up, this insures the gap is even. VERY IMPORTANT!!!
5. The pins keep a gap to allow a good amount of solvent into the joint, this lets the solvent melt the acrylic, you then remove the pins from the gap and the "softened" acrylic will melt together. I know it probably sounds complex, but it really isn't with a bit of practice.
6. You have a rather small time table to remove the pins once the solvent is applied, I like to keep it about 30 seconds. If you go too long, the solvent will have already started welding the plastic, and the pins will be hard to remove and will leave air pockets where the pins used to be.
7. The best way to do this I've found, is have a helper on hand. I run the solvent, making sure to get a gap free solvent run, and after 30 seconds have gone by, the helper starts removing the pins at the same rate that I'm applying the solvent. For short seams you can do it all yourself, but it's far better in my experience to take your time on long seams and use a helper rather than trying to apply the solvent and hurry back to remove the pins. It's just too much for one person to do.
8. I mentioned having the pieces overlap a bit. You want at least a 1/16" overhanging edge on your bottom piece for the melted puddle (fillet) of acrylic to set on, this seals in the edge keeping air out of the seam, very important for quality seams.
9. You want to peel back or remove part of the protective paper in the area of the seam, I like to keep the paper about 1/4 - 1/2" away from the seaming area.

Here's a pic of some pieces ready for seaming, if you notice the pins are about 6" apart, and they all fit snug so no shims are needed in this case



When you have the pins under the sheet it has a tendency to roll on the pins, you may want a helper to hold the sheet as you apply the solvent. With practice, you'll know what your limits are. For larger sheets, I've designed some holding jigs as shown. They're made from 1" PVC and I don't glue any pieces together, you just make the vertical piece as long as the sheet you're trying to hold, and interchange the vertical piece as needed per piece size. The double elbows on top can turn to hold the piece tightly and it works well to keep the pieces at 90 degree angles.



When you load your solvent into your syringe or bottle, it's a good idea to turn the needle upright and expel any air in the bottle/syringe before running a seam. This will keep bubble buildup to a minimum.

It's best to keep your needle on the lip of the lower piece as you run your solvent and try to keep the needle ahead of the solvent. It can get clogged if you're pushing the needle into the seam.

Try to keep your needle flowing quickly down the seam. If you have a spot that won't fill you may have to go to the inside of the seam to get the seam filled, but good joint prep and pinning/shimming should eliminate trouble spots.

Remember to allow 30 seconds, then start removing pins. The acrylic piece may move on you; just gently move it back into place and try to keep from spreading the melted plastic around too much.

Practice again is key here!

Once you've seamed a section, let it be for 3 - 4 hours before moving it. This is VERY IMPORTANT!

Clear, bubble-free joints are what you're striving for., Keep practicing until your results are bubble-free, solid and clear. It's not always possible to eliminate all bubbling, but your joints need to be solid from edge to edge. A couple pin hole bubbles here & there aren't a problem, but a cluster of bubbles or gaps could cause a failure down the road. You'll know when your seams are right after working with acrylic for awhile.

Assembling the pieces:

Once you're confident with your prep and seaming skills, it's time to assemble your tank. Here's the order that I use:

1. Seam the sides to the back panel
2. Seam the sides to the front panel
3. Seam the sides, front, and back to the top panel
4. Seam the assembled pieces to the bottom panel

This pic shows the two sides up for seaming. The side closest has already been seamed with an extra top support for my overflow. Notice the weight I put atop the PVC jig -- you need it for taller panels. This tank is 190 gallons.



Once the sides are seamed to the back panel, wait 4 hours and flip the tank over (carefully, with a helper) and seam the sides to the front. Notice the jig is now used to hold the center of the back panel from sagging. Just remove the two PVC elbows and it's the perfect height.



Wait 4 hours, put the assembled sides on the top panel and seam. Note the use of shims in this pic.



Wait 4 hours, flip the tank over and seam the bottom



If you have an overflow to install, you can do so after the tank is assembled. Most overflows mount internally, but in my application I needed one on the outside to integrate with another tank, retaining tankspace. I didn't take a pic of the assembly, but to mount this you have to put the tank on end and keep the seams horizontal.



Since you'll have a bit of Acrylic overlap on the sections that were seamed, it's a good finishing touch to use a flush-cut router bit, like the one shown on my router in the first pic. Be sure to keep the protective paper on and run the router against all the protruding edges to get a good, flush finish around all corners. Be sure to keep the router steady and flat against the plastic. If you haven't used a flush-cut bit it's best to practice on some scrap plastic or wood first. One last note, all outside corners will be very sharp and should be sanded down a bit to round the corners. Just use a power palm sander and 200 grit paper and just round the corner edge down a bit -- just enough to take out the sharpness of the edge. You may also want to do the same on the lip edges around the lid openings, as it can really get sharp when doing tank maintenance and aquascaping.



The picture to the right is the other tank completed. It's 110 gallons with a center brace & perimeter bracing rather than a one-piece top.



Here's a couple pics of the completed tanks. See, it can be done.



Getting the final inspection:

Be sure to let the tank cure at least a week prior to filling it with water. The longer you can wait, the better. I wait a month. Be sure your stand has a full support underneath such as a piece of plywood.



I know it's a rather involved project. Feel free to email if you have any questions. Hopefully most issues have been addressed in this article. Have fun building your new tank. □

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