

Making Simple PVC Flutes

by [Jnkyrdguy](#) on January 4, 2009

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intro: Making Simple PVC Flutes

This flute design is a common one on the net, and for good reason. Not only is it simple to build, it's also relatively simple to learn and rewarding to play. It only took a month of on and of playing to be relatively proficient (meaning I could get a clean sound from the first two octaves without difficulty.) The flutes are keyed instruments and only play in one scale (without more complex fingerings) which is actually a plus when just noodling around since you can't easily hit a note outside of the major scale of that flutes key.

My G flute can hit about 2 octaves easily and 2.5 octaves if you push it. My D fife can hit 2 octaves. There are already a number of good sites out there on how to make flutes, but I thought I would add some of my experiences making my own flute collection that haven't been addressed.

For a primer of how to play a PVC flute check out my website: [How to Flute](#)



step 1: Design

I used tested designs for my flutes which I found with construction information on Pete Kosel's [flute page](#).

I made a G flute as originally designed and a CPVC D fife to which I also made a modified version. The G flute works great as is, but I was having a lot more trouble playing the fife. It was very difficult to reach into the second octave. Part of the problem I found was to do with the thin walls of the 1/2 inch CPVC. To create for thicker walls with the same pipe, I decided to add a lip plate (like those used on metal flutes) made out of a 1/2 inch CPVC connector.

I also made some original flute designs out of the same material as the G flute but higher pitched in the keys of A and C. These are both easier to play in the bottom octave, but take more coaxing to push into the second octave, especially for the C flute.

To make your own designs or to adapt these designs to different PVC tubing or drill sizes, the [flutomat](#) is a handy tool that automatically calculates the hole placement from the tubing specs, drill sizes and key you would like to play in.

step 2: Construction

The basic construction of a PVC flute is simple. Six holes provide the western seven-note scale; one blown hole initiates the sound. Insert a block to the correct depth at the blown end and you have a flute. The steps can be performed in any order, but I tend to drill the embouchure first since is the most important hole to have a clean cut. It also tends to be the largest hole and most difficult hole to drill. To start the flute, I use a hacksaw to cut the pipe to length and sand the ends on the disc sander for smooth finish. It is easiest to lay out the holes with a pencil and then follow up with an awl to make an indent for more accurate drilling. Now that I have made a few flutes, I often use another flute I ve made to mark the positions of the holes: for a first flute you will have use a ruler to measure from the open (not the embouchure) end for each hole individually.

step 3: Drilling Holes in PVC Tubing

The most important trick to getting a clean hole in PVC is to commit. The bit tends to grab and quickly rip through the pipe, but if you keep going, it will finish the hole cleanly. Stopping half way through is the kiss of death. It leaves large pieces of material which are difficult to remove without the momentum of the initial attempt.

Workbench

I hold my pipes for drilling and cutting in a workbench which has two move-able table sections with a groove on their sides that can clamp together. If you don't have something like that, then a v groove or two pieces of wood spaced apart the right width will help to hold the pipe from moving around while drilling and cutting.

Which Drill Bit?

Either brad point or standard twist bits will do an equally effective job at a clean hole, but they are different. Brad point is easier to make an accurate hole with while they tend to be more likely to hurt the opposite side the pipe when punching through. The tip of the brad point has almost punctured the opposite wall on some of the holes I've drilled. I also tried using a drill press thinking it would be easier, but the feedback and control you lose with the drill press made it more difficult for me to use than a hand-held drill. It is a good idea to test out your drilling skills on a test piece before you invest time in your flute. It took me a few shots to get a clean hole the first time.



step 4: Making the Embouchure

Some builders make the hole in one shot by drilling a hole on an angle. I find that this tends to cause more trouble than it is worth for me, so I use a straight hole then shape it afterwards with needle files to its final shape. The most important part of the hole is the blown edge on the opposite side of the flute from the player. This edge should stay as sharp as possible. To get the right angle on the blown edge, I use the needle file to carefully undercut the hole. I start on the interior edge of the pipe where the most material will need to be removed with the needle file held at the angle I'm shooting for. I continue to work the angle back until the entire edge is uniform and cleanly cut.

Start with about 45 degrees between the outer and inner edges. Depending on the size of the tubing compared with the diameter of the embouchure hole, it may not take much to reach the right angle, but it is critical to getting the most out of the flute. More filing is needed on larger pipes and on smaller embouchure holes to get to the correct angle. It may be easiest to go ahead and finish the rest of the instrument so it is playable, and then tweak the blown edge until you can get the best tone and control. But don't get greedy: you can always take off more material later but you can't put more on.



step 5: The Cork

The cork can be made of any number of materials. It is more a matter of finding something that fits snugly, won't come loose and is easy to fit into the flute. I have used a cork from a wine bottle, wooden dowels and a rubber stopper. Regardless of the material, the face of the cork should be about one embouchure diameter from the center of the embouchure; you may want to experiment with this to get the best sound.

Cork

My preferred cork material is, not surprisingly, actual cork. It looks professional in the end of the flute and doesn't swell or shrink and come loose when moist. This is what I used for my favorite G flute. The problem with cork is I haven't found source that doesn't need modification for it to fit 1/2 schedule 40 PVC. A standard wine cork needs to be cut down to fit with a plug cutter. This was difficult, labor intensive and frustrating. I also couldn't find any workable cork locally or sufficiently thick cork pads to cut plugs from.

Wood Dowel

So, I tried wooden dowels. With a bit of a bevel on the end for easy entry and some sanding, a 5/8 inch diameter dowel fits well. I inserted the dowel to the correct depth I then cut off the dowel and smoothed the ends of the pipe and dowel to one smooth surface on the disc sander. This worked well for a while, but eventually moisture caused the dowel to loosen and fall out of the PVC.

Rubber Stopper

This brought me to the rubber stopper from my local hardware store. The stoppers are tapered but too big to fit in the pipe without modification. To install a rubber stopper, I insert it as far as it will go, then cut off the excess with a wide chisel using a smooth slicing motion. This works fairly well, but isn't as clean or nice looking as actual cork.

For CPVC Flutes

For 1/2 inch CPVC it is probably easier to find cork stoppers at a craft store of the correct size (there were none large enough to fit the 1/2 inch PVC pipe.) I haven't tried to make a cork of either actual cork or the rubber stopper method for this type of pipe, so I don't know how well they work or how hard it actually is to find suitable material. Dowels are much more difficult to use for the 1/2 inch CPVC since no standard sizes fit. I had to turn down a dowel on a lathe to get it to fit properly (although it hasn't loosened like some of the dowels in my PVC flutes.)



step 6: Tuning Slide

I used two different designs to act as the tuning slide. Both of these have problems, the largest for both designs being the disturbance to the smooth inner surface of the tube. This can mess with the flutes tone and playability. This isn't a huge deal but I have noticed the flutes I have with a tuning slides do play differently from my non-tunable flutes. On the plus side, this type of tunable system also (and probably more usefully) allows you to mix and match head joints and bodies. You may want to only make one embouchure and use it to play a family of flutes in different keys or experiment with different embouchure diameters on the same flute for comparison.

PVC Connectors

The easier method uses the 1/2 inch connectors already available for the pipes. To add one of these, it only requires that you use two sections of tubing for the flute. One section of the flute, the head joint, has the embouchure; the other has the finger holes. The only tricky part of this design is getting the head joint the right length so it is within range of the correct pitch, when near the center of travel in the connector. This can be difficult due to the small range over which the tuning slide can move.

Acetone

Although more time consuming, the acetone method can make for a better tuning slide since it can be as long as needed. The acetone softens the PVC so it can be stretched to fit on another piece of PVC. To start this method you will need acetone, which is sold as a solvent in the paint section of home centers. You also need a container that won't degrade sitting with acetone in it for a few days. Glass works well for this. The container should be as tall and narrow as possible so as to not waste acetone (once the acetone is used once, it is best that you dispose of it properly or store it separately rather than put it back into the original acetone container since it probably leaches all sorts of unknown chemicals from the PVC.)

To make the slide, I started with enough acetone in my container to submerge as much of the PVC as I wanted to stretch. The PVC sat for at least 24 hours before it was soft enough. At this point I took out the acetone soaked pipe and stretched it over another piece of pipe. I let the pipe dry in this position for another 24 plus hours before it was solid again at which point you can finish the flute as usual. You can stretch either the head joint or the body but it would be best to do this labor intensive process to which ever part you plan on sharing the most between other complimentary sections.

step 7: Lip Plate

For the lip plate, I used a 1/2 inch straight CPVC connector (They also make them for 1/2 inch PVC, but I haven't made a modified version of the G flute yet to see if it also improves that design as well.) These connectors are very cheap and, of course, fit the pipe perfectly. Unlike the end caps some homemade flutes use, the connector still allows you to place it anywhere on the pipe. The only difficulty in using them is the ridge in the center of the connector which is meant to stop the pipes you're connecting from sliding all the way through. I used a round rasp to carefully remove the ridge so the connector could slip all the way over the pipe. With the connector in place, you can drill the embouchure as usual. I was worried about the connector slipping off, even though it fits snugly, but it hasn't been a problem. If this becomes an issue, a bit of glue meant for PVC or some epoxy would ensure it would stay in place.



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Comments

33 comments [Add Comment](#)



zac d says:
I t dosnt even work

May 9, 2009. 5:47 PM [REPLY](#)



mach2 says:
I have been cutting embo's for sometime. I prefer the oval vrs the round hole for more robust performance. Generally the blow edge and the opposite edge should be equal, in that if you built a straight flute with no embo' offset, a player could play left or right. My ovals generally are the same as the boehm design though this can vary from as little as a millimeter difference in length (8.7x9.7 to as much as 8.5x12mm) The undercut blow edge and sides are not uniform but blend. The angle of the undercut is very difficult to measure because of the curve of the tube but I generally start with a 10 degree blow edge. Some cutters prefer a straight cut and some use a rounded edge. I use a straight edge or "chamfer" and the sides are slightly rounded. Depending on how the 'tuning' process goes I can make adjustments to the embo' by adding more angle on the blow edge. So if you're not sure start with less angle. Just remember you can't add material.

Apr 22, 2009. 10:48 AM [REPLY](#)


Rinse the embo with water before testing. You don't want to breath the dust.

I use an exacto knife to rough out, a jewelers file and also some 350 grit paper wrapped around the shank of a drill of near diameter size using double sided tape. I recommend using norton paper as it is also water resistant and finer paper for the finish out. then lighter paper etc.




wrightklaw says:
If you play the flute, a boehm system metal flute, perhaps, or maybe your baroque will help you, just look at how the embouchure hole is made on those flutes and try to copy it. The whole idea behind it is that the edge of the hole that you blow on splits the air, creating vibrations, so you'll want that edge to be fairly sharp. I hope that helps.


Apr 7, 2009. 8:41 AM [REPLY](#)


 **supergokou** says: Feb 19, 2009. 7:38 AM [REPLY](#)
I'm gonna revisit the embouchure question. I looked at a few websites and I can't seem to get a clear answer on the angle of the hole. If I'm looking at the pipe and the embouchure hole is to my left (this would be the side I would play from), then should I drill such that the drill bit tip is pointing towards me or away from me.

You also mentioned "right angle" in your instructions, and I'm not clear if you meant "90 deg" or the "Correct" angle. Should the inside edges of the hole be parallel to each other, or should there be a 45 deg angle on one side and a 90 deg angle on the other side?


Thanks for the help

 **Jnkyrdguy** says: Feb 21, 2009. 6:58 AM [REPLY](#)
I drilled the embouchure hole with the bit pointing straight at the center of the pipe since it is easiest to drill that way. Then I used a small file to bring the blown edge to the correct angle which is about 45 degrees between the edge of the hole that was just cut and the outside edge.

 **Rainx** says: Feb 13, 2009. 10:11 PM [REPLY](#)
Is this in any way toxic to the human body?? I hear PVC is quite dangerous to humans when burned or processed.


 **Jnkyrdguy** says: Feb 14, 2009. 3:41 PM [REPLY](#)
PVC uses some nasty chemicals when manufactured. That said, it isn't bad for you as long as you don't breathe in the fumes from burning it or the dust when sanding or drilling it. It's normally used to carry drinkable water, so it shouldn't leech toxic chemicals.


 **Rainx** says: Feb 15, 2009. 3:49 PM [REPLY](#)
okay, thank you! Much Appreciated.

 **bakermonitor** says: Feb 11, 2009. 5:04 PM [REPLY](#)
try using the pipe that has the joints built in to it and using the connection joint for the tuning slide

maybe bevel the end of the tuning slide to form a smooth fit

 **Lance Mt.** says: Jan 18, 2009. 3:32 PM [REPLY](#)
4.5 cause, hell it'd be sweet, if i made one.


 **germeten** says: Jan 15, 2009. 7:15 PM [REPLY](#)
I've played with flutes and recorders infrequently, not enough to be proficient.
One problem I've had with flutes is being able to purse my lips, get and maintain the proper angle to the blow-hole, while being finger dexterous with the others.
Recorders are better IMHO because the mouthpiece establishes the air angle, leaving one less skill needed to master. So can you advise how to make and add a recorder's mouthpiece to your instructable? thanks.

 **Jnkyrdguy** says: Jan 16, 2009. 7:45 AM [REPLY](#)
I haven't made a recorder or whistle, but this site has good plans and instructions for one: The 'Low-Tech' Whistle: How to Make a PVC Whistle.

And this site shows how to make a simple PVC clarinet: The \$5.00 Clarinet.

 **germeten** says: Jan 16, 2009. 1:47 PM [REPLY](#)
Thank you for those other site links, Apart from the instruments, indicate how to make a whistle in a survival situation, easier than I thought.

 **nepheron** says: Jan 16, 2009. 11:11 AM [REPLY](#)
5 STARS for awesome-ness.

 **yomero** says: Jan 15, 2009. 7:33 AM [REPLY](#)
great instructable, but i failed to understand the embouchure step, because you say that it has to be filed in angle, but in the picture i didn't see any angles... anyways, its a great one



Jnkyrdguy says:

Jan 15, 2009. 5:48 PM [REPLY](#)

The angle is the one created by the outside edge of the tube and the side of the embouchure hole cut into the tube. To see the angle clearly, you would have to cut the tube in the center of the embouchure and look at the end of the tube.

Hope that helps.



yomero says:

Jan 16, 2009. 9:33 AM [REPLY](#)

sorry, still dont understand, but no problem, this is the kind of instructable that i enjoy, i do play the recorder quite well. (baroque flute)



barri_kid says:

Jan 15, 2009. 7:00 AM [REPLY](#)

Hey, I made one of these a while ago out of metal. I dont know if yours has the holes in the proper location, you didnt give any hole distance. An A4 is 440hz so you will need to do some calculations with that number and the speed of sound (331 + 0.6T so generally 340). I did it quite a while ago, so I dont really remember what I did, but it did work and the notes were pretty accurate



Jnkyrdguy says:

Jan 15, 2009. 5:33 PM [REPLY](#)

I used an online calculator, the flutomat, to figure out the dimensions for my flutes. It worked really well for all of the different versions I made. Some of the flutes are easier to play than others, but they all play reasonably well in tune.



CobyHoff says:

Jan 16, 2009. 6:49 AM [REPLY](#)

When I made my PVC flutes, I used the method of starting with the bottom hole, drilling it too small, and enlarging it until it is in tune, then moving on to the next hole. I did have the advantage of an old vacuum tube strobe tuner, but I still tuned it mostly by ear.



etymological says:

Jan 15, 2009. 11:43 AM [REPLY](#)

I have a friend who makes beautiful self-tuned bamboo flutes with a similar method.



Superninjacamper941 says:

Jan 9, 2009. 6:15 PM [REPLY](#)

Can you use a cap over the end instead of the cork I think this would be easier for smaller diameter flutes.



Jnkyrdguy says:

Jan 10, 2009. 8:34 AM [REPLY](#)

I have seen someone make them like that. In his design, the end cap acts like the cork and the lip plate at the same time.

Here's a link to plans (scroll to the bottom for a dimensioned drawing): <http://www.markshep.com/flute/Pipe.html>



Madrigorne says:

Jan 9, 2009. 4:47 AM [REPLY](#)

For stopping up the end, have you considered using silicone sealant, cover the end of the flute with a bit of adhesive contact paper or masking tape and then filling the inner with sealant until it is enough to fill up the end - then letting it sit overnight? add it in through the nearest hole until it has enough and let it sit upright until it sets. Then the end would be white or clear or whatever - as silicone sealant comes in many colors it could easily match your pvc. It would not warp, would not care about moisture and would not come out unless you scrape/cut/dig/drilled it out. Just an idea.



Jnkyrdguy says:

Jan 10, 2009. 8:14 AM [REPLY](#)

Not a bad idea. One thing to keep in mind though is that the distance from the inside of the cork to the embouchure is critical to being able to get a good sound. That's why it's nice to have the cork as a separate piece so you can move it in and out of the end until you find the spot where it makes for the best tone and easiest playability. As long as you could accurately fill the end with silicone to the right distance, this could work.



hedgiehog says:

Jan 9, 2009. 7:02 PM [REPLY](#)

awesome



modelmanjohn says:

Jan 5, 2009. 8:42 AM [REPLY](#)

Nice, but I heard that overtime PVC can emit fumes that are toxic, cause cancers, etc.

A better option (ilke dung0beetle) is to use bamboo or cane.



Lt. Duct Tape says:

Jan 9, 2009. 3:51 PM [REPLY](#)

Only if it's scorched or if you breathe in the sawdust.



pinchebob says:

Jan 9, 2009. 11:07 AM [REPLY](#)

Nice job! I've got a lot of clear polycarbonate tubing that I'd like to try this out on. I've had good luck using a step drill bit to get clean holes drilling plastics. You will probably need to drill a small pilot hole and then you might need to modify your step drill bit to get the hole size you want without hitting the other side of the tube.



AnarchistAsian says:

Jan 8, 2009. 2:54 PM [REPLY](#)

woooahhh, I LUVZ PVC PIPE!!!!!!!!!!!!!!



mynameisjonas says:

Jan 7, 2009. 6:08 PM [REPLY](#)

no video?



dung0beetle says:

Jan 4, 2009. 10:59 PM [REPLY](#)

you can make a saxophone too, just omit the embouchure and add a 45 degree angle joint and a tenor mouthpiece. (use larger stock for the sax and cut it a bit shorter <to tune of course> sounds just like the real thing) I have a bamboo saxophone and it is awesome, just used red hot metal rods to make the holes.

Nice instructable! Everyone go grab a saw! There are tons of pipes under the sink!



jimstoffel says:

Jan 7, 2009. 7:14 AM [REPLY](#)

Great Instructable! And thanks for link.

@dung0beetle:

Do you have notes on how to make the "bamboo saxophone"?
