How to build
A simple
North American Style Flute

By: Donn Shands

INTRODUCTION & DISCLAIMERS

It often comes a time in a persons life when they hear music with a beautiful and pleasing sound and wish they were capable of reproducing that sound on their own and to make their own expression of music. For those totally without knowledge of music and the ability to play any musical instrument, it will most likely appear to be a daunting wall of learning to have to scale.

While flute music has been in the world since the earliest of times, the music produced by the North American Style flute was not well known until late into the 20th century. With the advent of advanced electronics and recording capabilities, along with the sudden surge of New Age Music, the NAS Flute was a natural to be included in the cadre of instruments with soothing sounds and meditative potential. Many of the indigenous Native Americans with the musical knowledge of the flute passed on to them from their elders, became great leaders in the movement and reawakening of the joys of the flute.

Unlike the fipple flutes, and embrasure blown flutes, the North American Style flute is tuned to the Pentonic scale and not the Diatonic scale. Being Pentonic scale, the usual 5 notes being played will sound pleasing, and not discordant.
The flute is also constructed with a mechanism that produces the sound without a great deal of effort by a player. Much can be written about the history and the uniqueness of the North American Style flute, and that is saved for future writings.

Usually the first thing that comes to mind when a person wants to learn more about the NAS Flute, is they will inquire as to a source on where to purchase one.
A music shop will probably try to get them to go ahead and purchase a Recorder flute, which would be a huge mistake.
Then, the person would go on the internet and search about. Not being properly informed, they just might purchase a cheap knock off of what appears to be good craftsmanship and get a cheap, mass produced flute. Most often the knockoff was made in a foreign country and if even near to be in tune it would be a miracle.
Trying to learn on an inferior flute is frustrating and very unproductive.
The other thing that happens is that the person is daunted by the price of a well made flute.
What is left is a determined person that wants a flute and thinks they can make one on their own.

At that point, they have no clue that there are many more just like themselves that desire to own and play a flute. They have no idea that there is help available through internet forums and through Flute Circles in their local area.
Usually, the first thing they will do is search on line on how to make a flute, and usually wind up trying to construct a PVC flute. Usually the first attempts will be miserable failures due to lack of crafting skills and lack of the proper tools for crafting. That also leads to great frustration.
The more fortunate will be lucky and find help through a local flute circle and a member that can pass on the knowledge of crafting a playing flute. If a person has gone this far, and still determined to obtain a quality instrument, and still has the desire to learn to play, then they have passed the first mark on their flute journey.

The set of chapters that have been provided in PDF form on this Beginner NAF Flute Forum that follow this introduction are provided by myself and several dedicated makers and players of the North American Style flute.
Each of us have gone through the hardships of the first steps of our personal Flute Journey.

Much thought has gone into coming up with a simpler method to produce a playable flute that was, made of wood, did not require the use of the more dangerous power tools in a workshop, and when finished, taught the basic skills needed to build future, more advanced flutes.

The simplicity of the construction lends itself to actually pre-cutting all the pieces needed for assembly and being provided as a kit for individuals to assemble in work shop type classes under supervision of a qualified flute crafting instructor.

The design of the flute in the project we are providing is that of a North American Style flute. The design results in a square shaped flute with a square bore. The shape has no effect on the playability or the sound. The design is not something that can be patented, as the concept is in the public domain. There might be individuals that will try to take the concept of providing a kit to construct this type flute to make a buck and try to patent the kit idea as something of their own creation. I am all for any instructor, or dedicated teacher of flute making, to being creative in making their own kits for their personal workshops. I would believe the World of flute makers would frown on any one person trying to corner the market on an idea that will provide for so many, a simple, inexpensive, safer, approach to making and playing their first flute.

Disclaimers

I am not presenting this How To Manual as "The" only way to construct a flute. It is merely a simple means to an end that will provide a playable instrument with some of the pitfalls and more dangerous aspects removed that are found in advanced power tool filled wood workshops. It basically avoids the use of PVC, which is a possible source of toxic dust. Every attempt is made to explain possible shop dangers, and how to avoid them. Myself, and all those associated with the How To Manual, will not be held liable for any injuries, accidents, or medical problems that may result from any attempt to construct any portion of the project described.

At no time is the project to be construed as an official project sanctioned by an indigenous North American full or partial blooded native Indian. All caution has been taken as to call the flute being produced as a North American Style flute and not "Native American Style" flute.
All caution has been made to show respect to the history and the culture of the peoples of the lands of the Americas ***where the designs of the flute evolved over centuries of time to what it is today.***

My name is Donn Shands, I am of Scottish/Welch/English decent. I claim no other blood lines. At no time do I represent myself as a blood line member of the American Indians.

Knowing there will be questions to be answered, I am providing a source of contact below for as long as the links hold up.

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Chapter One The basic items needed to have in your beginner flute workshop.

Oh, the first thing you noticed was that the flute was square. Right, and it just so happens that it plays in tune and is a High D. Some people still believe that bumble bees can't fly and still can't understand how 747s stay in the air, and all steel ships float. Well, as long as the length of the walls are straight and the bore is consistent for the length of the flute, physics allow the flute to work as well as any round bore flute.

So, why a square bore flute? Because it is probably the easiest flute to make out of wood without using a workshop full of tools. Most beginners of flute making will try to construct a North American style flute out of PVC for their first flute. Many a beginner has started his flute journey with PVC. Problem is, most of the beginner makers have no clue about the potential dangers of working with PVC. The finished flute will not kill you, but what is produced during the process of making the flute is what gets you. PVC saw dust and sanding powder can get into the lungs. Like black pepper that never dissolves in your stomach and sticks to the lining, PVC dust gets into the lungs and does not dissolve. It stays there, and sometimes the chemical make up of the plastic can create a form of lung cancer. If you must use PVC, then take the precautions of using a filter mask and other measures to cut out any breathing of the byproducts of flute making.

For a better idea, use wood to make the new flute.
Don't have a router? No problem.
Don't have a lathe? No problem.

You will need some simple tools, and we will discuss each of them and some suggestions as to how to obtain some that may not be readily available at the hardware store.

You are probably wondering why I am going to all the trouble to walk you through the tools and where to find them. First, you will need them to complete the project. Second, these tools will be part of your starter workshop for crafting future North American Type flutes. Sometimes it seems a bit costly to do a start up for such a simple project, but you need what you need to do the job. If you don't want to make the investment in the future of a great hobby, and still want to play a flute, then just purchase a nice NAF from a reputable dealer. There are plenty to choose from, and they want the support.

The parts and tools suggested to be available are as follows:

Wood.
Lowes and Home Depot have a couple of bins of specialized wood back in the lumber department.
There will be a bin of wood dowels, both round and square. Pick up a length of ½ inch **square** dowel. And for later use, buy a round dowel. Maybe ¼ in diameter, but smaller than ½ in diameter.
For the dowels try to obtain poplar if you can. Avoid oak if at all possible.

In another area, will be a bin of cut slats of finished smooth cut wood.
Usually the bin will be of **poplar** wood. Some stores have white and red oak, and finished cut pine usually called craft wood, and some even have white aspen wood.
For your first project, it is better to stay with the poplar wood.
You might as well pick up about 4 pieces of 4 ft long poplar. The slats are finished smooth, and are about ¼ in thick and about 1 ½ inches wide. The label will say ¼ X 2 X 4. The finished wood cut comes out to be 1 ½ inches wide.
Find the slats that have no cracks in the length, have no holes. The color of poplar ranges from off set white, to a greenish tinge, to almost black. Some slats will have some interesting patterns of all the colors mentioned. The more varied the colors of the grains, the more interesting the flute will be. The stains you might add later can enhance some of the patterns, or you can finish with a clear coat. For now, the main thing is getting a nice piece of tight grain wood to work with.

Glue
Most makers of North American style flutes have settled on using the White Gorilla Wood Working Glue, the type that does **not** foam up. Tight Bond III glue is another option. These glues will perform very well for wood projects. Usually, during glue up, the clean up is just water. They do not give off offensive fumes, and when dry, can be sanded smooth. Within reason, they are water resistant after curing.

#2 Pencil….sharp

Ruler ….usually a nice metal one that is 18 inches.
Ruler square…..does not have to be a real expensive one. But fairly accurate.

Clamps. For this project, it is better to use spring clamps. You can use C type clamps if necessary. Clamps that have rough faces will require some sort of cushion on their face to prevent marring of the wood surface.
This is a square flute being made, so it is **not** recommended to use rubber bands, Bicycle inner tube strips or bungie cords, or surgical tubing as a wrap clamp. The pressure will warp the sides of the project. The wrap type clamps are used on future projects when you learn how to make branch type flutes.

Small files. Diamond file sets are a good investment and will be a mainstay in your work shop.

Sand paper. For practical purposes, you could get by with a sheet of 80 grit and a sheet of 120 grit. The black water proof paper is more durable.
Small Exacto type knife set. You could get by with just one handle and a #11 blade. But it is better to make the investment as you go on a whole set.

Knife…..carving type. While the Exacto knife is the norm for most craft workers, the blades are usually too thin and brittle to use safely on certain carving projects.
The thick and stiffer blade on a good whittling knife is recommended, one that has a sturdy blade that ends in a point.

Rasp…..wood type. Most wood rasps are pure overkill on wood projects.
If you can obtain one, the small fine Microplane rasp is the best tool for the project. Do not get the Stanley rasp…it is overkill.

Chisel You will need a ¼ inch wide flat blade chisel. See later notes on the chisel.

Saw. Well, we can get really basic here. If you have absolutely no power saws, then you could get by with a simple hand coping saw. Buy some extra blades for backup. You could use an electric scroll saw. You could use an electric saber hand saw. You could use a band saw. For short cut offs, you can use a fine hack saw blade. I say **no** to any table saws for this project.

Further, there is no need to endanger yourself with trying to use an electric planner, or router for any reason in this project.

Sander. While I personally use a bench 4 inch wide table top belt sander, with a 6 in flat disk sander, and also an up-right oscillating drum sander, you could get by with only the rasp and the sand paper.

Safety equipment Eye protection…glasses. Leather apron. Leather gloves.
Eventually you will need a dust mask, and possibly Nitryl gloves.

Burning rods to make the finger holes. We will discuss that at a later time in the project. Burning rods make cleaner holes than drill bits and over all give you less problems during and after construction of a wooden flute.
You may already have a bottle of propane along with a propane torch head in your tool collection.

Electric drill. Usually a common 3/8 in chuck electric drill will do. Personally, I have a table top drill press with a small drill press vice on the table plate.

Drill bits. Brad points are nice, and a good set of Forester bits are great to have. A few really fine drill bits should be obtained, you will need them in the project.

Dremel set. Best investment you will ever make. ½ inch sander drums with 120 grit are essential.

A bench vice. Usually every shop has one. I added some thick leather glued to the vice faces to help keep from marring the surface of the wood project being held.
No place for a vice? We are going to have to use something to hold the wood steady while cutting. If you have to, find two pieces of long 1 by 2 smooth straight boards, and clamp your piece of ¼" wood between them. Use your C clamps or even a couple of Vice grips if you have them.
When you get down to it…..this flute can be made without one power tool if necessary, and with the lowest common denominator of hand tools at your reach to use.

Now, before we get into the project, lets discuss where some of the sources are where you can obtain the mentioned tools and material you will need.

Wood Lowes and Home Depot. This is your first project, don't attempt it with expensive exotic woods.

Glue Lowes and Home Depot. Maybe Walmart. The other local hardware stores and specialty shops will zing you for another 20 % mark up.

Pencil, Metal ruler, Square…. Small desk calculator
Nine out of ten of those reading this have a local Dollar Store. While you are there, pick up a pack of the water sand paper in an assorted pack for just a buck.

Clamps You can never have enough of them.
Over a few years, I have collected quite a few of the plastic spring clamps of different sizes. Probably for project, the 2 ½ inch jaw clamp is the best size.
These clamps are available from Harbor Freight and Poppa Johns Tool box.
http://www.pjtool.com/springclamps.aspx
I think the 2 ½ in jaw is his 6 ½ long clamp
Get a box of 15 for less than 30 bucks at 2010 prices.

These clamps have a nice articulating plastic face too, that does not mar the wood surface. Try to avoid those metal flat spring clamps. They exert too much pressure on a smaller area of contact.

While you could get by with your old Buck knife for whittling, these custom knives will be in your tool kit for life. Super strong carbon steel that keeps an edge. The top knife is the best to start with and give you the most use.

http://www.woodcarverssupply.com/FLEXCUT-ROUGHING-KNIFE-2-KN14/productinfo/993014/
Wood Carver Supply is a nice place to start unless you have a Woodworkers or Rockler's in your neighborhood..

You can almost start a war on the forum about which is the best cutting tools.
I was introduced by the Fallen Branch group to the Flexicut tool line.
Shown above is the flat blade, ¼ in chisel. The handle is called a power handle and can be used with a whole assortment of different blades. The blades easily pull out and replaced very securely in the handle. Later, when you learn to do gouging of flute bore blanks, you will purchase other blades with curved gouge tips to use in this handle.
While most people are familiar with the common carpenters thick ¼ in chisel, this blade is thinner and is far easier to use for flute making purposes and will be a constant companion on your work bench. Make the investment, you will thank yourself hundreds of times over.

Exacto Knife

The more economical sets can be bought as off brand types at Harbor Freight.
You can find some Excel brand handles and blades at Hobby Lobby. Be careful, some brands of blades are a lot thinner than others and break easily.

Dremel When young, every kid's dream was to own a Dremel kit.
It is an investment that keeps on giving. Just down the road, you might have to replace the electric brushes, and they are cheap at Lowes at the Dremel counter.
The best investment is the unit with the flex shaft.
Hang the unit over your work bench and attach it to a spring. Do not let the shaft hang down so that it will touch the floor. You might drop it and break or bend a tool in the chuck.
When you get established later down the road, go to the Master Carver site and investigate the Master Carver tool. Or check out the Fordom. Make sure you purchase a handle for those units that will take a ¼ in shank bit. But that is later.

Diamond Files
Probably the best place to find sets of diamond files is Widget Supply.
Their sets usually run less than 10 bucks.
http://www.widgetsupply.com/page/WS/CTGY/ht Search for files or type in diamond files in the search box.

Microplane rasp http://us.microplane.com/8snap-inrasps.aspx

If you don't want to buy a whole set of Microplane files, then just get the 8 in handle and the fine 8 in flat blade. Stay away from Stanley rasps…they are too rough.

Drill bits Browse Harbor Freight for economy drill bits. For your use, you will need a small set of foresters, and a set of brad point bits. Harbor Freight also has small blister packs of small fine drill bits. The finer drill bits will be a great help later on. The finer bits can be used in an adjustable chuck on your Dremel.

Protective gloves
Harbor Freight has a great assortment of work gloves.
Depending on your wallet, buy a good pair of comfortable gloves.
You can obtain a pair of Kevlar gloves, and there are gloves that protect against knife cuts. Most of my shop work, I find a good pair of flexible pig skin work gloves is the best protection and dexterity type. Stabbing yourself in the other hand with a knife or chisel can ruin your day. A sander will do a much faster job on bare skin than it will do good on the piece wood you are working on. Sanding damage can be like 2nd and 3rd degree burns…..not pleasant.

Which brings to mind the leather apron.

http://www.woodcarverssupply.com/MASTERCARVER-LEATHER-APRON/productinfo/510009/

One day you will thank me for suggesting this.
It not only saves you a tongue lashing from your spouse about messing up your work pants with dust and glue and stains, it also helps to save you from slipping and poking a chisel into your leg.

If you can't afford this apron, then a bit thicker apron which is a welders leather apron can be purchased from Harbor Freight for half the price. This one is a lot more comfortable and well worth it.

A respirator mask to filter out dust is a good investment. Check out all the respirators on Amazon. Com and find one to suit you. Purchase an extra set of filters at the same time you purchase the mask. At least with this mask you can wear your glasses.
Remember, in the future, you will be working with some woods that just might be real allergenic to you personally.
If you don't believe me, blow your nose after a session in the shop after sanding.
Or open up your shop vac and look at the filter.

*For more information on respirators go to **Chapter 1a***
Basic explanation of respirator use by Ellie Barbarash

While a good ruler is essential, one of your best friends in the tool box is a good caliper. Not something you pick up at the dollar store, but for a reasonable price usually at Harbor Freight.
Note the one on the left is plastic. No frills, but effective in a pinch.
The two in the middle are composite. One measures inches, mm, and fractions, while the other measures inches and mm.
The third is metal and composite. When not on sale, it is usually in the 20 buck American range, but sometimes gets down to the 12 buck American when on sale.
It measures in inches and mm. It has the added feature of being able to thumb screw down and set a measurement temporarily. The metal, under thumb wheel makes precision setting of a measurement easy.
The thing to understand about the three electronic units is that they measure in decimals when looking at inches and mm. Later, when you are using the flute making programs like Flutomat, measurements are inserted into the program in decimals. These calipers save a lot of headache in trying to convert inches to decimals. When flute makers on the forums are exchanging data, they will usually give each other required dimensions in decimal inches.

Think of all the suggested items as the beginning basics of your flute making work shop.
As mentioned, you could make the flute in this project without using one power tool if you had to. But, there are some tools that with a bit of ingenuity, if you cannot buy them, you can come up with other solutions. However, I would not recommend the use of cruder tools to be used for cutting. The Flexicut chisel and knives should be the choice. Trying to use a cheap tool that will not hold up to pressure and use and not hold an edge will only frustrate you and provide shoddy workmanship.

This was an introductory chapter, mainly to get you off to the right start on this project, and to provide you with the basic necessary items to get you into the project.
As mentioned, you can really over spend and get distracted when shopping for workshop items. Having the basic items on the bench, BEFORE you start, will help to suppress the frustration of having to stop and go to the hardware store and pick up a missing item.

Please go to Chapter 2

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Chapter 1.a Some simple language about respirators.
By: Ellie Barbarash

A respirator is better than a dust mask. It lets you breathe through a filter that protects your lungs and your nervous system from toxins in the air. A respirator is only as good as the way it fits on your face. If you have any facial hair, like big sideburns, a big mustache, or any kind of beard at all, a dust mask or a respirator is pretty ineffective, though it will keep the really big stuff out of your lungs at least. You can figure that for a poisonous gas or dust particle, the space between your beard hairs is a big open tunnel to get through to your mouth or nose, and some of the toxins will bypass the filter altogether and you'll just breathe them in through gaps in the facepiece seal. It's better than nothing, but when you're dealing with a chemical or a solvent that can slowly kill you, it's good to know you have all the protection you can get.

When you get a respirator, whether a disposable one or one of the silicone half faced ones, pay attention to the kind of filter you are purchasing. For sanding and cutting, you want a particulate filter. HEPA is best. If you're working with any solvents or finishes at all, you'll want one with an organic vapor filter. You can get a dual filter that has both. Comfort is important, and so is keeping the inside of your respirator clean, and storing it in a sealed Ziploc bag in between uses.

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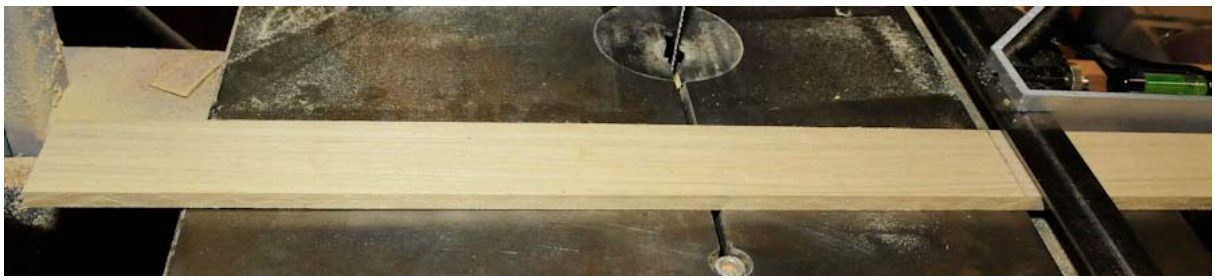
Chapter Two: Let's get started with the project.

Lay out the first items you will need for the project.
Rulers, sharp pencil, the ½ in square dowel and the flat lengths of 1 ½ inch by ¼ inch thick poplar wood.

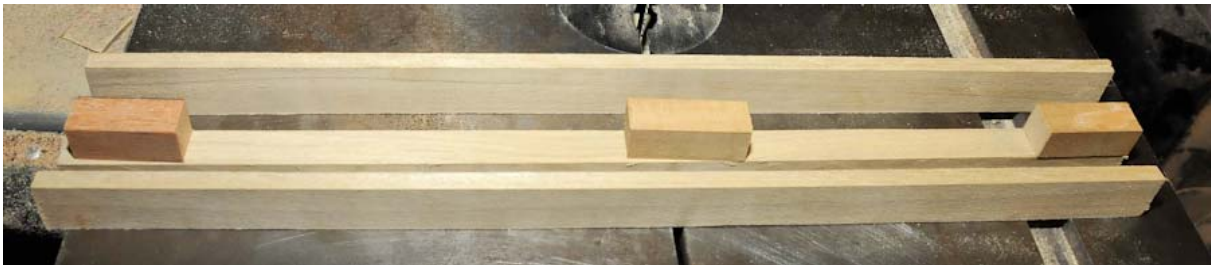


The first thing you do, is select a nice clear grained section of the slat and mark off 13 inches. Your band saw will probably not be able to cross cut this piece. Use the coping saw, or your table scroll saw, or in a pinch, use the shop vice, and carefully cut off the needed piece with a hack saw blade. If you have a miter box saw, that is the better answer.

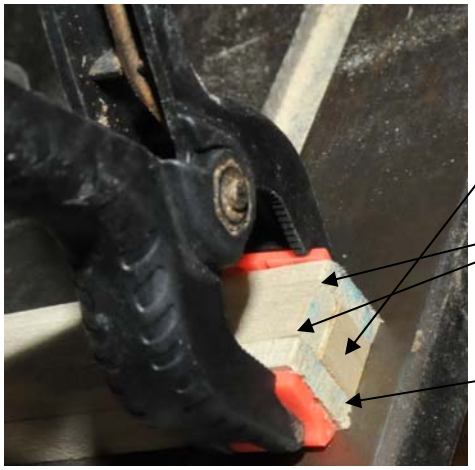
Now, find an absolutely flat, hard, smooth surface to work on. The band saw table top is about the most flat available. Turn the cut piece of slat on the edge and place it behind the dowel as shown in the picture Use the square dowel as a ruler and mark a line the full length of the wood slat set on edge. The purpose here is to obtain, after the next wood cut, a piece of the wood slat that is exactly the same width as the square dowel.

Cutting this long piece may present a problem to people that do not have a holding vice for wood. It is simple on a band saw or a scroll saw. As mentioned before, you might want to pinch this board between two other boards and clamp down with c clamps and extra pieces of thin wood to protect the work surface. That should hold the piece to be cut securely enough to cut with a coping saw.

Check the piece you just cut. It should have a smooth edge, and a rough edge. If you measure it to the square dowel, the entire length should be perfectly the same width as the square dowel. (oops….did you cut on the wrong side of the line?)
Take the cut piece and place it under the square dowel and place another piece of 13 inch cut slat **behind** the two and on edge. IMPORTANT….make sure the smooth edge of the slat is facing the bottom or on the table. Mark this with a pencil, then cut this piece to size.
Find another 13 inch piece of slat and repeat the cut, so now you have two sides for the flute.



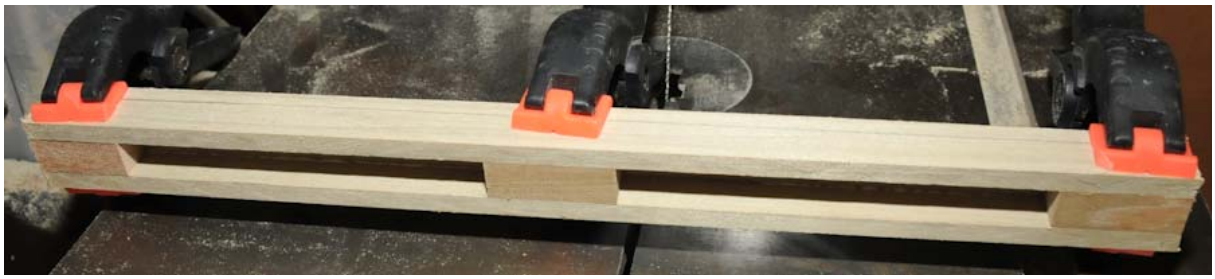
Use a saw and cut three or four short pieces of the square dowel. Make them about an inch and a half long. These are not a functional part of the flute, but provide accurate spacing while doing a glue up of the flute.



First step is to place the spacer blocks on the table.

Second step is to place the piece you have cut for the flute bottom, and put it on **TOP** of the spacer blocks. Remember, both of the edges should be as smooth as possible as this should be the exact width of the square dowel and when glued up, should show no open cracks along the seams.

Make sure that the two side pieces have the SMOOTH side facing down, the Rough edges facing UP.
This is the position you should be in when you have applied the glue in the next step. Failure to follow these instructions will give you problems with a proper seal of the top of the flute when that step comes.



Now that you have things lined up, Have a paper towel, some water in a cup, and the white glue ready. Without any clamps on the project, and all in place, gently lift the part which will be the bottom of the flute, up and away from the other pieces on the table.
Put a bead of glue down each side of the edges of the wood that is to be the bottom of the flute. Use your finger and run it the length of each of the glue beads until the area is smooth. Run your finger down the sharp edges and remove any over flow excess. Clean up with paper towel and water. Gently place the bottom piece back in the groove on top of the spacer blocks, and press the two sides together to position it in place.
Apply pressure downward on this piece to make it rest evenly on the spacer blocks under it. Apply the clamps only on the part where the spacer blocks are located. Note in the picture above that the spacer blocks and the smooth edges of the sides are all flush.

For just the time being, remove the center clamp. Inspect the position of the bottom slat. More than likely, you did not make a precision cut of the two sides, usually, they will be slightly wider than you anticipated and they leave a slight raised edge on both sides of the bottom slat. Perfectly OK, as this will be sanded smooth later. But, the area where the top playing holes will go will have even seams.

Note here, that when the clamps are applied, that some oozing of the glue is apparent. First check to make sure all the cracks have glue in them the length of the seams, then wipe off excess with wet towel. Apply the center clamp.

Shown here is a flute glued up with more clamps applied. You can apply more clamps, but you must use this type of flat surfaced plastic clamp. The main impact is actually pressing on the glue joint holding the bottom of the flute in place.
Absolutely do not use rubber bands, surgical tubing, or elastic bands to bind this flute. Remember, you are making a square flute. Pay attention to the physics of the project. Bands would warp the shape of the flute sides.

During the process of checking your glue up at this stage, it is a good idea to inspect the area where the spacer blocks are seated. You do not want a lot of excess glue to get on the spacers as they will be glued to the inner surface of the flute, and will result in a lot of extra work trying to remove them and all the clean up and smoothing later.

It is time to give this stage of the project time to set up. Usually that will be better if you left the project in a safe place out of direct sunlight, excess heat…or excess cold.

Proceed to Chapter 3

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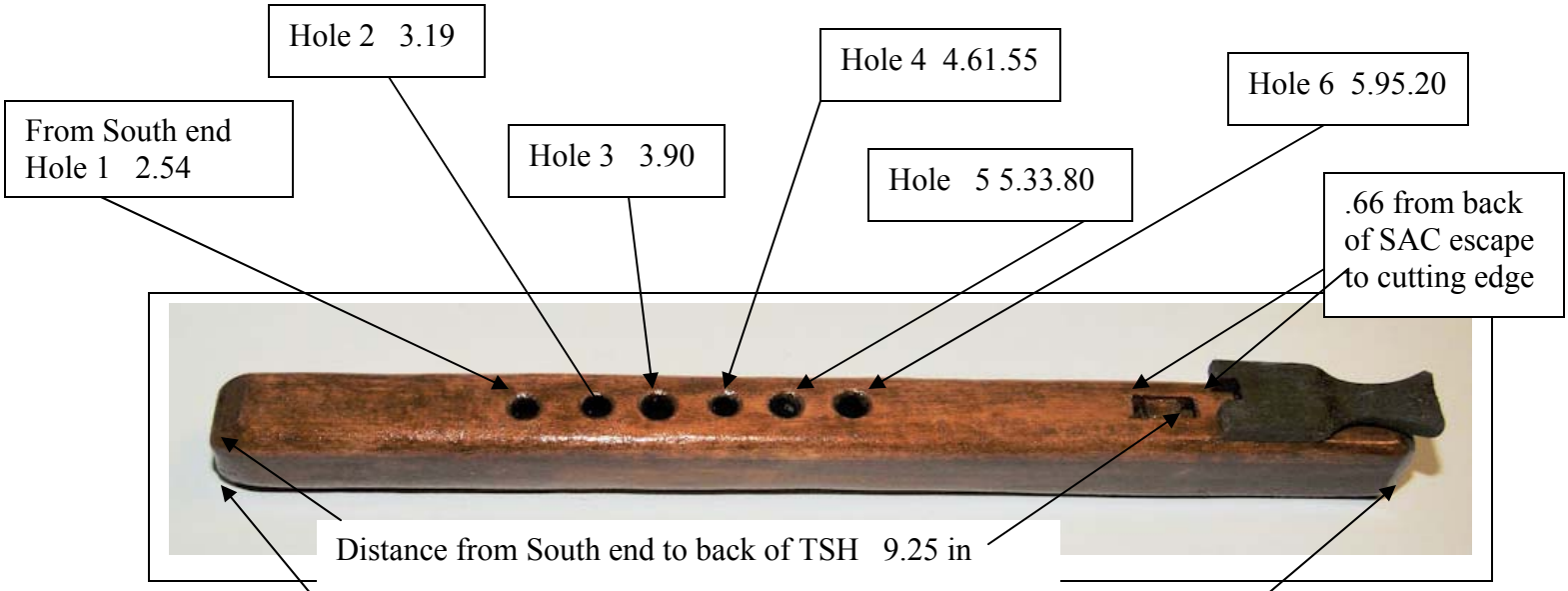
Chapter 3: Measurements and crafting the sound mechanism, first steps.

This chapter takes up after the glue has dried on the assembly of the bottom three pieces of the flute.
The thing to do after removing the clamps, is to inspect the way the three pieces held together. All sides should be evenly spaced into a perfect square U. As a safety precaution, place a glove on your holding hand and use the flat blade chisel to gently lift out the spacer blocks. Some might have had some glue holding them, but usually the glue is not totally over hardened yet and will come loose with out much coaxing. Inspect the seams both inside and out side the piece. If you see that glue is missing and cracks evident, then add some more glue to the area, and use a cotton tip swab and some water to spread into the cracks. Then clean up any excess with a dry cotton tip applicator or a piece of paper towel Try not to leave any excess in the flute interior which may cause bore perpetrations and cause problems in tuning.
You should have a fourth piece of the wood slat cut to the 13 inch length ready to use. Lay the piece to be used as the top down flat on the table with the surface you will want to be the final top to the flute. Place the bottom assembly down on the slat with the two edges down and use a sharp pencil to line off the length of the top. This will give you the exact width of what will be the top of your flute. Remember to cut on the outside of the line. After glue up and finish, you will have time to round off and sand the edges.

The picture above shows the bottom section of the flute glued up and the top piece measured and cut.
Not all of the pictures used in this presentation are of the same flute in a stage of being built. This particular flute had some interesting grain in the wood. It sort of creates an optical illusion in the picture. Over 20 of these flutes were constructed during the documentation of the chapters.



All holes are measured to the center of each hole.

Over all length of finished flute. Approx 12 inches. The pieces you have cut to length are 13 inches for now. If you pay attention, you will have some extra length left over on the South End of the flute. You will need that extra when tuning. Some of it will be cut or sanded off to make the flute shorter distance from the rear of the TSH to the end of the flute. Cross that bridge when we come to it later. More than likely, the distance will finally be 9.25 in +/ -

Missing a few numbers…like the size of the TSH? And the size of the holes? I hesitate to go ahead and give that to you, because I do not want you to just measure out and cut and drill stuff just because the diagram said so.

Something that new flute makers just refuse to learn on their first flutes, is that getting measurements off a blue print will not guarantee the end result will be a working flute. A flute is an experiment in physics and variables. No two flutes will turn out the same. No two flutes will sound exactly the same. Try as you may to be exacting, there will always be some little difference in the way you cut, sawed, sanded, chiseled, or finished every mm of your project.

A true craftsman of flutes will eventually learn from experience how to adjust each variable of a project so that the sum of all the parts of the flute work as they are expected to.

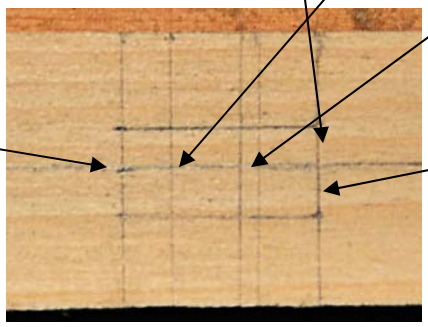
So many beginners rush to the end for completion, and produce a non working piece. They are angry, frustrated, and blame the blue print and measurements, but some where they missed an important and sometimes very crucial step.

What I have illustrated so far, is a way to get you safely to a point where you have a solid non air leaking bottom to your flute. The next steps will show you how to construct the portion of the flute that gives the character of the sound of the flute. Crafting the sound area is not something to go rough shod over. The more time and detail attention paid to this area, the better the possibility of getting a good sound out of your flute.

Now, that being said, keep the glued up bottom portion handy for measurements, and put the piece you will use for the top of the flute on the bench….with the outer face up.

Get your calipers, calculator, sharp pencil, and 18 in ruler, and determine where the center of the slat used for the top will be measuring from side to side on the narrow side or across the top of the flute.
For now, take time to determine for sure, which side of the top you will use, and which end will fit the best as the top of the flute. One edge of the top piece should be smooth, It is best to make that smooth side meet up flush with the top of one of the edges of the bottom piece. Carefully observe that you do not have much if any hanging over the other side of the top of the flute. If you do, it will throw off the measurement of the sound area being directly in the center of the channel of the body of the flute. Part of your decision for deciding where the sound area will go, will be the configuration of the grain in that area. It is better to try to obtain an area where the wood has consistent straight grain. Some woods will have extra thick heavy wavy grains in some areas. It may cause you problems when carving some of the sharp surfaces needed for the crucial shapes of the TSH area. Look, and plan ahead. You should always consider the final location of parts of a flute in relationship with the grain patterns of the wood.

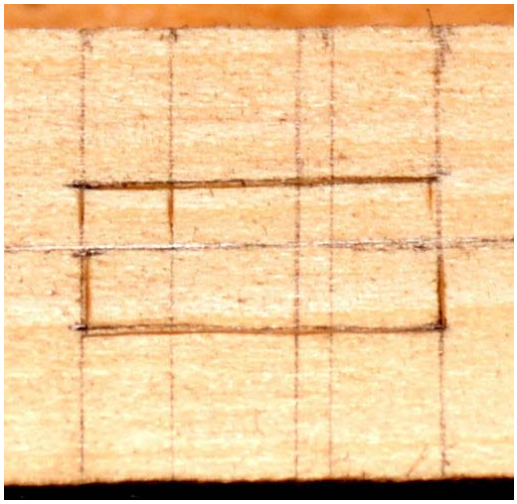
On this project, we will go contrary to regular measurements used, and take a measurement from the North end, or where the blowing end will be. Measure on the center line to the South 2.44 in. Make a small mark. That will be the back or the North End of the escape SAC hole. Measure 2.92 in and place a small mark. That will be the rear of the TSH. Use the calipers and measure 0.17 to the South of that line of the rear of the TSH.
Measure from the line of the TSH back to the North 0.23 in. Mark that as the beginning of the ramp back down into the escape hole of the SAC.



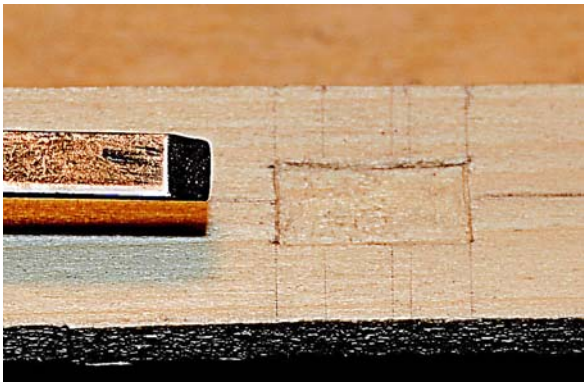
Future cutting edge, do not cut out in any first DEEP cuts. You have to sneak up on it later as you shape the TSH.

Rear of SAC escape hole

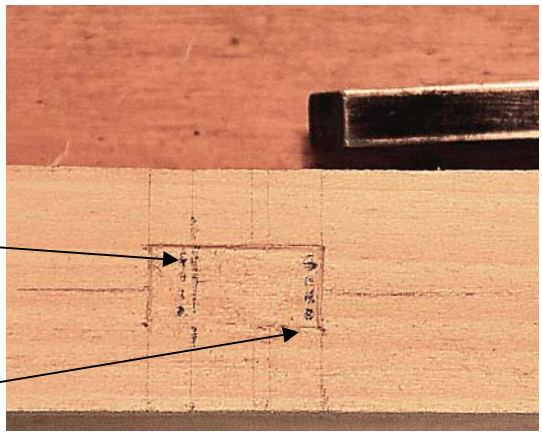
This is delicate work, and sometimes wood and wood grain has a mind of its own. Plan ahead when you make cuts with a knife and a chisel. Pay attention to how the grain of the wood reacts to being cut by the tools.
The goal here is to maintain sharp clean edges that do not have fuzzies of wood splinters sticking up.
Use your chisel edge, or the point of your knife, and dent the wood at each corner insuring that it will cut clean to the square corners. When all corners are dented and cut, then carefully draw as straight a line as possible with the knife edge on all sides of the rectangle.

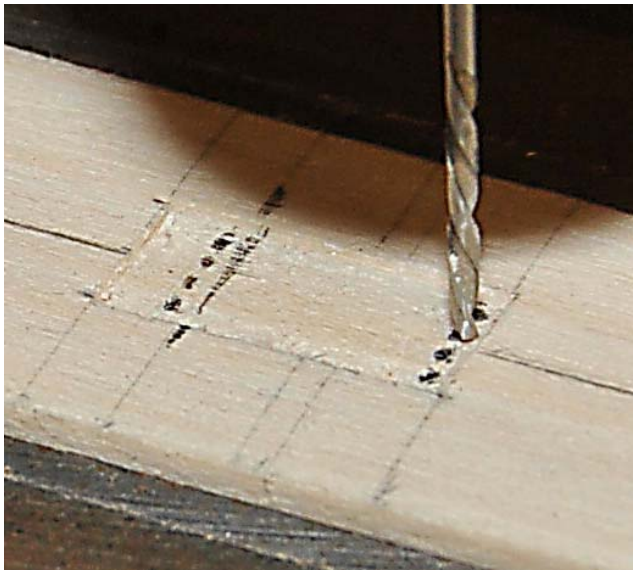


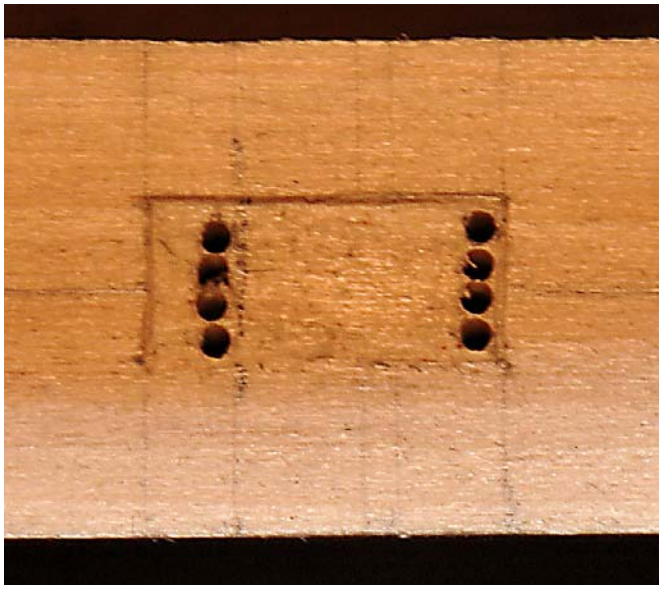
This next step is a bit tricky to do. Personally, if I were a first time maker, I would try this first on some of the scraps left over from the first cuts for practice.
You use the ¼ in flat chisel to start real slow at the point where you have cut into the grain with your knife. You do not go very deep… you give the chisel a slight push, then stop and go from the other end , then from each side. You are not digging a hole through the flute top yet. You are just defining the <u>beginning</u> depth of the sound hole area.



Use a sharp pencil and place a series of dots that will be where fine drill holes will go.
A series of small holes goes right to the South of the line designating the back of the TSH. Another set of holes goes just to the South of the line designating the back side or North side of the escape hole for the SAC.

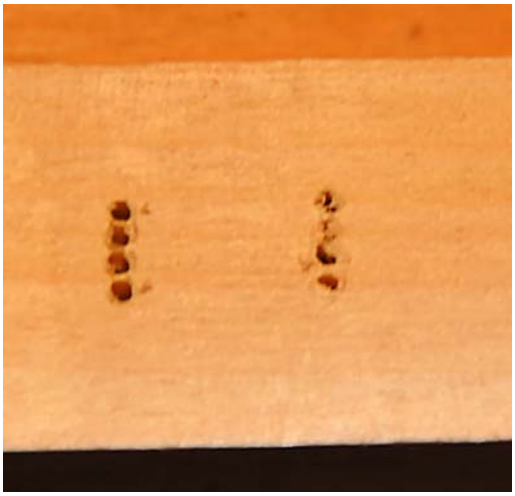






Remember that pack of small fine drill bits from Harbor Freight I suggested? Well, they come in handy about now. You do not want to be using huge 1/16 in drill bits for this part of the project.
These holes are very important as they mark both sides of the flute top for cutting locations. Make sure they are drilled straight through, perpendicular to the surface.

Just in case, turn the wood over and check the other side to see if all the holes are well defined and all the way through.



We will end this chapter at this point.
The next chapter will detail how the sound area is cut into shape.

Go to Chapter 4

How to build
A simple
North American Style Flute

By: Donn Shands

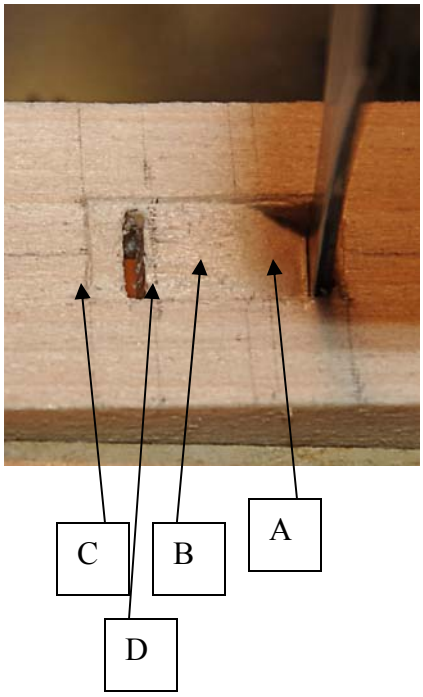
Chapter 4: Crafting the Sound area….continued.

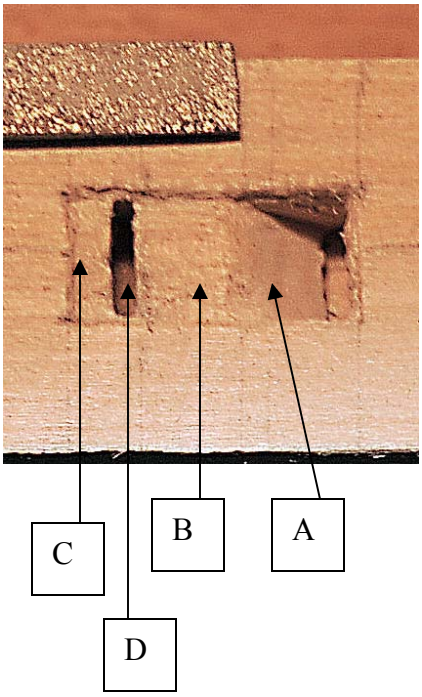
Take a second to reorient yourself to the task at hand. This first photo looks a bit crude, as it should be. (It will be refined later.) It is the top side of the flute sound area. To your right or the North End, you have made the first chisel cut at an angle down toward the bottom of the back wall of the SAC escape hole. Know where you are now?

Now turn the wood over to the underside of the sound area. Start from the bottom of North end and angle down toward the drilled holes. The purpose here is to eventually produce a gentle ramp up and out of the SAC.

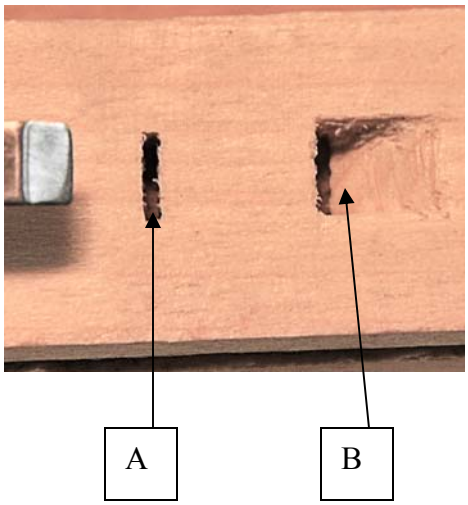
Sometimes it helps matters along if the holes were drilled closer together, and you are able to place the flat side of the chisel to the back wall of the TSH and the back wall of the SAC escape hole. A clean cut through both holes saves a lot of later refinement work.

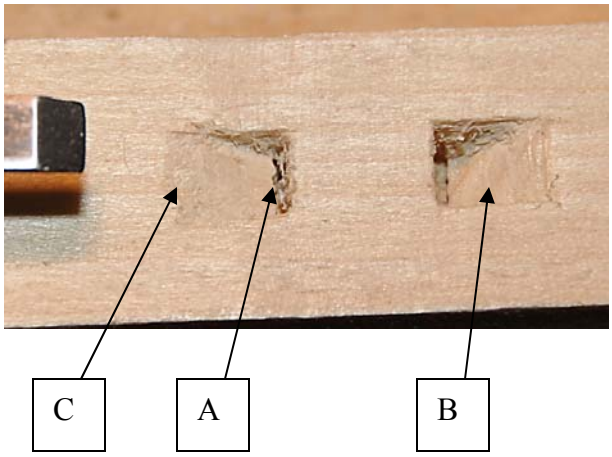
This is not a task where you put the chisel in the hole and just hammer the chisel through. You have to work this area a little bit at a time from each side. If you don't, it will splinter the wood and ruin your project. Keep remembering how grains of wood react to the stress of knives and chisels as you work and apply pressure to each area.





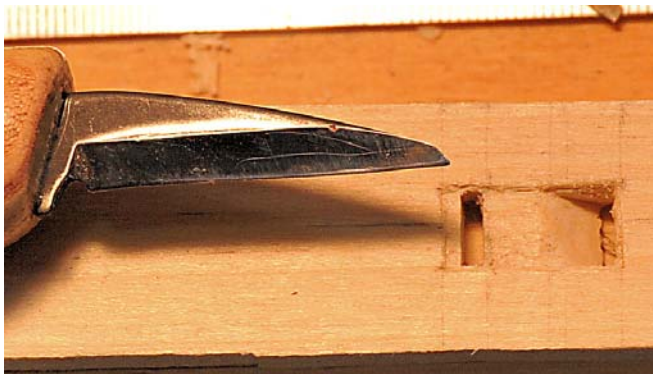
The two photos above show you still working on the top side of the sound area. This area is highly critical as to how you shape the contour of the ramp down into the SAC. (A) Notice the flat area on top (B) . This is where the flow of air from the SAC will travel across, go over the edge of the back of the TSH, and continue on to the splitting edge. (C) Which will be about where the arrow is pointing. Notice (D)….that is the rear wall, or North end of the TSH.



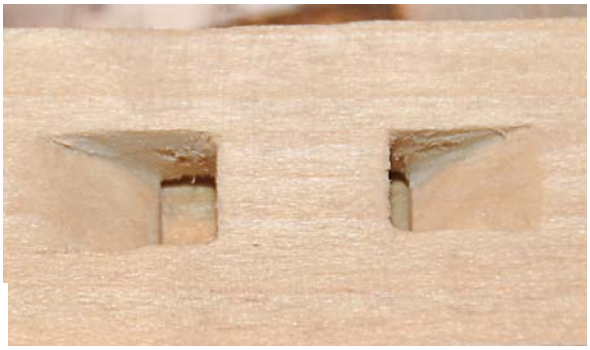


Turn the wood over and work on the bottom side of the sound area. Clean up and smooth the rear of the TSH (A) Clean up and smooth the ramp out of the SAC (B) Keep working the chisel in the area (C) Try to keep the chisel canted so the angle will wind up around 30 degrees if possible. Too much or too little angle and it will make or break the way the flute even works, or sounds.

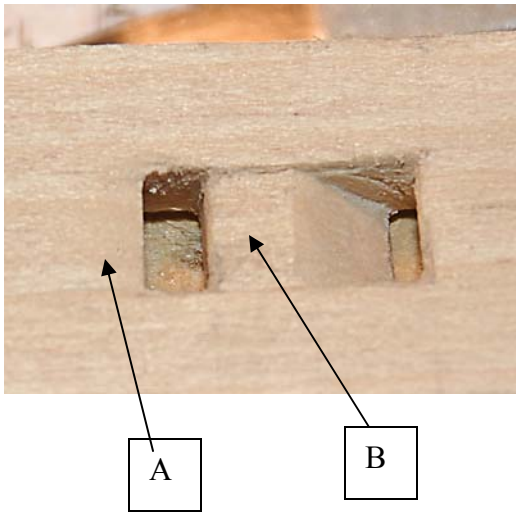
Turn the board over so it is face up again. You have been working on the ramp that slants down into the bore of the flute. Some of the flute makers have called this the labium, or lip. The edge across from the TSH back wall is also sometimes called the splitting edge.
The picture to the right shows the knife getting ready to cut a very small part off this cutting edge. The sharp knife is a precise and quick way to do this. You can use a diamond file to take off the wood, but it is a bit of work. Work both sides of the wood, do not try to finish all on one side. This is part of learning what really is the relationship of the inside and outside of the flute.



On the right you are looking at the bottom side of a completed sound area. The areas are distinct and clean. Air has no fuzzies to catch on and cause ripples.

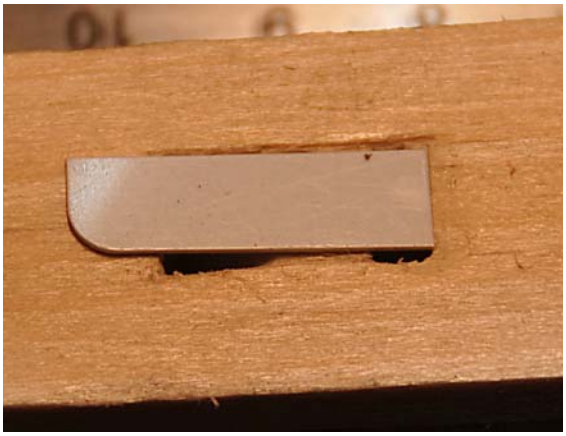


The photo on the right shows the top side of a sound area. Just about finished. Needs a little touch up here and there. The general rule of the width of a TSH is that it is usually ½ the dimension of the cross section of the bore of the flute. Measurements are made in inches expressed as decimals. The approx dimension of this flute is 0.50 times 0.62 = 1.12 divided by 2 = 0.56. Half of that is 0.28. You could go 0.29 or 0.30, but it is better to start with the lower number in case you need to straighten up the edges while final tuning. The gap, or distance between the rear wall of the TSH and the splitting edge. Or from North to South across the TSH…..should be about 0.17 at least to start.
Too much space in this area will create an "airy" flute. Too much; then you might find that tuning is impossible, …..sorry, you will have to rip the top off and start over on a new piece.



A bit hard to see in the photo, but there is a **slight** slant on the top lip of the cutting edge. (A) This is added and is highly important as the actual splitting edge needs to be just slightly lowered so that it is in a place where the flow of air coming off the flue in a laminar sheet of molecules, will hit it directly on. The flat area (B) is the actual flue of the sound area. Much controversy by flute craftsmen is raised about this area and dimension. Some want it longer, some want it no less than ¼ long in size, but all want the area to be at least as wide as the TSH. If you had a stony bed under a shallow stream of water, and the water flows across it, ripples will be caused in the water flow. If the same volume of water flows over a smooth surface, there will be little or no ripples on the surface and few if any deviant currents in the flow of water. All these areas where air flow is smooth and the path is direct as possible will not introduce pink or white noise into the notes of the flute.

The picture on the right might have you guessing at first. This is a simple way to see if the depth of the flue is adequate, is it deep enough? Is it in line with the splitting edge? Does the splitting edge need to be lowered or brought up?
Cut a piece of old credit card and place it in the flue. It should touch right to the splitting edge dead center.



1

2

3

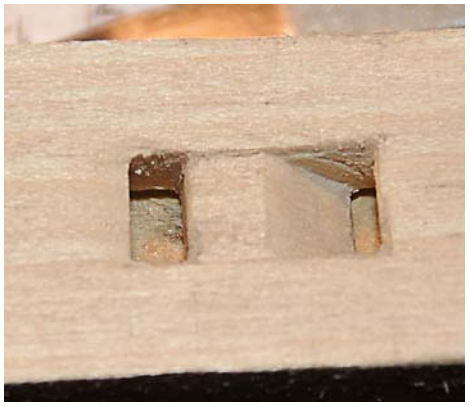
Sorry for the photography on these three photos. Rather hard to get an in focus shot when you are looking down a long length of wood.
What you are looking at is what the TSH looks like at a steep angle from the North or blowing end of the top side of the flute. You are looking over the flue and at the cutting edge on the opposite side of the TSH. Note in (1) that the splitting edge is not straight across. And, the angle underneath is not sharp enough, so you see more wood in the angle. In photo (2), the splitting edge still needs work. Also the surface bed of the flue needs to be smoothed again so it is flat and even directly across the flue. On (3) it is just about right, on the left side under the splitting edge, it needs to be shaved off a bit to make it all straight and even. This interaction of all the crafting in this area can make or break the usability of a flute. Clean, neat, flue not too deep, flue deep enough to allow a good flow of air. Too deep of a flue, then the flute is airy. A flue that is too tight….or not deep enough, will cause too much back pressure. It will be difficult to play and be expressive.

For now, we will close this chapter.
The next chapter will show the steps needed before you glue the top on the flute.
Go to Chapter 5.

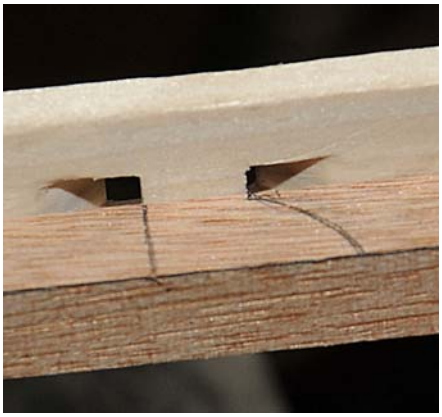
How to build
A simple
North American Style Flute

By: Donn Shands

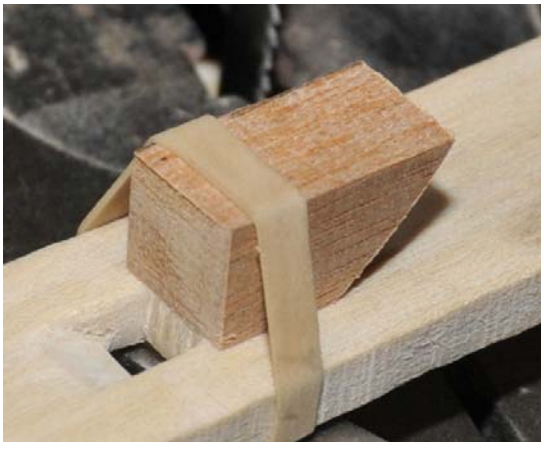
Chapter 5: Crafting the Sound area….continued.
Adding the divider block and top glue-up.



The top of the flute is almost ready for glue up, but there is a very important part that still needs to be cut, fitted, and placed correctly inside of the flute chamber.



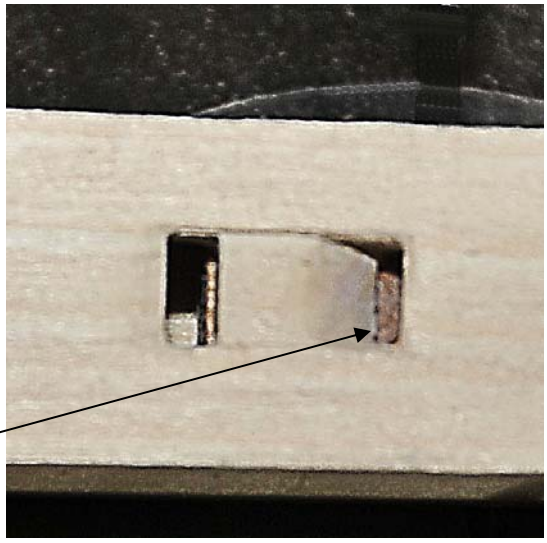
The first step is to measure and cut a piece of the ½ inch square dowel to make the divider block. First line is drawn square across the dowel. This line meets exactly to rear wall of TSH opening in top piece of flute. Draw the second line so that it continues and completes the arc of the ramp going out of the SAC and toward the flue.



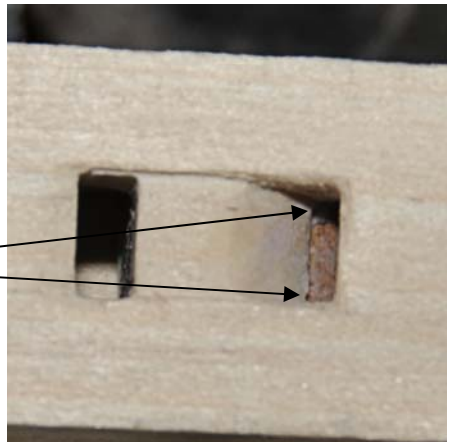
The picture above shows the shaped block in place. This is only for illustration to show the relative position of what the underside of the top and the divider block looks like when in place

This picture shows the divider block from the back side. As with the previous picture, this is only an illustration to show what the area should look like.

The step of inserting the sound block divider is a slight test of dexterity, and patience.
Before applying any glue, test the position of the sound area divider block. Seat the top making sure the North or blowing end is flush with the bottom U channel. Sight down directly into the TSH and use a flat file or a tool that will help move the block so it is even with the top hole so that the rear of the TSH is one flat continuous wall. The picture on the right shows the block needing to be moved back slightly. What might happen after moving, is the rear edge of the top of the ramp of the block going back down into the SAC will have moved back a bit. Sight down into the hole and use a sharp pencil and mark a line showing the excess. Remove the block and sand the excess off keeping the arc of the ramp. Replace the block



Looking down into the holes, the TSH rear wall is flush even, and the ramp is smooth and continuous.
If you have a problem with the rear ramp being one even smooth ramp without a gap, you can use a dab of Elmers Wood putty along the line where the top ramp meets the beginning of the ramp on the block. Wait to do this until you are finally ready to glue on the top. A wet cotton tip applicator can be inserted into the hole and the gap smoothed over .

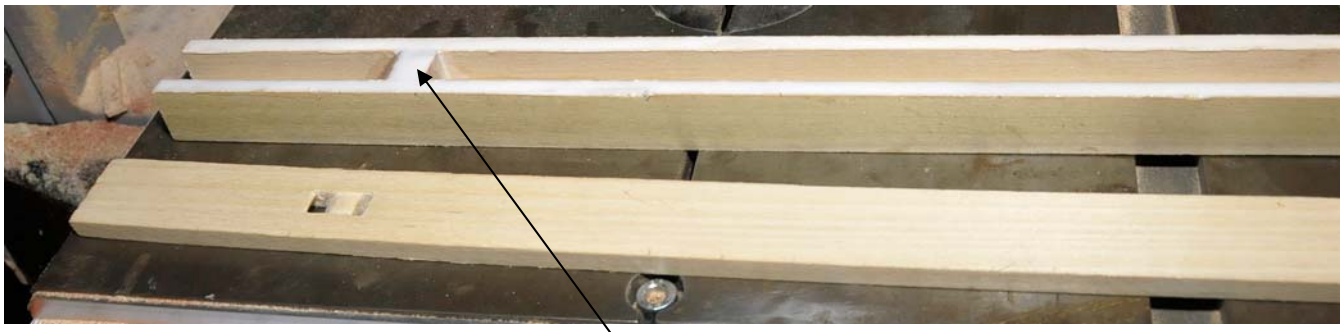


Remove only the top at this time
Put a pencil mark where the rear wall or face of the divider block should be. Remove the divider block and apply glue and reinsert to exactly the same spot. This is a good time to take a cotton tip applicator and add some extra glue around all the cracks of the block. While you are at it, check the rest of the open chamber to see if any cracks are left without glue in them. Use a couple of cotton tip applicators dipped in water to smooth the glue. Finally use a wet paper towel and remove any excess glue. All seams should be smooth and cracks sealed.

It is time to glue on the top of the flute.
Break off a couple sheets of paper towel. A bit of water in a cup. Have your clamps ready.

Remember all the trouble we spent to make sure that the top rails of the bottom of the flute were smooth and even? That trouble pays off now by providing smooth even seams during glue up.

Apply a bead of glue down both of the edges of the bottom section of the flute. Note the gaps in the glue.



Use your finger tip to smooth down the beads of glue so there are no gaps along the edges. Add glue to the bridge across the top of the sound area block. (As noted earlier above, this is a good time to add that small gob of wood putty in the gap of the top and the sound area block where it goes down into the SAC. Remember to smooth as needed.) Wipe any excess glue on the edges inside the chamber of the flute. Carefully seat the top on the bottom part of the flute.

Sight down the sound area holes and make sure the top is aligned again properly with the edges of the block. Use a wet cotton tip applicator and reach in the sound block area holes and make sure there is no excess glue, and the rear ramp is smooth. Secure the rear or North end of the flute with a clamp. I prefer the flat articulating face plastic clamps. To start with, use one clamp and clamp above and below. Go to the South end and do the same.
Now place a clamp in the center. Take time now to inspect the edges of the top of the flute where it meets the bottom of the flute. Add any glue if needed, wipe off excess with wet paper towel. Repeat the inspection on the second side. Use a small round dowel and a wet rag to swab any excess glue from the interior of the SAC and the main bore of the flute.
Where the end clamps are located, rotate them around so each is facing direct on to the ends of the flute. Move the clamp in the center slightly over to one edge, and apply another clamp directly opposite. Add more clamps opposite each other where space is available.
Allow the glue to set over night at least.

Please continue by going to Chapter 6

How to build
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North American Style Flute

By: Donn Shands

Chapter : 6 After the top is glued on, what is next?

To the new impatient craftsperson, they would hustle to get the clamps off the next day and find a small block of wood to make a makeshift totem or bird and try testing the flute. If they did so, they may or may not get a sound out of the flute.
Which of course is a bit of frustration.
Most of the time after pulling the clamps off, there are several reasons why the sound, if any, is noway near correct and the unfortunate result comes from several factors.
Usually, just grabbing a block of wood to use as a totem will not be what is needed in size and edge surface at the TSH. The flute itself may be longer or shorter in the bore than the proper match for the size and construction of the TSH. Then there is the possibility that there are air leaks in the seams of the flute, or through pin holes or knots in the wood.
The first thing to do is to test the flute for air leaks.
Put a finger over the TSH to seal and blow in the South end of the bore. It should be air tight.
Turn the flute around and put a finger solid down on the SAC escape hole and blow in the North or blowing end. That area should be air tight. If not, then track down and seal the leaks.

It is better at this time to construct a simple bird or totem to use with the flute being crafted. Eventually, you will learn how to make many different totems to match different flutes. Totems are made in many different configurations. You will eventually learn a good rule of thumb that for every flute, a totem that is specifically matched to that flute is the best insurance of the flute playing properly. Just grabbing another totem off another flute is not always the best answer.
Some totems are just flat blocks of wood to cover the sound hole area and allow the air to pass in the flue under the smooth surface of the bird. Depending on the construction of the flute, some birds have the flue underneath the bird. Other flutes have the flue in the top surface of the flute and the bottom of the bird is smooth.
The basic classification is that those flutes with the flue in the bird are called Plains Flutes, while the other flutes are called Woodlands type flutes.
For reference, our project at hand has a flue in the body of the flute, and any bird or totem to be used with the flute will have a smooth bottom.

Some flutes can play with a simple piece of wood to cap over the flue area, and the front edge sit right on the edge of the back wall of the TSH. The perpendicular edge is anywhere from ¼ inch to possibly 1 inch high. Sometimes that front wall is angled forward about 30 degrees over the TSH. Some times the face of the wall takes on the shape of an alcove, or a hood that covers the TSH, but is open to the front or South end.

Other flutes require totems with little sphinx legs out front. The little legs guard the sides of the TSH and usually extend from the rear wall of the TSH to the edge of the splitting edge. The height of these legs varies from about ¼ in to higher up to even an inch… The little legs form what is known as a flute chimney. Some totems are crafted whole as one unit with a carved effigy or totem figure on the top part, some glue an effigy on the totem base.
In any case, the totem block is usually held down by leather lacing that binds it to the top of the flute over the sound hole area. If not seated properly so the air is channeled across the flue and directed to the splitting edge, then there is no possibility of a note being played.

Personally, I use a simple ¼ inch piece of the poplar wood that is almost as wide as the body of the flute, and about 2 ½ inches long. Each crafts person will eventually gravitate to making a bird or totem which they will find to work, be simple to make, and will be an expression of themselves and their handiwork. The pictures shown are my simple totem or bird that I use. For some reason, I have found the little sphinx legs for a chimney work best for me. You and many teachers may have your's and their personal designs that are preferred.
Remember that no two flutes ever come out exactly alike. When a person begins to design other flutes from scratch, then a whole lot of new variables come into play. Your new design just may require a very different configuration of a totem or bird to make the flute play properly.
For now, I happen to know that the configuration I will show you will work, and suggest you use it. You do not have to get fancy with all the carving. Just put the little sphinx legs out front, and make sure the bottom of the totem is smooth and is wide and long enough to adequately cover the flue and sound area.
To save time putting the totem on and taking it off for testing and further finishing the flute, just use a rubber band and twist it on a couple or three times until secure.

To the right is my simple design of a totem or bird. The easiest way is to just cut the rectangular block out. Then measure out the distance across the TSH and the depth needed to cover each side. Make sure you have enough length to cover the SAC escape hole and enough surface area to cover both sides of the entire flue .I use the Dremel ½ inch sander drum to carve the piece into shape. Make sure you use a leather glove to hold the piece when carving.

The picture on the right is just an illustration of using a common block of wood for a temporary totem. Just remember, that the bottom of the totem and the top of the flute must match evenly so that no air escapes out from under the totem, except directly forward via the flue. If in question, hold the assembly up to a light and no light should be showing through under the totem clamped in place. Sand the bottom of the totem on a flat block to adjust if necessary.

In the next chapter, we will discuss options of what to do next…..most would say sand the flute down…nope…not just yet.

Please go to Chapter 7

How to build
A simple
North American Style Flute

By: Donn Shands

Chapter : 7

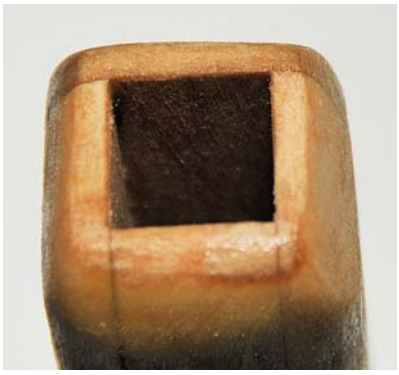
The flute now has a totem attached. Now what?

At this point, there is always the desire to stop any useful crafting, and start sanding down and shaping the flute, and prepping it for decorations.
The most important rule a flute maker should learn to live by is that you make steps at crafting a project in a proper sequence. There are many more steps to go through in shaping this flute that we have come so far with. If we get ahead of ourselves in the chain of sequences, and spend all that time and effort, then by some fluke, make a drastic mistake that cannot be corrected…..and it can happen….then you have wasted a whole bunch of time for nothing. Your intention is to carefully craft a personal project that will be able to play music, and be a functional usable instrument. You will have plenty of time later to decorate and refine your masterpiece. "Wall Hanger", is a taboo word for a true flute craftsman…..

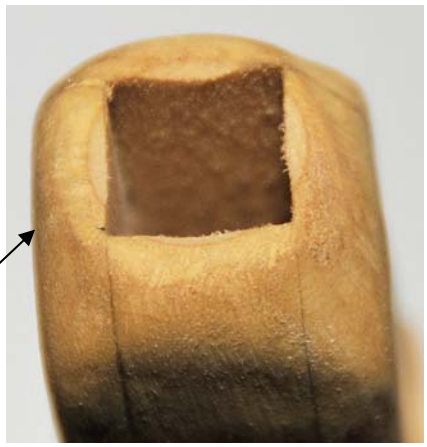
For now, lets determine some of the basics of the construction of the flute.

Don't want to confuse you, but the picture at the right, because the flute was constructed square, could be the blowing end or the South end of the flute. The shape is not refined.

Shown at the right is the South end of the flute when shaped. Notice that the inside edges are kept straight.
Now….before you get hasty….**don't spend time shaping this just yet.** There are many more steps before you get to this step.
The next picture will have a bearing of how the blowing end of the flute will be crafted.

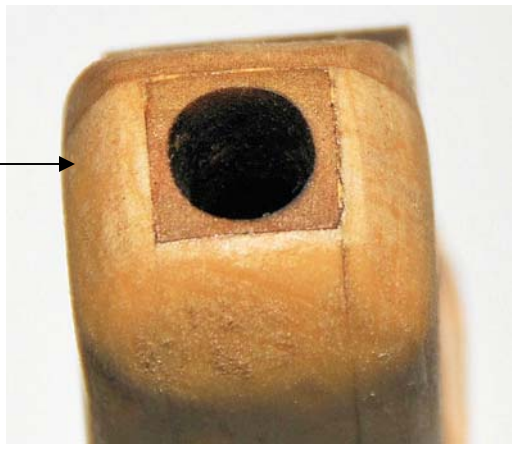


These are some of the ways to form a mouth piece or blowing end of your flute.

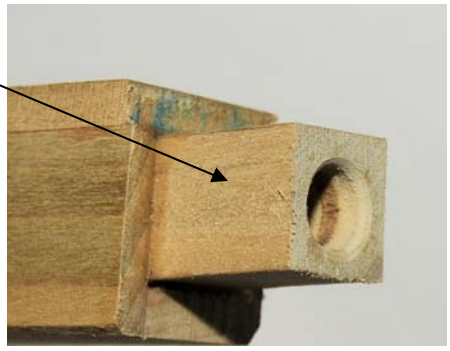


You can just leave it square and round it off.

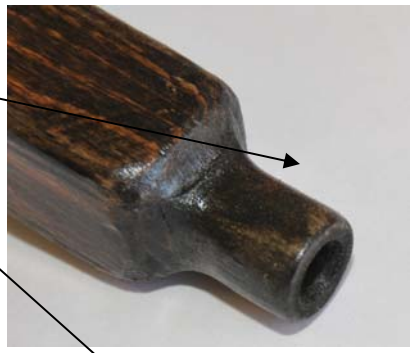
You can get a piece of the square dowel and drill or burn a hole in the center and insert the plug into the end and sand smooth.



Or you can make the mouth tube longer and insert and glue it in.



The two examples shown were sanded smooth with the Dremel ½ inch and ¼ in sanding drums.



So, before you decide to continue with the next step of tuning, make up your mind what type of blowing mouth piece you want.
Should you consider the use of the square dowel, then you must use a drill press, a drill press vice, and a forester bit to cut the hole. You could use a conventional fine drill for a pilot hole, and use burning rods to make the hole. The use of burning rods however comes later in another chapter. Do not insert the plug in the hole then try to drill it out. It must be done outside the flute then inserted. (Trust me, it may take you several tries depending on your skill to get the hole dead center in the dowel.) Do not be stupid and even try to use gloves to hold the plug in your hand while trying to drill or burn through it. It is just unsafe and don't even consider it. This is not a Darwin Club work shop.

By the way…remember, do not attempt to refine the South end of the flute just yet. Crafting of that end will be detailed in the next chapter.

Please go to Chapter 8

How to build
A simple
North American Style Flute

By: Donn Shands

Chapter : 8 Take time to learn some things about necessary tools and accessories that you will need to complete the next step.

I am sure some of you might be tempted to skip over this chapter.
If this is the first time you are going through this How To Manual, then do yourself a favor and take time to read the chapter. Just by happenstance, you might learn something you can use in the future and might do a better job finishing your flute.

Granted, there were some tools discussed in Chapter 1, but at this stage of building this flute, there are some specialized tools that are just not easy to obtain. Even after obtaining them, it will take some extra work to understand how to use them.

We will start with the burning rods.

Fellow flute enthusiast, Mike Jones taught me how to make my own set of burning rods. At the top right is his set. Believe me, that set has seen a lot of miles of use. While Mike's main interest is crafting bamboo flutes, the techniques he taught me were immediately transferable to the crafting of branch flutes. Many of his tools and methods are described in this How To Manual.

The set on the right is my personal set. Mike had a few left over lengths of sizes of the steel rods, and I purchased the rest. This is a good afternoon project to assemble. This is only a length of round dowel cut to make the handles, A few steel washers to dress up the appearance. And some glue.
Remember to buy only cold steel. Do not attempt to use aluminum, copper, brass, or a soft metal. Lowes or Home Depot have the rods available in a bin of several sizes. The sizes needed are listed below.

These two are flat steel bars
0.499 by 0.123 inch. The tips of these are ground down to use to burn in TSH on bamboo flutes. Can be used on wood, but causes too much over burn.

This one is, 0.185 inch

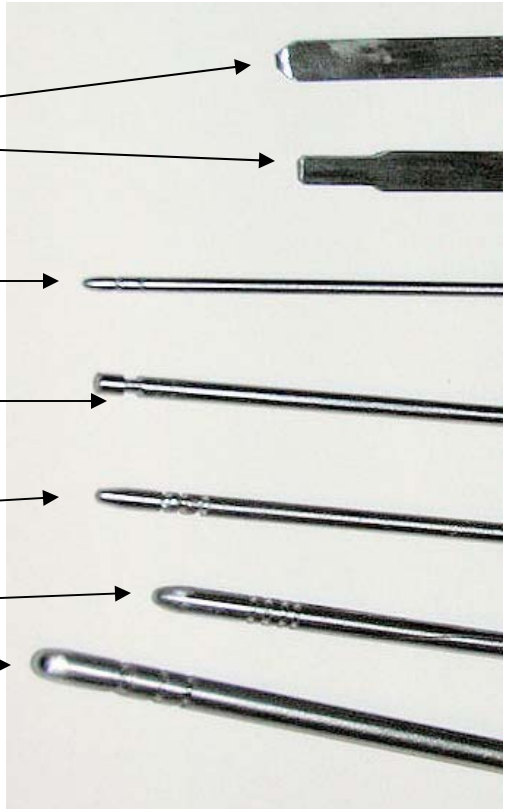
This one is 0.247 inch and has an inverted tip to help with getting under the edge of sound holes.

This one is 0.247 inch and used for just regular round holes.

This one is 0.317 inch

This one is 0.374 inch

Not shown is a really fine one 0.122 inch
Used for small bore flutes needing very small sound holes.



The best way to purchase the rods is to go in with another person when buying the lengths of steel from the hardware store. Each bulk rod will probably make two to three of the same size burning rod.
Use a grinder with proper eye and hand protection. Fine finish with a sanding disk.
If you are wondering why there are ridges on some rods, in some wild theory, they are supposed to help with heat dispersion.
When building the flute featured in this manual, you will only use 0.185, 0.247, and 0.317 size burning rods.
In reality, burning rods can be made out of old drill bits, old steel screwdrivers, even old steel bolts, ground down or otherwise. Just try to get something long enough so the heat can be kept at a distance from the wood handle.
There are ready made burning rods available for purchase, but usually they only come in two sizes at most. Do a search on the internet if you are interested. Remember, once you construct this set, you will use it for life. It is a great investment for your work bench.

What's this?

At my senior age, the hands are not always steady when trying to hit the mark with a red hot burning rod. By chance, I was at Harbor Freight and ran across a set of shim tools used to help remove window handles in automobiles. The shape was exactly what I was needing without having to cut, grind, bend and invent my own. With the flute held down securely, you have one hand holding the burning rod, the other positioning the rod in the V near the tip, to accurately guide the tip to the spot marked to burn the sound hole. Cork was added to one of the tools on the bottom surface. It is handy for use with round surfaces, especially bamboo. The cork helps to not mar the wood, and also helps to keep the tool from sliding over the surface.

One thing for sure, if it is not already invented or available at the local store, the garage shop hobbyist will create it out of self defense to make life easier. Shown in the picture, is my set of holders for the burning rods. It was made out of a 2 by 4. Purchase a length of steel conduit, ¾ inch. Measure the length of your burning rods and find the one with the longest length of the exposed steel portion. Use that measurement to cut as many equal pieces of conduit tube. When hot burning rods are returned to their holders, you will want them completely covered in the safety of the conduit tube and not being able to come in contact with another surface. Mark off an adequate distance of space between centers to allow rods to sit next to each other. Drill a forester bit hole that is the same size as the conduit. Insert the cut lengths of conduit. Good idea to put a little glue in the hole with the pipe. A couple of long lag bolts will hold the new rack to your work bench and you are set.

In case you forgot, that orange thing is a safety push stick to use when dealing with your band saw. (Sold at Harbor Freight.)

Of course, you will need something to heat the burning rods. You can use a camping stove running off propane. Or, you can use a portable bottle of propane with an attached regulator. Or, you can use one of those larger propane tanks, like the one on your BBQ grill, add a length of extension tubing, and then use the regulator on the end. Attach the regulator and tube assembly to the side of your work bench in a safe location. Note the great engineering of tape attaching the assembly to a 1 by 2 that was tie wrapped to the leg of the work bench. Hey, it was cheap…and solved the problem.

Note the flame spreader that is attached to each of the regulators shown. There is a very good chance you will not find that flame spreader at your local Lowe's or Home Depot. I had to go to a local small hardware store like Ace to obtain the spreader. The spreader helps to heat the burning rods a lot faster than just the straight flame.

If you check some of the files on the flute forums, you will find some really clever setups of the propane burners. Some are crafted to provide holding devices for the rods that are being heated.

I was gently reminded by my proof reader, who was a safety engineer at a company where she worked, that I was forgetting to mention a highly important safety item for the workshop. The portable fire extinguisher.
In fact, a couple of these in strategic areas might be an even better idea.
Take time to review the way you use open flames in the work shop. Secure flammable liquids, and items that are readily combustible in a separate area, or a safe distance from any use of open flames. The extinguisher should be right within reach in the area where you are using your propane setup for the burning rods.

It was requested to provide a bit more detailed explanation of how the burning rods were constructed, so a **SUB** Chapter has been added. **Chapter 8 a**, which is included with the rest of these chapters.

Shown on the right are sets of our in shop, constructed hand tools that were created out of necessity. While the orange stone shown in the center of the bottom picture is used most of the time in a Dremel chuck, (as shown below) having one in the hand tool set has its place. So, how and what are these tools used for? When a playing hole, (or a tuning hole) is drilled, or burned into a flute, it is sometimes necessary to smooth out the sides, and also chamfer the rim of the hole to take the sharpness off the edge. Doing so, helps to allow the player to better seal off the hole, or slide or bend notes while playing.

This is actually an orange cone stone chucked up in Mike's Foredom extension hand piece. Often this stone is used to help open a hole slightly to raise the note a few cents.

The two stones shown on the right are the ones most used for the final smoothing of the rim of the playing holes.
All the stones shown above and here are mounted on either 1/8 in shanks, or ¼ in shanks. The ¼ in shanks will not fit in some Foredom chucks, and for sure, not in Dremel chucks. They will fit in Master Carver Stealth Handles. We decided because these stones were only needed for short term use, it was much easier to just mount them in wooden handles for use.

Once again, the shop worker had to improvise. We used pieces of wooden dowels for handles. At the local Hobby Lobby, we found the round balls that just conveniently fit the palm of your hand comfortably, and we used them for handles. This set will join the other hand made tools in your shop as life time companions.

I have been requested to write an expanded description of the stone tools and how they are made, so, a **SUB** Chapter has been added. **Chapter 8b** is included with the rest of these chapters.

In case you were wondering, I have no affiliation with the businesses I mention as sources. Harbor Freight only recently opened up retail stores in our area, and across the USA. For those of us that want to acquire tools and accessories for our workshops, Harbor Freight provided on a local level a source for items that were a good step above the quality of cheap dollar store tools, and a fair quality tool that was far more reasonable than what was being sold at Lowes, Home Depot, and Sears. Those craftspeople that progress in their skills will eventually go on and purchase their more precision tools for their shop, such as band saws and drill presses. They will shop for a brand name tool with more accepted precision and reliability. A workshop with a full compliment of tools does not just come into existence over night.

I will attempt to briefly discuss the needs for computers and computer programs that are used by a great deal of flute craftspeople in their crafting work.
There are several methods of determining the positions and locations of where components of a flute should go while being constructed. Some of the methods are much easier when assisted by computer programs. The most basic method, the "grandfather method," while sometimes being adequate, and not in need of computer assistance, will not be exact enough to keep a beginner out of making mistakes during construction. Each of the tuning processes have their individual merits, no one of the methods is "The Way" to construct a flute.
There are many ways to be assisted to find out what frequencies are being played for each test of a note for a finger sound hole. Get a room full of flute people, and each will claim they have the best way. We will suggest a few.

The first vital tool that is needed is a tool to identify what frequency is being played while in the process of tuning a flute.
Not everyone has perfect pitch or the perfect ear for a frequency of sound. There are some that can play a note and tell you almost to the cent what the frequency is that was played.
The rest of us need help.
We are in the age of electronics and that rest of us have to depend on electronic precision instruments to determine sound frequency.

Once again, you get 20 flute crafters in a room and ask what they use for tuning, and you will pretty much get 20 separate answers.
You could use an electronic self contained tuner usually something like a Korg tuner with a digital display. It has a built in microphone and reads out the frequency, shows the note being played, and whether or not that note was being played plus or minus increments in Cents. The unit is accurate and portable.
I found out the hard way that the cheaper guitar tuners with just red and green
LED lights for indicators are not accurate enough for fine tuning North American Style flutes.
I was introduced to two important software programs that run on standard Microsoft computers. They do have the software for the Apple computers, but you may have to research the source.
Most flute crafters do not have access to a second portable computer. However, having an old retired lap top that can be dedicated to the workshop is the best solution. The main thing is that the lap top will need to have a working sound card, be able to attach a microphone, and have a CD/DVD drive. Having wireless to connect to the internet is a plus.

Korg Tuner, just one of many models.

A very simple and easy computer program that is a free download off the internet is, "The Auto Tuner," previously known as Shakuhachi Tuner, or **Syaku8.exe**
http://www1.ocn.ne.jp/~tuner/tuner_e.html will take you to the web page. Scroll down and download off the link for "Sound color analyzer and Tuner for Shakuhachi."
This will be a .zip file, so you will need a program to open a zip file if you do not have one.
After installing the program, you will need to click on Options and do a check on your sound card.
As mentioned earlier, you will have to have a microphone attached to the computer, going to your sound card input. You might have to go into your control panel and check the input levels.
On the program, select "Flute" for the instrument.
Use a flute, and blow a note. The note will register on the computer screen and show you the letter of the note played, and the frequency of that note.

We are very fortunate to have a few individuals that have graciously made soft ware programs available for North American Style Flute builders. Pete Kosel was the author of the original Flutomat program. Edward Kort helped to improve the program by an addition of a web interface. Clint Goss is noted as a contact for more information.
The original concept of putting the program together was based on information gleaned from some books written by Lew Paxton Price.
For a more concise and correct explanation of this history, please go directly to the FluteKey website.
The address for this information is found available at:
http://www.flutekey.com/htm/naflutomat.htm The complete program is available for use at this address. The most recent up-grade of the program is always available at this link.

What most people overlook is that not only is the web page interactive, but it has a very thorough, "Easy Walk Through Explanation", included by courtesy of Edward Kort.

What did we say about all those impatient people? They never stop to read the instructions.

Thank you Ed, eventually the rookies will wake up and go back in and read the operator's manual. ☺

So, it might be wise if you go ahead and down load the two mentioned programs to your computer. Take some time getting acquainted with how they run. It might help avoid some frustration later when you are actively into the actual tuning process.

It was requested to write an expanded description of different methods of flute measurements, and how to determine locations of playing holes. so, a **SUB** Chapter has been added. **Chapter 8 c**, which is included with the rest of these chapters. Chapter 8c was written by Mike Jones.

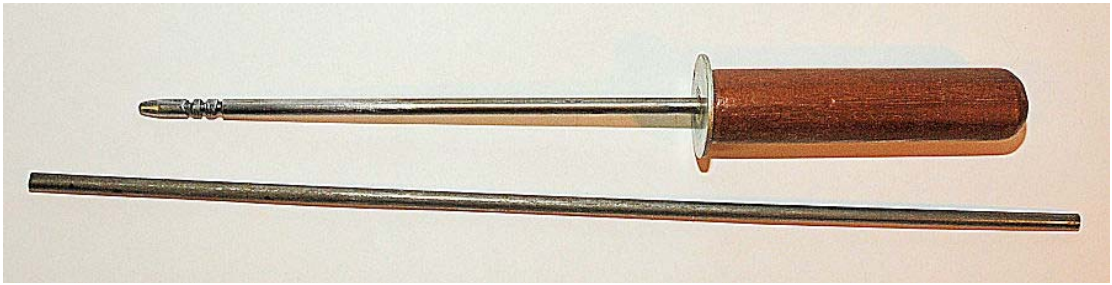
Please go to Chapter 9

How to build
A simple
North American Style Flute

By: Donn Shands

SUB Chapter 8a: Detailed explanation of crafting a burning rod

Chapter 8 gives the main sources of the materials for making burning rods.
It was requested to give a bit more detailed explanation of how the burning rods were made from scratch.

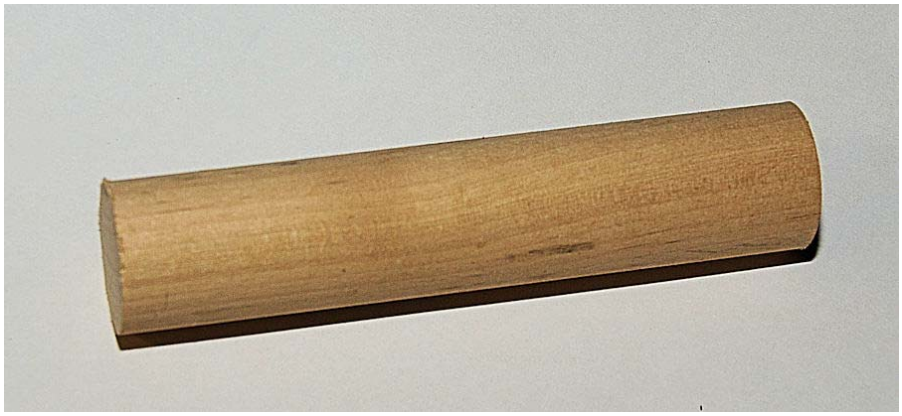


At the top is a previously completed burning rod.
Below it is a piece of raw cold steel. In this case, this piece was left over from making a couple of the same size burning rods as above.
Measure and mark off approx 9 inches of length on this blank rod.
Use a hack saw and the proper safety protection items and cut the rod down to the 9 inch size.

Take a little time and use a metal file and place scoring marks on one end of the blank burning rod. Later when you insert this end into the handle with glue, the scores will help hold the rod in the handle more firmly.

Put all your safety gear on, eye protection, and gloves before attempting using the disk sander. Remember, the disk sander rotates counter clockwise. Always do your sanding on the left side of the center of the wheel. Never go to the right side. Hold the rod at an angle and twirl it evenly to obtain a rounded point.

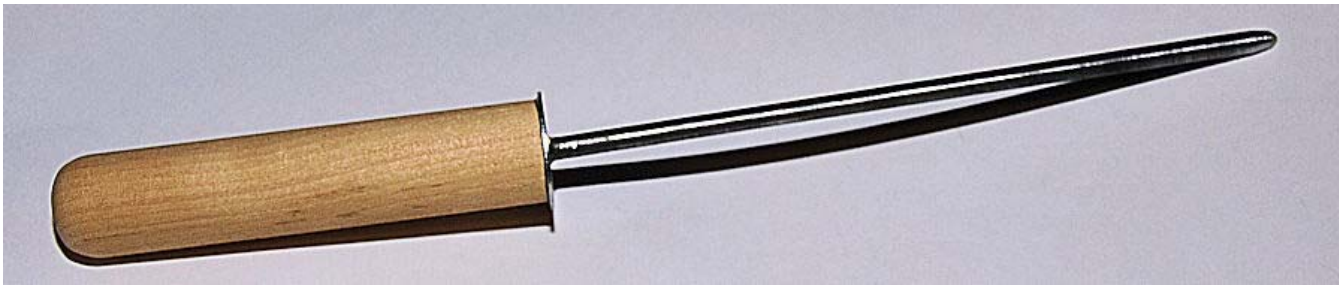
Usually sandpaper will help to smooth out the roughness and provide you with a nice smooth rounded end tip.
For this rod, I did not include the additional rings near the tip.
The rings are only added if you feel that heat dispersion is absolutely necessary. Since these rods are as long as they are physically, heat dispersion rings are not necessary.



The handle is a simple matter of cutting a length of round dowel. Usually 5 inches long is adequate. A diameter of 7/8 inch to 1 inch is comfortable in the hand.

Take a little time and use a rasp, or sand paper and round over one end of the handle blank. It just makes handling the burning rod a lot more comfortable.

Being able to drill a hole in the end of the handle that is dead on straight is a bit problematic. You can make a jig that is 90 degrees and up right.
You can mount it on a platform. By holding the dowel in place with a clamp, and drilling into a predetermined center of the dowel, the task is simplified.
This jig just so happened to be a left over piece of plastic that was part of a packing accessory to help prevent damage on a refrigerator during shipping. Sometimes you just find solutions right under your nose.



I found that a bit of epoxy mixed up is the best to hold the rod firmly in the handle. The addition of a fender washer helps to dress up the face where the rod meets the handle. The epoxy will hold the washer on. You can finish off the handle with a little stain and lacquer.

This is the end of SUB Chapter 8a, please return to the main chapters of this series.

How to build
A simple
North American Style Flute

By: Donn Shands

Chapter : 8b Detailed instructions on crafting a hand held stone hole reamer

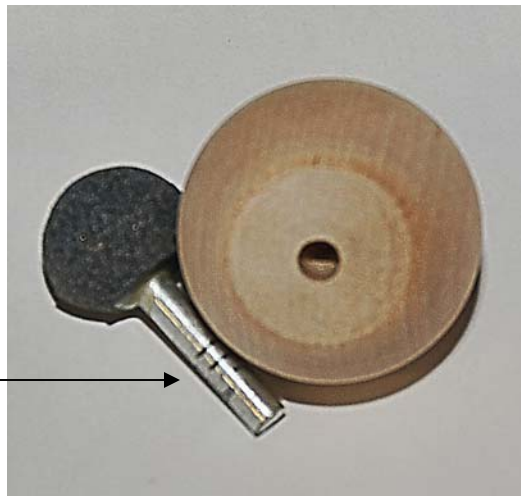
In the main body of Chapter 8, hole reamers were discussed. It was requested to expand on the explanation of how these reamers were crafted.

The stone cones will normally come as a set. They are often on sale at your local Harbor Freight store. They will come in sets of 5 and some sets will have 1/8 in shanks and others will have ¼ inch shanks. Some other cones will be part of your extras in your rotary tool set. For flute making, I have found little use for these stone tips for their usual purpose of grinding metal. Turns out that they seem to do a great job of grinding out and smoothing playing holes on a flute.

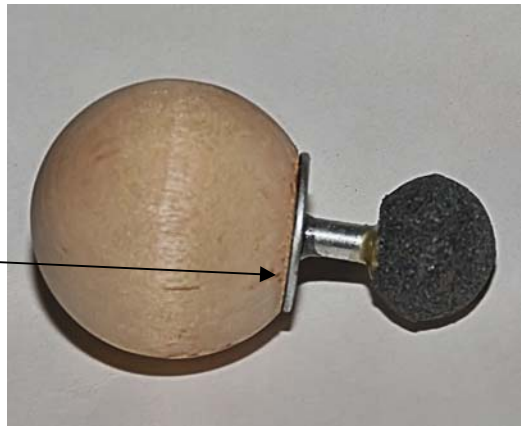
If you read the Sub Chapter 8a on making burning rods, you can apply the same techniques to making dowels into handles and drilling mounting holes.

Shown at the right, is a stone with a ¼ in shank. Along with it in the picture is a pre made ball that has a pre flattened side.

Note that like the burning rod blank, the shank of the stone has ridges cut into it with a file. This will help to hold the shank in the handle when glued with epoxy.



As shown in the burning rod chapter, you can add a fender washer to dress up the contact point.



The round balls are found at Hobby Lobby. They are listed as Ball Knobs 6 to bag…. 1 ¾ inches diameter. 3/16 in pre drilled holes. These have a side sanded off. Item # 165845

The stones in the first picture above, were mounted in completely round balls with no flat surface pre sanded off. The completely round balls do not have pre drilled holes. These are better when mounting the smaller shank stones (1/8 in shank) into a handle.
In the bottom picture of page one on the right side, is an experimental handle of both a flat surface ball and a short piece of dowel. After making many flutes and using these hand reamer stones, we found that the use of the ball handles were a lot kinder on the hands during use.

Eventually, I will build me another set of burning rods and combine the ball on the end, and a short length of dowel for finger rest. The addition of the ball helps to control the rod when twisting it during the burning process.

How to build
A simple
North American Style Flute

By: Donn Shands

Chapter : 8c

Mike Jones' method for using NAFlutomat and tuning finger holes

Note that I use a tuner program on my PC and/or laptop for tuning. These types of programs not only will tell you if you are sharp or flat but how many cents sharp or flat and the actual frequency being played. Most have other features as well and I STRONGLY suggest that you try one out, some are even free! In the instructions below I am assuming you will be using such a program or device that will give you the actual pitch in frequency.

A bullet tip shaped grinding stone is often used to friction burn the holes while fine tuning. When getting close to being in final tune I use the Dremel to round off the upper hole edges to be more comfortable for the players. I also have some other handle mounted cone shaped grindstones to bevel the outside edge of the holes

Below is the Basic procedure I use to tune a Native American style flute. I sometimes use other methods and I have chosen not to go into details dealing about fine tuning cross-fingered notes. Please see Bob Grealish's very well written document on that subject. It can be found in the files section of the Native Flute Woodworking Yahoo group.

1. Launch NAFlutomat (version 37) and make sure that Internet Explorer allows it to run the ActiveX script.

2. Set the playing and tuning temperatures in the computer program, where prompted to.

3. If you only want the finger holes tuning (pitch not placement) info, skip to step number 8

4. Set the bore diameter, use an average if it is not consistent or approximate, or if it is not perfectly round. You want to use the diameter of an equivalent circle with the same cross-sectional area.

5. Measure and set the East-West width of the TSH, and then the North-South length of the TSH

6. Set the wall thickness at the TSH

7. Set the Length/Diameter (L/D) ratio you want to use. For 1 1/8" or larger bores, use 18-21; for 3/4-1" bores use 16-18; for 1/2-3/4" bores, use 15-16.

8. Move down to the finger hole section and put in the desired pitch of the flute. Keep in mind that Middle C is 262 Hz, and an A flute is 440 Hz. This will help you pick the correct octave for your flute pitch.

9. If you have a long flute and you want to use tuning/direction holes, turn on that section with the check box. Otherwise skip to step 11.

10. Use a digital tuner to put in the fundamental frequency that the flute is currently playing. Set the size holes you want and the wall thickness and click on “Calculate.”

11. Move back up into the finger hole section, Set the hole 6 wall thickness to whatever your wall thickness is for all the finger holes, and then click on the button at the top of this section to "replicate hole 6 wall thickness" so that all the finger holes are the same.

12. Directly above the button you just clicked on, you will see a box that indicates the minimum playing hole diameter. If the box is empty you need to click on the calculate button. Make a mental note of this diameter.

13. Go to the hole 1 hole diameter and put in a size a little bigger than the minimum hole diameter you made a mental note about. For the typical A and lower flutes I try to stay between 0.25 and 0.4 inches, usually close to 0.3 - 0.35, never less than 0.25. Now put in the minimum size for all 6 finger holes then click on “Calculate.”

14. Look at the column marked Distances between Finger Holes. Calculate a mental average or typical value from the values displayed. Now, adjust the finger hole sizes for holes 2-6 to get most of the distances between finger holes close to the same value. Be sure to click on the Calculate button after each change to see the effect. If you make a finger hole larger, the distance from the previous hole and the one you changed will get smaller and the distance between the changed finger hole and the next higher one will get bigger. Try not to set a finger hole diameter that is smaller than the minimum. Note: a hole somewhat bigger than the minimum is best for hole #1 to give good tone and to make half-holing easier (to sound right the half-hole has to be very close to the minimum size!)

15. Once you are satisfied with the finger hole distances, put a piece of masking tape on the flute to the side of where the finger holes will be put. Mark the distance from the end of the flute to where the tuning/direction holes will go, where hole 1 goes and where hole 6 goes. These are all measured from the foot end of the flute.

16. Now measure the distance between hole 1 and hole 6 and use a calculator to divide it by 5. This is the actual distance to use between finger hole centers. Mark the location on the tape for holes 2-5.

17. At the bottom of the tape, near where the tuning holes will be, write down the playing pitch and the tuning frequency for the fundamental. The frequency for tuning is in the column labeled "tuning frequency" and is already adjusted for the tuning temperature (if you put that in in step #2.) From now on do not concern yourself with the tuning letter or pitch. Only use the frequency.

18. Write the tuning frequencies for holes 1-6 on the tape next to the location of each hole.

19. Now you can put the tuning holes in the flute by drilling or burning. Start smaller than you put in NAFlutomat and gradually enlarge the holes until they are right on the money for the fundamental tuning frequency. NOTE: The fundamental will get slightly flatter after the rest of the finger holes are put in the flute. We will fix it on the 2nd pass.

20 Put in hole #1, smaller than you expect to have it at the end. Enlarge it until it is a little flat of the target frequency.

21. Put in the next finger hole and tune it to be a little more flat than the previous finger hole was. Repeat this for all 6 holes. NOTE: If you see that the finger holes are getting too big or are getting progressively bigger, shift the next finger hole a little higher on the bore. Each following finger hole will have to be moved up the same amount. Repeat this step for each finger hole.

22. Use a dowel (with sandpaper glued to the last 6 inches or so,) to remove any splinters or material hanging in the bore after the finger holes were put in. After all the finger holes have been made in the flute, and the bore checked to be clean and clear of debris, go back and check the fundamental. Tune it to be right on the tuning frequency.

23. Now adjust each finger hole to be very slightly flatter than the previous hole. For example, if the first pass you made them each 7 cents flatter than the previous hole, this time make them about 3 cents flat.

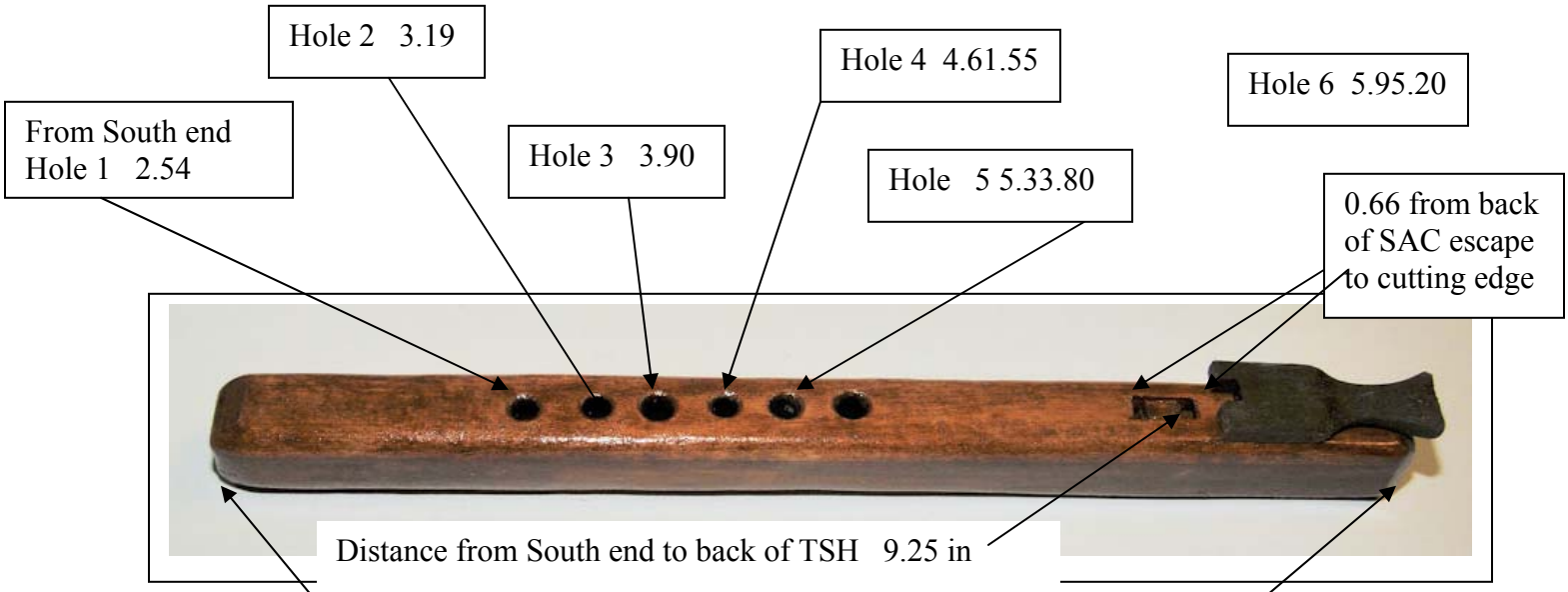
24. Use an Xacto knife, (I prefer the curved carving blade (#28),) to bevel the inside edges of the finger holes. You have to do this in four steps for each hole. Start at 12 O'clock and shave the bevel until 3 o'clock, then start at 12 o'clock and shave the other direction until 9 o'clock. Now start at 6 o'clock and shave until 3 o'clock, then from 6 o'clock until 9 o'clock. You do this in the above 4 steps to prevent splintering. Now bevel the top of each hole the same way or use a Dremel or large cone shaped stone to put a slight bevel where the player's fingers contact the playing hole. You want this edge to be smooth and comfortable for the player. A dowel about the size of a finger with sandpaper wrapped around it can be used on the outside, sanding lightly across the hole in the East-West direction. The finger hole should now have a shape similar to the inside of a donut or bagel. This will help to make the flute responsive and clear toned at each hole.

25. At this point the beveling should have raised the pitch of each hole slightly and they should all be VERY close to the tuning frequency. IF you have to adjust a finger hole to get it closer to being in tune, be sure to touch up the inside and outside beveling. Finish each hole on the outside edge with some 400 - 600 grit sandpaper.

How to build
A simple
North American Style Flute

By: Donn Shands

Chapter 9:



All holes are measured to the center of each hole.

Over all length of finished flute is approx 12 inches. The pieces you have cut to length are 13 inches for now. If you pay attention, you will have some extra length left over on the South End of the flute. You will need that extra when tuning. Some of it will be cut or sanded off to shorten the overall distance from the rear of the TSH to the end of the flute. We will cross that bridge when we come to it later. More than likely, the distance will finally be 9.25 in +/ -

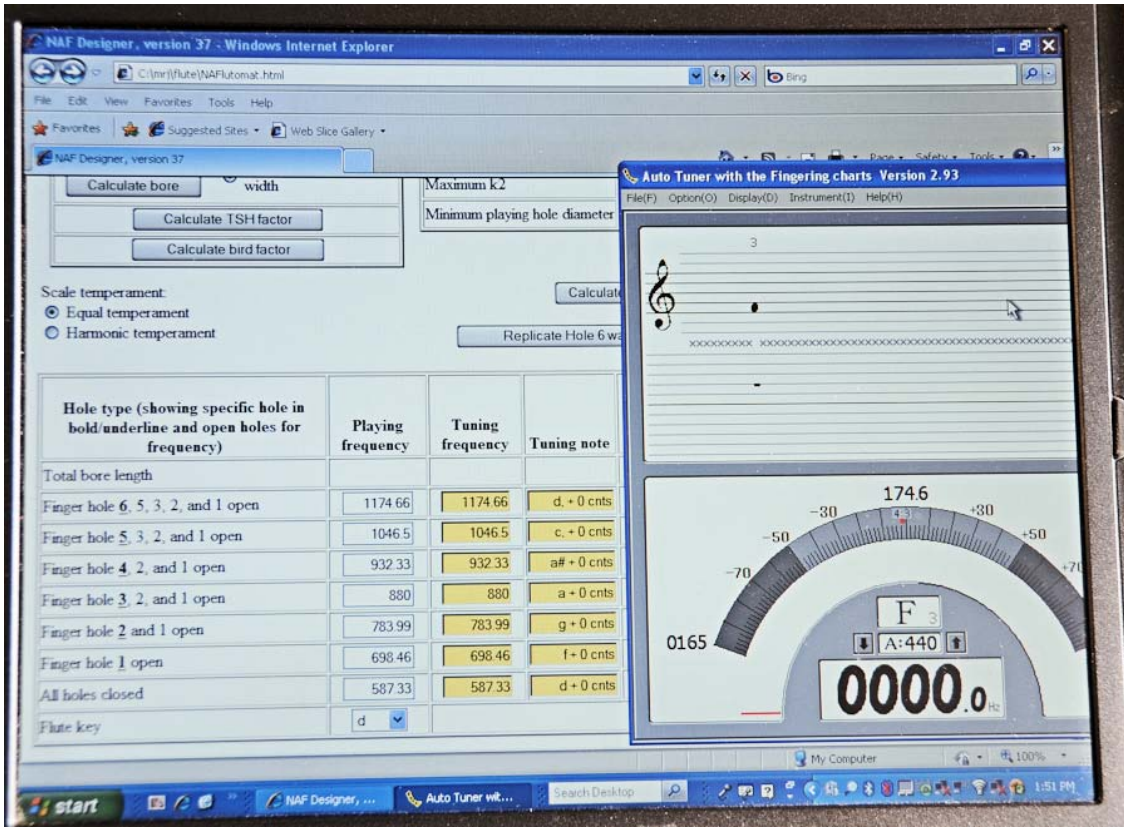
Remember the picture above from Chapter 3?
It is a picture of a finished flute without the tie holding the totem over the sound area.
Probably the hardest task I am up against when writing this is finding a way to explain how those measurements were derived. It is a combination of using Shak8 tuner, Flutomat, and as Suttles, (OzarkGuru) likes to call it, "HillBilly Engineering". So, we will try walking you through the basics. You will have to go back to the reference from Mike Jones in Chapter 8 c from time to time, or you can read the detailed instructions included with Flutomat.

We are supposed to be at the stage of building the flute where we are ready to begin the tuning process. If you will notice, the flute above has not been sanded, trimmed, or shortened in any manner from the beginning of the process. The flute has the sound area carefully crafted. The bird or totem is shaped and the portion that covers the sound area is carefully sanded smooth and checked by placing it on top of the sound area and holding the assembly up to a light. You should not have any light passing through under the bird or totem. A rubber band is a convenient method of holding the totem on the flute while testing, due to the possibility of having to remove the totem several times while adjusting the sound area. Note also, that we have not tried to put a mouth piece blowing tube in the blowing end yet.

I still want to impress on you why we have not gone to a lot of trouble trying to pretty up the flute yet. There are several very crucial steps to go that are "constructive/destructive" in the tuning process. Everyone with experience in flute making will have to admit that somewhere along the way, at least once, they either failed to pay attention to the road signs and measured wrong, or drilled /burned a hole in the wrong place, or made the hole just a little too big. Other possibilities are getting overzealous and cutting off too much from the end of the flute, or cutting the flue too deep, or getting carried away and making the TSH too, too big.

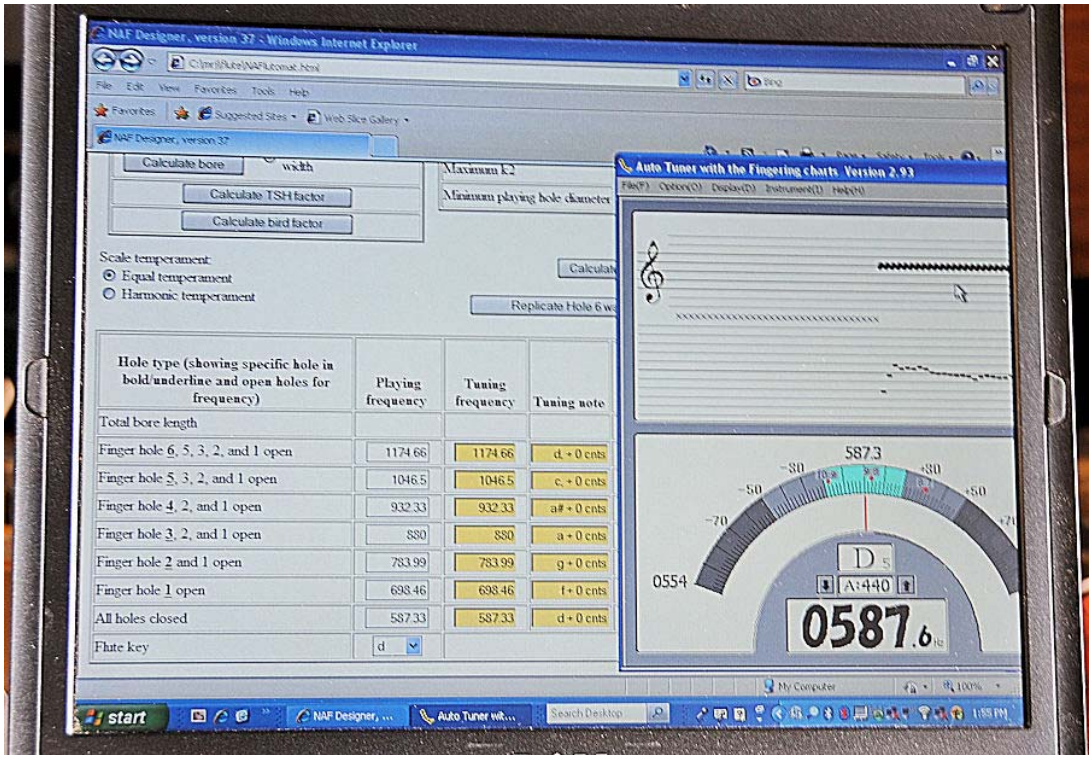
If you mess up, just admit it. Pull the top off the flute, make a new top, glue up, and start over. We are flute makers, not wall hanger makers.

Time to fire up your lap top with Flutomat and with Shak 8. You will have to go through the process and input all the dimensions of your flute. Once you have determined the basic measurements in Flutomat, then open up and overlay Shak 8 on top of Flutomat as shown in the picture. Shak 8 is ready for you to blow a note on your flute to determine the fundamental frequency.



The first time you blow a note into the microphone, there is a good possibility that you will not get a clear note. It might be due to several factors. You might have to adjust the depth and smoothness of the flue, you might have to adjust the angle of the splitting edge, up or down. There are several posible fixes. We will probably have to write a special chapter on how to adjust existing holes to get a solid fundamental.

For now, we are going to assume you have attained a nice solid note when blowing steadily into the flute. From the Flutomat scale, we know that this flute is supposed to be set for a high d on the program. The fundamental note is supposed to be 587.32 Hz . Because we left a little length on the South end of the flute, the first blown frequency will probably be around 550.00 Hz. This means we have a low note, and we need to raise it up to the required fundamental frequency of 587.32 Hz. When you insert all of your measurement figures into Flutomat, the program will tell you what the adjusted length of the flute should be, measuring from the rear of the TSH to the end of the flute. When you measured it and find it is maybe ¾ in or a bit more actual length, then you know you have to shorten the length of the South end of the flute just a bit. To be safe, only take off 1/8 in at a time. Blow a steady note and watch Shak 8. It might have gone from 550 Hz. to 565 Hz. Take another 1/8th inch off. Test again. If you get to 578, then use only the sander disk to remove a fraction of an inch off the end at a time. Keep the totem in the same place on the flute each time you test. Eventually you will get right on the frequency of 587 Hz. Don't worry about the .32 Hz just yet. OK, you have the basic fundamental and the flute is the correct length.

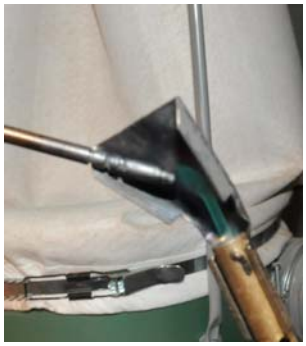


The screen should have registered somewhere as above on the Shak 8 scale. The note should be an even low register tone. It should be clear and steady. Blowing harder should not cause the note to jump into the next octave, or do what is called over blowing. The basic fix for over blowing is usually to angle down the splitting edge. Remember to use the piece of credit card in the flue to check how the air is supposed to be directed exactly to hit the splitting edge.

Please take time to observe the piece of wood used to make the top of the flute.
The crafting of the sound area was carefully done. You precisely placed the sound holes in alignment to the interior divider. At this point, notice that you probably have some of the wood of the top edge hanging over the edges of each side. For this reason, please do not try to take a measurement across the flute and just divide in half to find the mid point of the flute. Instead, remove the totem and rubber band. Go to the North end of the flute and determine the point that is dead center on the top of the flute. Use the bore as your guide to divide it exactly in half. Go to the South end and find the dead center of the top. LIGHTLY, draw a line from North to South on top of the flute. Draw too hard and you will never get the mark out of the wood unless you do a lot of sanding. This line will be your guide to mark the holes you will be burning into the top of the flute.

If you have followed all the instructions correctly and input your dimensions in Flutomat correctly, you should derive *approximately* the same figures as those we gave you at the start of the chapter. Put a light pencil mark on the North /South line you already drew for each of the 6 holes to be burned in.

Get some masking tape and apply it down the side of the flute. This is only temporary for reference.
Look on the Flutomat screen and copy the frequencies down the side of the tape.
Of course, the 587 Hz that we found to be the fundamental will be written at the South end of the flute.

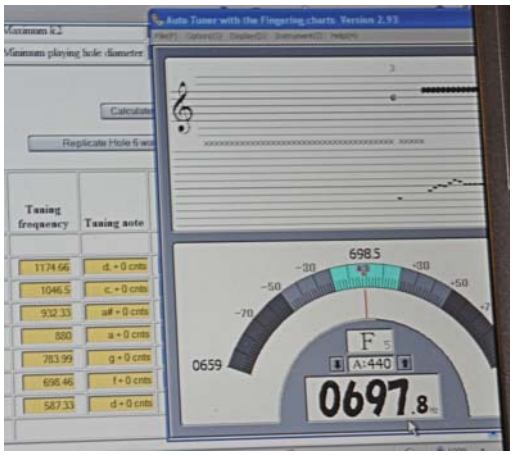


It is a good idea to select a small burning rod for making the first hole in each of the hole locations. For this flute, select the 0.185 inch rod. Heat it enough so the tip is red. Use the tool we suggested for helping to guide the rod in place. Place the rod directly on the dot that was marked for hole 1. Rotate the handle of the burning rod with a light twisting motion. The first attempt will usually only make a black dot on the surface. Reheat the rod and replace into the hole you have started. Note that the black tool shown above is a great help to accurately guide the point back to the proper place. Hole burning should not be a show of force. Try not to apply a lot of pressure. Let the rod burn through for itself. As soon as it goes through, withdraw the rod quickly. There will be a plume of smoke on each burn through. Provide adequate ventilation for your area.

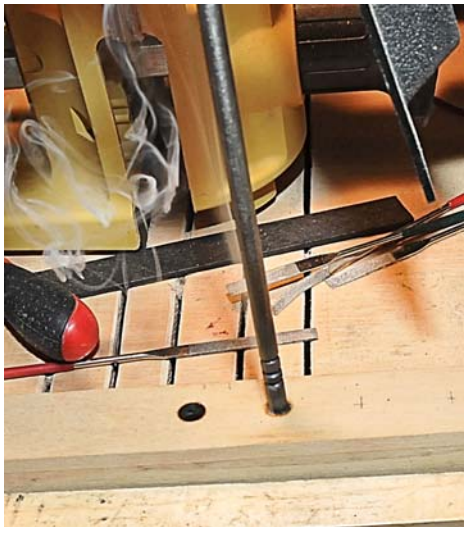
I think it wise to spend a moment here to remind you of the need to pay attention to a few safety precautions. When doing hole burning, you should survey the area you are working in. It should have adequate ventilation. It should have no flammable liquids or materials in the immediate area where the work is being done. When heating the rods, you are dealing with an open flame, and the rod tips will often have a residue that flakes off sparks. It is a good idea to wear eye protection and wear your leather apron. Those errant sparks could catch something on fire, so keep your area clean. Of course, keep a fire extinguisher within reach in the area.
So far we have not mentioned the use of the respirator. Most of the wood we deal with is not toxic for casual inhalation. But, there is always a chance that one individual will have a rare sensitivity to poplar, or pine, or whatever. Pay attention to your sensitivities, when in doubt, use the respirator. Not everyone enjoys the smoke.

OK, back to the hole we just burned. The 0.185 inch rod you used will probably only let you provide a note around 620 Hz at most. You get the next size up, 0.247 inch and burn to enlarge the hole. If you have done your calculations properly, you will blow a note of near 698 Hz.

If you are this close, then leave it alone for now.



Grab the 0.185 inch rod and reheat and burn in hole #2.



This hole will require the 0.247 inch rod just as was required on hole #1.

Again, if calculations are correct, you will get a note of around 783 Hz for the second hole.

For hole #3, the nature of the beast is it will usually be slightly larger than the first two holes. In this case, you will take the 0.185 inch rod, burn in a small hole, then use a 0.247 inch for the next enlargement. For this flute it is pretty well known that the hole #3 will require the next rod up or the 0.317 inch .
Usually a bit of caution is exercised before using the next size up of a rod. It is best to stop and test blow a note to see where you are.
That next size rod might put you over with a too big of a hole. As you build more flutes, you will get a feel for making a decision of going for the next size up rod.
What to do if the rod would put you over? Don't use the rod, use one of the stones instead. Use the orange cone stone in the Dremel and just slightly enlarge the hole. Test for the correct note until on frequency.
There are other ways to fine tune, but for now, try to get within 10 cents under the desired frequency. If you got the hole too large, then you will have a higher and incorrect frequency for the specific hole. You might have to plug and reburn the hole, or possibly put some epoxy on the North end edge of the hole.

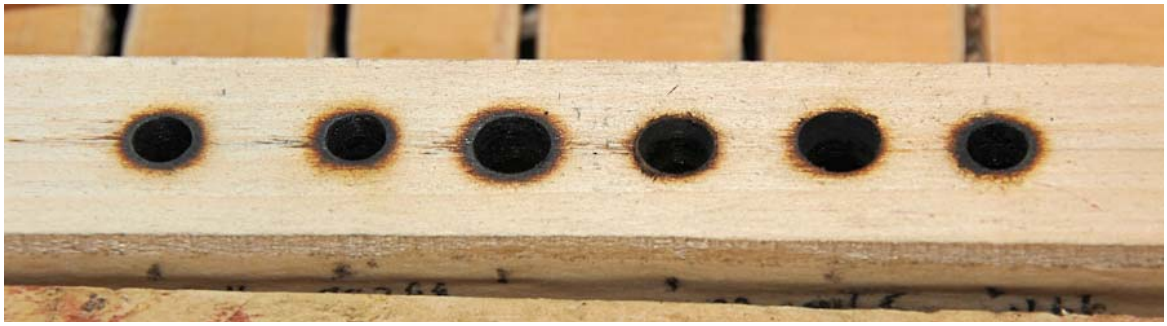
Again, if you got things right, you will get about 880 Hz for hole #3.

So far, so good.

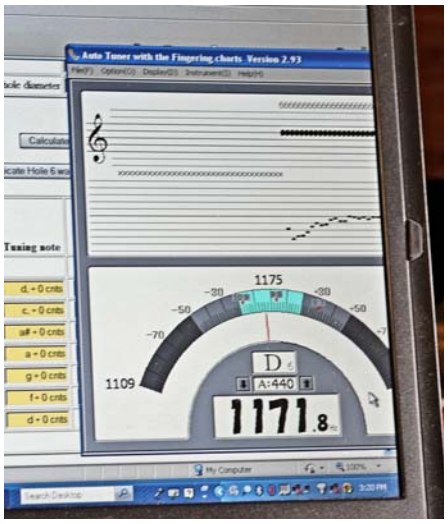
For the next hole which is hole 4, go ahead and use the 0.185 rod. Rather than try to tune this hole, leave it alone, and burn in hole #5 using the 0.185 for a start.
The reason we skip over tuning of hole #4 for now, is because it is a # or sharp note. Flutes can be 5 hole or 6 hole for the Native American pen tonic scale. Most flute makers will include the hole #4 to have a total of 6 holes on a flute. Five hole flutes skip over this hole. When playing a standard 6 hole flute, the third finger down on the left hand usually keeps the hole covered. On occasions, the #4 hole on a 6 hole flute can be used in a method of having both hands on the flute and using the playing fingers of both hands to create various combinations of open and closed playing holes. The method is called cross fingering, and it allows an advanced player to attain many other notes to enable to better "color" a song being played.

The reason we went ahead and just put in a small hole for #4, and not tried to tune it just yet is that the physics of the flute changes when you put holes in. Each hole you add changes the dynamics of the air traveling through the bore at the location of each hole. Even when you put your finger over the #4 hole you made, there is still a change of resistance under your finger. If you had not gone ahead and put in this hole, then the next hole or hole #5 would be affected. You would fine tune hole #5 and #6 and then when hole #4 was burned in, suddenly find all your fine tuning was thrown off. Getting at least a small hole helps to eliminate some of the possible problem. So, in the illustration above, we put in hole #4, and we used a 0.185 inch rod. But, to be safe, we used the orange stone cone in the Dremel to open #5 up a bit. When testing the note on hole #5, you leave all the bottom holes open, but keep hole #4 covered.

If you got this close, leave it alone for now and go to the next hole or hole #6.



With hole #6 burned in with a 0.185 inch rod, tested, and the hole slightly enlarged with the orange Dremel stone, Test it with all holes open except for hole #4, The note should be near 1174.66 Hz. If you are about there as shown in the picture on the right, leave it alone for now and we will go back down and tune hole #4.



There is no picture to illustrate the frequency of hole #4. When tuned it should be 932.33 Hz.
Hole #4 is tested by leaving #1 and #2 open, close #3, leave #4 open, and close #5 and #6.
Fine tuning a hole is a learned craft from a mixed bag of tricks. If you are fortunate enough to have a great mentor, that person can show you all the little ways to tweak the configuration of a hole to bring it into tune. Usually the two most common methods are to adjust the size of the hole, or to adjust the undercut of the hole. Usually, if the note is still only about 10 cents off below the desired frequency, then you can slightly enlarge the hole. But what if you were in a situation where enlarging the hole would make it bigger than acceptable to cover comfortably? Then a little trick of using a carbide burr on the Dremel is done, and the Dremel is used to cut material from under the North edge of the hole. Use real caution and remove only a little material at a time.

Go back down to hole #1 and check the frequency again. Use your skills now acquired, to retune all of the holes in a sequence from 1 to 6.
If you can play a flute, then test out the playing ability of your new masterpiece in the making.
It still might need to have the flue regulated, or the cutting edge. The smartest thing to do at this point is to just set the flute aside and let it dry out. Save any more tweaking until the next day. There are other steps we have to go through yet, that might alter some of the fine tuning.
Just to satisfy your curiosity, take an unheated 0.247 inch rod and see if it fits in hole #5 and #6. Nine out of ten times, it will be a direct fit for this dimension flute. We just took a bit more caution this time.

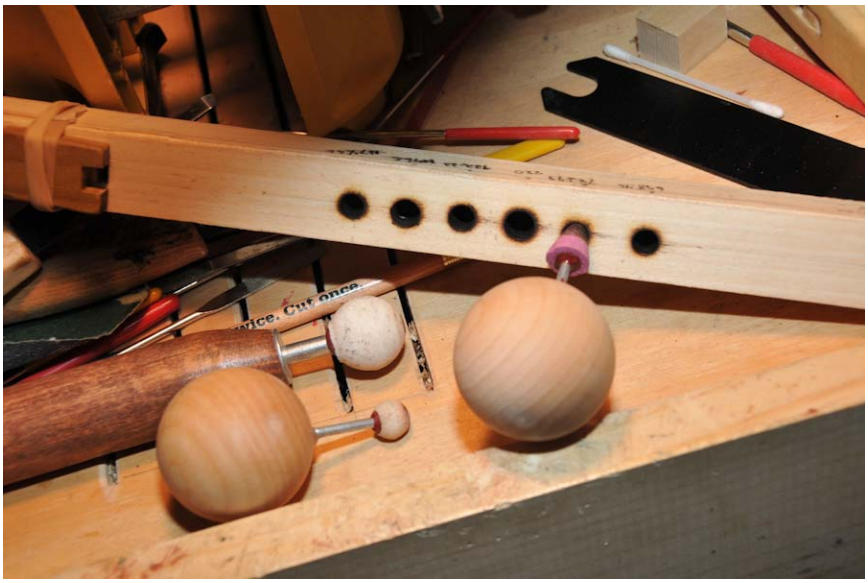
The next chapter will deal with adding the blowing tube on the North end. Then, I will cover how to shape and sand the flute. Note, we have not applied any stain or sealer to this flute as yet. Each step in it's own time to come.

Please go to Chapter 10

How to build
A simple
North American Style Flute

By: Donn Shands

Chapter 10: Preparing the final shaping of the body of the flute.



Remember that chapter on making the tools with the stone cones? Well, this is where you will use them now.
Take the most pointed stone and twist it into each of the holes lightly. Some of the burn char will come out. Gradually increase the size of the stones until you have used each of them in a hole for a couple of twists. On the next to last stone, use the little round one to twist across the top of each hole. Finally, take some caution and center the large round stone exactly on top of the hole and twist lightly until you see a nice ring around the top of the edge of the hole.

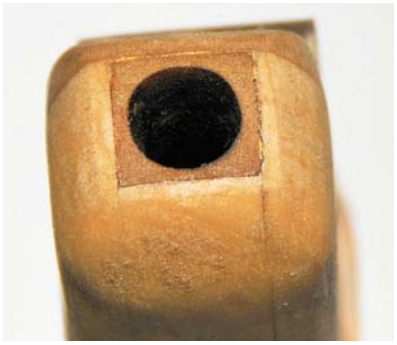
What you have done is provide a nice smooth chamfered edge on each of the playing holes. A player in the know, enjoys a well crafted flute that has smooth edges on each of the playing holes. It allows the player to better seal off each of the holes when covered by the fingers. It also allows for slurring a note, or half-holing a note while playing to augment the individual's playing styles. A little fine sandpaper over the ball of your finger tip can provide an even smoother finish.

Now is a good time to inspect the interior of your flute. Use a flash light and shine it into the TSH while looking up the bore from the South end. If there is any hanging shreds of wood from the process of making the playing holes, then find a small dowel and make a thin slot on one end and insert some sand paper. Roll it tightly on the dowel and rotate the dowel and sandpaper carefully up and down the bore of the flute. **Make sure that all that goes in, comes out.** Sounds like I am joking, but it has happened that a stray piece of sandpaper has been left in a bore, and about drove a few people nuts wondering why their flute was no longer in tune.

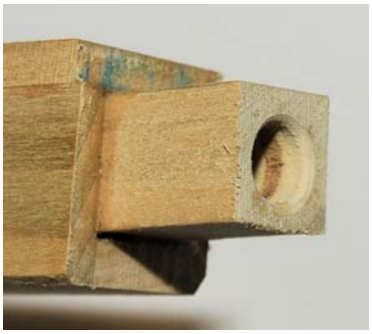
Remember these photos?
Here are a few possibilities of things to do with the blowing end of your flute.

Use the above as an example of an unfinished North or blowing end of your flute.

If you wanted to, you could just smooth off the blowing end and use it as is. It will not make any difference in the sound of the flute, just the esthetics of appearance and player comfort.



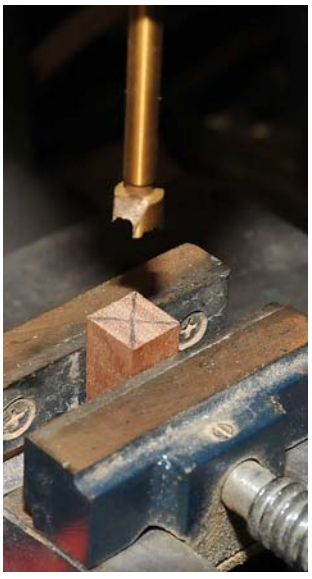
You could drill a plug and insert it and sand it smooth.
Even this could be tapered more to a point.



Or, you could drill a plug and insert it, then shape a nice blowing end.

Finished end that has been formed and sanded into a nice smooth mouth piece.

If you want to put a plug into the blowing end of the flute, either just a flat plug, or the extended blowing tube type, you must drill a hole through the ½ inch square dowel first.
Do not put the plug into the flute and try to drill the hole. Do not put the plug into the flute and try to drill the hole. (Were you paying attention?)
Second important thing. Do not get stupid and try to hold the plug while you are trying to drill a hole through it. Use a vice, and observe all safety precautions.
It is better to use a sharp forester bit to do the drill through. Be patient and do your calculations, Chances are, you will not get a straight hole the first time you try. You can drill a very small hole first, and use a couple of sizes of burning rods. Again, do not get stupid and try to hold the plug when trying to burn through it.



You might have to lightly sand the edges of the plug to get it to fit into the end of the flute. It will be snug, but don't try to use too much force to push it in as you might bust out the end seams. Add a little glue to all the edges as you slide it in. Then add a little more glue to make sure all the cracks around the plug are filled. Use a tooth pick or something to make sure. Wipe any excess glue off.
Let this assembly harden before going to the next step.

Personally, I use several types of sanders. One that I find very useful is the vertical oscillating sander drum. It is very useful with this particular project. I find it very essential when crafting my branch flutes.
Here we are ready to begin sanding and shaping the flute. Before you start, put on your eye protection, put your gloves on, and turn on the vacuum if you have it. The goal here is to first get each of the four sides of your flute smooth.
Because of the way we constructed the flute, it is a good chance that the bottom of the flute will be the most uneven. Start with the bottom side first.
If you do not have a sander such as this, then put the flute in a clamping vice with soft facing to protect the wood, and use a flat block of wood with sand paper wrapped around it. Repeat the smoothing for the right and left side of the flute. For the top, only lightly sand across the top to remove any marks you have made.

Do not attempt to sand or shape either end of the flute just yet. Try to do a good job of getting each side of the flute as smooth as possible. You will notice that when you sand enough, the seams will start to become less visible. Try to make them as least noticeable as possible. Refill any gaps with glue or wood putty and continue to sand as needed.

The next step is a learned art of eye and hand coordination when sanding your flute. The trick is to apply the pointed edge of the flute to the spinning sanding wheel. At the same time, with your gloved hands, apply pressure on the piece being sanded on the rotating drum while moving the piece forward and back wards and rocking it from side to side. Begin with the bottom edges first to learn the feel of sanding and shaping. Do only a little over half of the length of the flute at a time, then flip over the flute to the other end and work the unfinished end till that edge is even with the end you have just sanded.
When doing the top edges, take caution not to rock too far toward the top surface, you do not want to sand into those holes that were given their nice round edges.

The focus at this point is to give a shape to the exterior of the flute. We are not trying to make this flute into a cylinder. We are keeping the crafting as simple as possible, at least for this project. Nothing wrong with a square exterior to a square bore flute. It does feel a lot better having the sharp edges smoothed off though.

What if you did not have the oscillating drum sander?
Course sand paper followed by fine would work.
Use the fine blade Microplane shaver.
Use a wood rasp and sand down to finish. While some solutions might take longer and more effort, the same job is finally accomplished. It is fully understood, that not everyone has that magic workshop full of the wonder tools. I keep thinking about that ancient flutemaker who sat around the fire and spent hours with a sharp rock and a burning stick to do all this work we have done so easily with our modern tools. Even sand paper.
If you were really desperate, you could get Grandad's old Buck knife out and chip carve the flute body into shape. Or even use that nifty new carving knife from Flexicut.

The next step is to use your best method to round off the South end of the flute. Be careful not to sand on the inside edges of the end, and try not to take any more of the length of the flute off. Your purpose here is just to provide a smooth appearance to the end of the flute. Finish with fine sandpaper.

Just to see if you were paying attention, which is the top and which is the bottom of the flute in the picture to the right?
The bottom is in the top of the picture.
Notice how much more of the bottom we sanded off to get the whole side smooth and even. The bore remains square, but the wall thickness was reduced. If we had sanded the top down, it would have changed the wall thickness of the playing holes. That would have thrown off the tuning that we have already carefully adjusted.

Shaping the blowing end is another element of a learned art of hand eye coordination. There are all sorts of ways to shape wood - chip carving, rasping, and sanding. Personally, I prefer using a ½ inch Dremel sander drum to begin with, and a ¼ inch Dremel sander drum for finishing. You hold the flute in one hand and rotate it as needed while using the sander drum to shape and carve out the curves and eliminate the sharp edges. Looking at it end on while working will help keep you from eating too much wood and making one side of the tube thinner than the other.

When finished, it should look similar to picture on the right.
Note that all the cracks are filled in and smooth where the plug meets the end of the flute.

At present, your flute is only about two thirds the way finished.
Ah, I know you are disappointed, but there are things still need to that will make this flute continually playable, in tune, and protected against unwanted deterioration.
Oh, you can test play it if you want, but we have a bit more to go to finish it properly.

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By: Donn Shands

Chapter 11: Basic Ideas for preserving and finishing your flute

At this point, a whole bunch of flute makers would go off on all sorts of wild tangents and start decorating their flute. A good craftsperson with the proper attitude would stop and think about doing something to make sure the creation would not be subjected to wear and tear, rot, or general deterioration.
A flute of the block type, of course has no moving parts. But, it is, at least in this case, made of wood. To use the flute, moisture laden air is used to play it. It is an obvious fact that unprotected wood will absorb moisture. It just so happens that moisture laden air also is crawling with microbes. Yech…
We need something to seal the flute, both inside and out.

Let's hold up just a minute to discuss what color you want your flute to be. Some people want to just have a clear coat on their wood. Others want to have the wood stained to enhance the appearance, and to accent the special grain of wood. Do your research on the stain you want. Apply it properly, then expect to begin a sealing process that will trap and prevent any allergenic properties from leaking out. Try to use the type of stain that is stain only, and not a urethane and a stain combined. Make sure you keep your leather apron over your clothes, and wear the protective gloves. Stain is very hard to get out from under your nails and off your skin.

Extensive arguments have been raised and fought over the best method to seal a flute, both for inside and outside surfaces. Put 10 flute makers in a room and ask the question, and you will get 10 different answers.
What ever finish you use:
Is it toxic to you personally, or to a person you might give the flute to?
Remember, you might not be allergic to some paint, varathane, oils, preservatives….but someone is. One fellow I know mixes bees wax and baby oil, and soaks the whole flute in it. I know a couple of people that have a severe reaction to bees wax. Their lips will swell and the over all reaction is severe.
Another fellow has a severe case of nasal congestion and sneezing just being in the same room with a certain oil containing citrus oils. Some people have dermatitis from some very bland wood or nut oils.
So, what can you use that probably….and I say probably is the least toxic?

Probably the most benign coating is shellac. It will go on and will help to fill the pores of the wood, seal any cracks or air leaks that were there and not detected. It provides an easy way to coat the flute inside and out.

But, there is a problem. It is not totally water resistant.
If you were to try to get some of the flute makers that sell their flutes routinely on the open market to tell you what finishes they use, they are (and have been to me) quite rude and refused to tell, saying it was a trade secret.

One was very nice to me when I was starting out, and just told me to use Deft Lacquer, the spray can being the easiest to use. I never had a bit of trouble since with finishes on a flute. The finished coat, when cured and hardened, is not tasted when playing, and the odor is gone. There is no chemical "biting" of the lips. It seals in the stain, and protects from moisture.

Why use both shellac and lacquer? You don't have to. Personally, I like to dip my wood flutes in a 50 % shellac and 50% alcohol solution.
Quite often, I will do this dip of the flute right after I have tuned, and shaped the flute.
The shellac solution is sorta like a primer coat. It penetrates and helps the sealing. But, it does an even more important job of hardening up the wood fibers.

Usually after a day of drying out after the dip, it is best to put the totem back on the flute and go through a series of tests with Shak 8 tuner. You may need to fine tune a few of the holes and the TSH area again. One hole just might have gone flat on you, and you will need to under cut to bring it back up to tune. With the wood being a lot harder now, the cutting and filing of the wood surface is slowed down a bit and the strokes can be more precise.

Now what? What did you just do? All that tweaking left some of the wood surface exposed again. Take a fine brush and spot paint what you adjusted. Or, give your flute a heavy shot of lacquer spray down the barrel and in the SAC area. Roll it around and make sure that excess lacquer is drained off any outside surfaces. Try not to let it build up in the flue or the back ramp area. Take a rag and wipe the exterior of the flute clean of the Deft spray. Now is a good time to take some black acrylic paint and use a fine tip brush or a q-tip and go inside the playing holes, the tuning holes if you have any, and the open area of your TSH hole and other parts of your sound area. It helps to hide that raw white color of unfinished wood that can be seen sometimes on the inner edges of playing holes or wherever. Just a little finishing touch to show you care.

Find yourself a dowel or a little stick that you can put into the bore of the flute and be able to hold the flute away from you while you spray a coating on the flute with the Deft lacquer.
Keep this in mind….you will not put a final coat on your flute with one spraying. Do not dummy up and try to spray a beautiful glossy coat for the first coat. It will without fail streak and run on you. When spray painting, learn the lesson of patience. When all else fails read the instructions on the can. It tells you how many hours you need to wait before you can spray the next coat. Spray too soon and the coat will sag and you will have an ugly mess on your hands to have to sand down and refinish. How many coats and how slick a surface is all up to you.

I did not get into the safety tips as yet….but common sense would tell you not to smoke or have any open flames in the area when spraying. Do your spraying out side with plenty of ventilation. Use the respirator. If you were not using your protective gloves, and the fingers are full of paint, then (still outside) use some carburetor cleaner spray and it will take it off. Just remember to wash your hands with soap and water and use some hand cream immediately.
I have been reminded that even with carburetor cleaner, you risk absorbing toxins through the skin. Some times, the risk of short term exposure seems worth the hours of trying to get the paint and stain out from under your nails and off your skin, especially when another function in life demands hands presentable in public. Another possible less drastic solution is to use products like GUNK or that Orange Hand Cleaner. Use your own decisions in exposure risks, bottom line, gloves are a better value.
Dispose of rags and paper towels properly. Spontaneous combustion is a possibility.

Finally, find something that you can sanitize your flute with on occasion. There will be a build up of bacteria in the interior. Remember, if you only sealed with shellac, alcohol will dissolve the protective coating you first put down. Listerine may not be that bad on a coating of Deft, as the Deft will protect the alcohol-based shellac from the alcohol in Listerine. Think carefully about your protective finish before you use a sanitizer on the mouthpiece of your flute.

Please go to Chapter 12:

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Chapter 12: Considerations for decorating your flute.

My first prototypes were just simple natural finished flutes. They are shown here with just rubber bands on the blocks. The totem blocks were later shaped and finished. Leather ties and some beads were added before giving a few a way.

Shown here are just 4 of the completed flutes that have homes with known professional flute musicians and teachers. At present, there are more than 15 of these flutes in the hands of recording and performing musicians.

A little suggestion about your flute creation. The first time you craft your flute, it just may not be your best work. Then again, perhaps the precise and tedious work you put into it produced an outstanding playing flute in perfect tune and sound. Luck of the flute gods. Whatever.
If you are very fortunate to have a great playing and sounding flute, hold on to it. Don't put too much effort into decorating it and wanting to show it off. Reason?
That flute will be your salvation for future flutes. Something you did right that makes it sound great and play correctly is now there to use as a real reference, and not something off a page or a section of a PDF on a computer.

If your flute was a clunker, then use that on your bench as a reference tool of what not to do.

Once you learn to do your crafting the correct way, and you painstakingly use the same techniques and measurements and continue to get great results, then and only then can you later try to experiment with your work to try something different.

Decorating your flute with designs, beads, feathers, should be done with tact and consideration. If you are not of Native American blood and culture, it is not wise to try to emulate designs or symbols you might just "think" are cool to you. Some symbols are very sacred to some organizations, clans, nationalities, cults, and to certain individuals with a different slant on life. You risk offending someone by just indiscriminately using a symbol without researching it or understanding the meaning.
Decorating with feathers can sometimes be dangerous. The use of plumage from non game birds plumage could get you into trouble. You cannot even use those mockingbird feathers that were shed from your Spring nester that visited your yard. You could be fined if caught with them on your flute.
The shape of your block for your flute is your personal totem. Again, try not to use a theme that would be considered offensive to someone. Even I have enough sense not to use a Nazi symbol for a decoration, even though I happen to know it was actually a symbol of the representation of the path of the stars in the heavens. When the pattern went the other way, it represented the path of the sun in the heavens. Sad that symbols got used by bad people and their proper use was tainted with bad meanings.
Just be creative with your designs, but stop and do your research if you are not sure.

I wish to thank you for taking the pains to read through the detailed instructions I have laid out for you. I hope your project was a success and that you are on the road of your wonderful Flute Journey that should last for the remainder of your life.

I have been most fortunate to have some fellow flute makers and players that have been not only an inspiration for me, but great helpers and companions and teachers over the past few years on my personal Flute Journey.

Ellie Barbarash For helping with editing and proof reading. And being a great sport for being a shoulder to lean on when distractions were wavering my sense of direction.

Mike Jones For being a great flute associate that has been a close workshop mentor as well as a personal friend. Spending time in both of our shops and being part of the local flute circle together, is a constant learning experience.
And a mention of thanks to Mike's mentor, Jim Guilland, a well known flute craftsman.

John Suttles For teaching me the basics of branch flute crafting. Without the basic knowledge gleaned from the flute making skills learned from crafting simple branch flutes, the concept of an even simpler method, as presented with this article on easily making a square flute, would not have been possible.

Keith Stanford For providing the concept of using Acrobat PDF to provide a beginners guide in a readable, concise, and illustrated format.
His Cherry Cows Flute Manual has been probably the most basic beginner flute manual available. His personal input has been a morale boost and an over all great help.

Russ Wolf For his Flute Shop Guide, another great beginner reference book.

Lew Paxton Price For his series of books providing valuable research knowledge on theory and crafting of the North American Style flute.

There are others to be thanked for the tidbits of knowledge here and there that were offered. Most were great friends made through the association of the internet flute forums.

I will include this disclaimer a second time in this article.
My name is Donn Shands, I am an American citizen, born in the USA.
I am full blooded lineage of Scottish decent. The original families arrived in the USA in the 1600's.
I have no Native American blood line claims and do not represent myself or my teachings or craft as that of any of the indigenous Natives of the soils of the Americas.
I have deliberately referred to the flute being described in the article as North American type flute. I am very specific about not naming this instrument a "Native American flute".
I caution any Native American Rights Groups to not contest this matter as every precaution has been made to be respectful of the legal aspects of the Native American culture. A flute is a flute, and the concept is in the public domain. No article, or flute that is crafted by me is represented by the name or description as being "Native American."

My nickname of Tejas Medicineman was given to me years ago when serving as an United States Army as a Medic. It stuck with me through out my life's work in the medical sales field. It later became a showmanship character that won several honors with CASI, Chili Appreciation Society International. The name is registered as Medicineman and not Medicine Man. While my knowledge of Native American culture, and history is very extensive, I take extreme caution as not to offend any Indigenous Natives, their rights, religion, or violate any known taboos. I will ask that I be given my own space to acknowledge He Who Sent Me, as I give you space to do the same.

This article is merely a suggestion as how to assemble the items necessary, and to produce an in-tune playable musical instrument/flute.
I will not assume any responsibility for any injuries occurred while an individual or group uses the knowledge imparted to attempt to construct their project.
Every attempt has already been made in the body of the article to warn of any possible physical dangers that might occur during the crafting procedures and how to prevent them.
I have continually emphasized common sense in use of safety equipment when actively working on the project.

Again, I will not assume any liability for any personal injuries that may occur while attempting to craft your personal project.

In a sense of fairness to all, any suggestions for improvement or corrections will be considered and dealt with when found appropriate.

Should corrections or suggestions be made, please be specific and refer to Chapter and to page number.

Providing the links still hold up,
I can be contacted at:

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Dated March 1st 2010