The *Serpent Website's* **Squarpent**

Disclaimer

Neither The Serpent Website or the author make any guarantees that the following instructions are free of errors, or that a resulting instrument (the "Squarpent"), will play at any anticipated level the builder might desire or expect. These instructions are intended to be used as a printable alternative to The Serpent Website's 'Squarpent' construction webpage and article, in order to duplicate the author's prototype. The resulting instrument is intended to be an educational device, and no promise is made regarding its suitability for performance situations. Refer to www.serpentwebsite.com

the author playing the Squarpent prototype

Errata

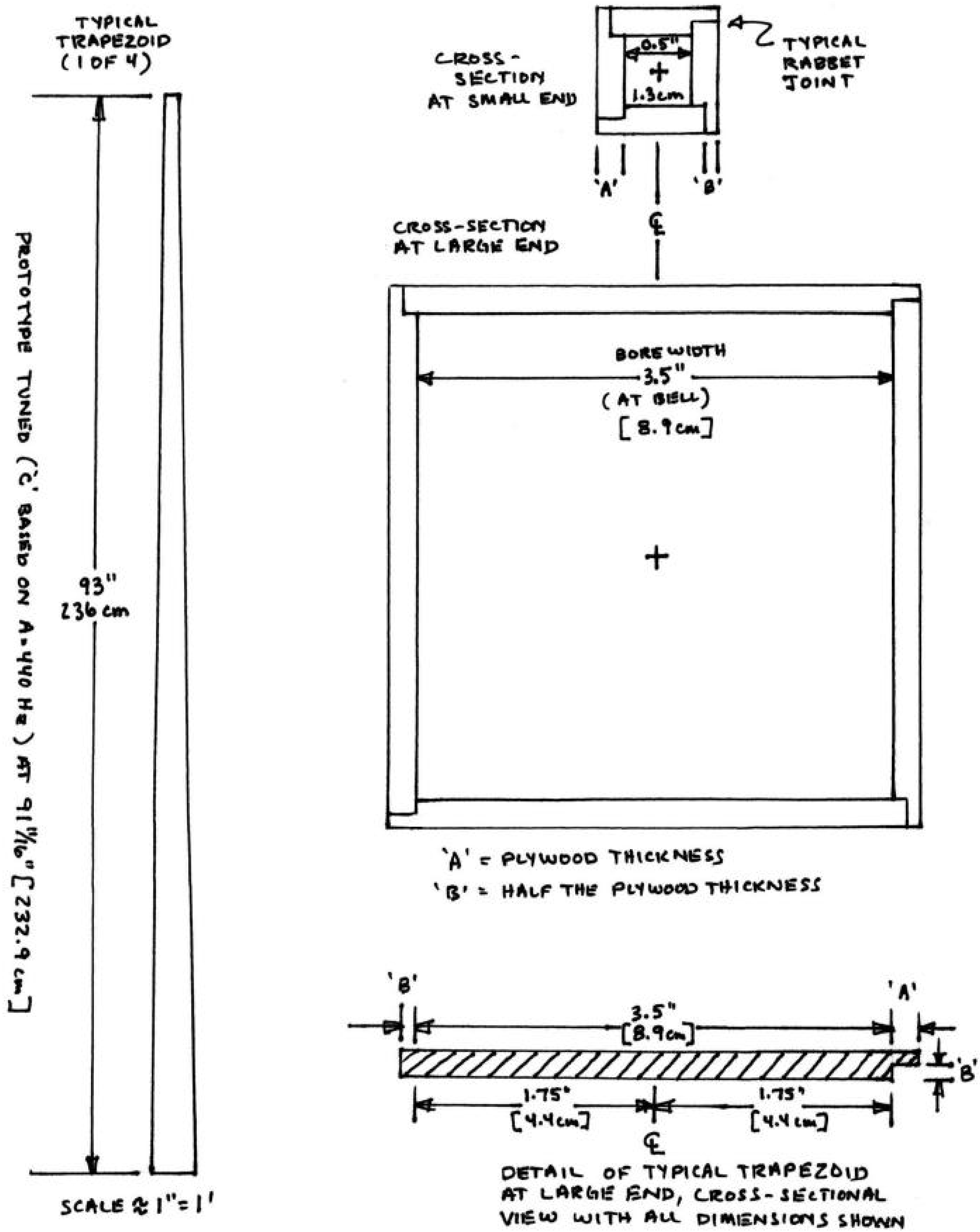
The previously available website plans for the Squarpent had an error in one of the layout drawings, regarding the 'Cut A' near the bocal. If followed, this would result in the bocal facing away from the player instead of towards the player. The mistake was originally made on the prototype, necessitating the later cutting of the 'Up Tube' in order to flip the bocal around to the correct direction. This in turn required the addition of reinforcing plywood plates over the repair, visible in the photo at left. The revised diagrams are included in this document, and have been verified to be correct. The website's downloadable version of the same drawing has been replaced with the corrected version as well. Be aware to check this area if the original website instructions have already been viewed or printed.

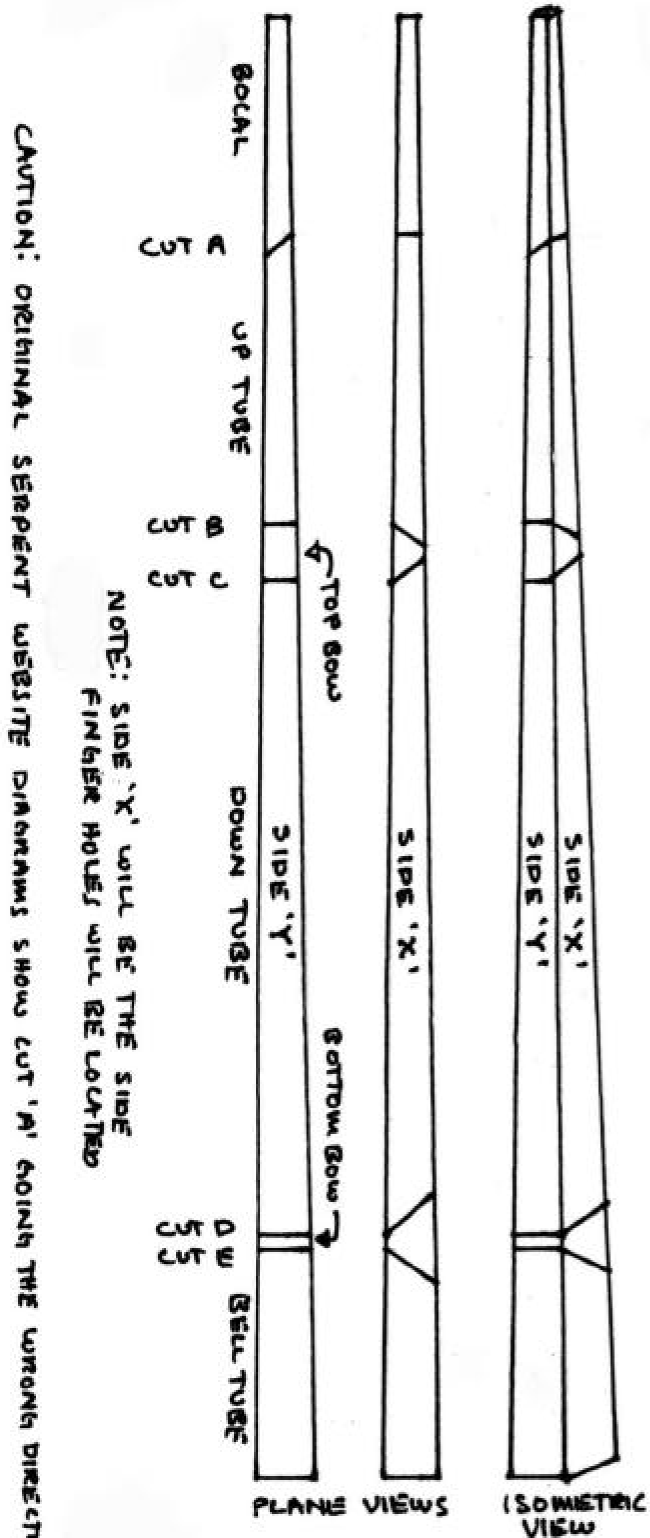
Materials

- 4' x 8' sheet of 1/4" plywood (actually 0.2" [0.5 cm]), with two finished/good sides, preferably exterior grade, preferably hardwood type (Oak, etc.)
- scrap of 1/2" [1.3 cm] dia. wooden dowel
- scrap of 3/4" [1.9 cm] dia. wooden dowel
- wood glue, exterior (water resistant) type, preferably gel formulation to resist running, e.g. Elmer's "Pro Bond Weather Resistant Wood Glue for Exterior Use"
- 5 minute epoxy (2-part)
- mouthpiece; serpent mouthpiece preferable (see Makers page of Serpent Website), but trombone/baritone/ euphonium type will work
- steel wire, for twisting twight to hold objects together during gluing (approx. 19 gauge [0.7 mm])
- cotton swabs ("Q-Tips" or similar)
- polyurethane varnish

Tools

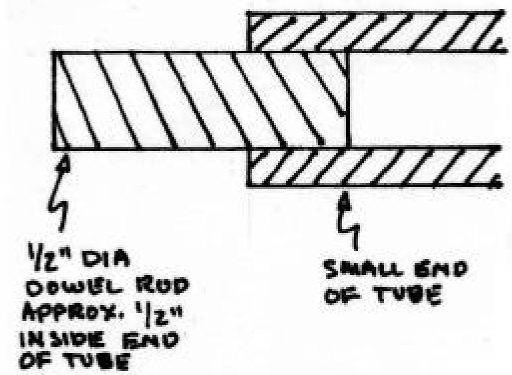
- electric hand drill or drill press, with assorted small bits (size is not critical), plus a 1/2" [1.3 cm] dia. bit suitable for wood boring
- wood saw, circular or table type preferable, 'saber' or 'jig' saws or handsaws will also work *(radial arm saw, band saw, 'saws-all' types are not suitable)*
- X-Acto knife or similar razor edge modeling or woodworking blade
- pencil with suitable lead for marking wood
- sand paper
- metal straight edge to guide knife blade
- carpenter's 'square' or drafting triangle, to assist in marking accurate 45 and 90 degree angles
- ruler or drafting scale
- tape measure
- mitre saw or other wide-blade wood saw with fine teeth
- router with straight bit, for making rabbet cuts (optional; other methods may also be used to make these cuts)
- small round wood file ('rat-tail' type or similar), or preferably 'Dremel' type rotary tool with small wood

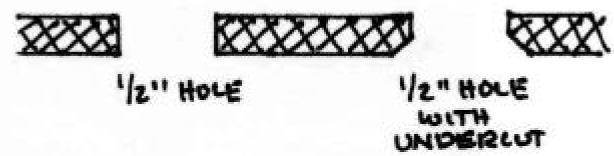

TYPICAL TRAPEZOID (1 OF 4)
PROTOTYPE TUNED ('C' BASED ON A-440 Hz) AT 91 11/16" [232.9 cm]
93"
236 cm
SCALE ≈ 1" = 1'
CROSS-SECTION AT SMALL END
0.5"
1.3cm
TYPICAL RABBET JOINT
'A'
'B'
CROSS-SECTION AT LARGE END
BORE WIDTH
3.5"
(AT BELL)
[8.9cm]
'A' = PLYWOOD THICKNESS
'B' = HALF THE PLYWOOD THICKNESS
'B'
'A'
3.5"
[8.9cm]
'B'
1.75"
[4.4cm]
1.75"
[4.4cm]
DETAIL OF TYPICAL TRAPEZOID AT LARGE END, CROSS-SECTIONAL VIEW WITH ALL DIMENSIONS SHOWN



MITRE CUT DETAIL
NOT TO SCALE

MOUTHPIECE RECEIVER DETAIL (TO SCALE)





FINGER-HOLE DETAIL

OUTER JIGS [FROM 6" x 6" SQUARES]

1	1" [2.5 cm]	CUTOUT
2	1.35" [3.4 cm]	"
3	1.7" [4.3 cm]	"
4	2" [5.2 cm]	"
5	2.4" [6.1 cm]	"
6	2.75" [7 cm]	"
7	3.1" [7.9 cm]	"
8	3.4" [8.7 cm]	"
9	3.8" [9.6 cm]	"

CORNER HOLES ARE 3/8" DIA. [1 cm DIA.]

FINGER HOLES

COUNTED STARTING AT SMALL END + MEASURED TO CENTER OF HOLE

1	44 5/8"	[113.3 cm]
2	46 5/16"	[117.6 cm]
3	48"	[122.0 cm]
4	60 3/4"	[154.3 cm]
5	62 5/8"	[159.1 cm]
6	64 3/16"	[163.0 cm]

HOLES ARE DRILLED AT 1/2" [1.3 cm] DIA. THEN OPENED UP SLIGHTLY AND UNDERCUT AS SHOWN ABOVE

cutting bit (e.g. Dremel #115)
- wide pliers (for twisting wire tightly)
- wire cutters
- heavy twine or nylon cord (clothes line, etc.), about 8’ required

Typical French / Church style serpent, showing complex curving shape

What is a Squarpent?

The Serpent Website receives many requests from individuals who wish to obtain a serpent in order to satisfy their enthusiastic urge to get better acquainted with it. For the serious, this site provides links to serpent makers. However, there are still many others who have the desire, yet are without the funds necessary to purchase an antique or reproduction serpent. There are also the casually curious who never want to bother with a real serpent, yet would like to try their hands at playing one, perhaps for a school project.

To accommodate folks in the latter categories, the editor of the website has designed an original serpent-related instrument, dubbed the Squarpent (pronounced Square-pent). It can be built for very little money (less than $30 US) and with minimal skills and only about a weekend's time.

The Squarpent design gets around the difficulties inherent in fabrication of all real serpents, bass horns, and other related instruments. See in the above picture of a Monk church-style serpent how it would be very difficult to build satisfactorily at home.

The Squarpent uses a square cross-section instead of a round one. It uses square 'bends' instead of curved ones. It avoids metal work by being made solely from wood. It uses a common brass instrument mouthpiece instead of a proper serpent type. See the complete Squarpent prototype in the picture on page 1.

Still, the Squarpent uses typical serpent fingerings, has serpent-like playing characteristics which are acceptable but not as good as might be expected from better antique serpents or the best reproduction serpents, has the sound quality of a typical serpent (which can be made even better by using a real serpent mouthpiece), and responds like a typical keyless church-style serpent to the extent that a seasoned player can immediately play it on first attempt.

the four trapezoids after cutting them out from the plywood sheet

Initial Cuts

The bore of the Squarpent is made from a single tapered wooden tube with a square cross-section. *Refer to the diagram on page 2.* The tube is made from four identical pieces of plywood, cut in tapered shapes and called *trapezoids*. After cutting the trapezoids from the plywood sheet, they need to be cut for making ‘rabbet’ type joints where they come together.

- Determine the actual thickness of the plywood; this will be dimension ‘A’. Dimension ‘B’ will be half of ‘A’.

- Decide which surface of the plywood has the better finish, and place it facing up on the floor. Mark lines on the better side of the plywood; there will be four lines of about 93”

[236 cm] length, drawn parallel to each other, and separated by about 4” [10.1 cm]. On a typical 4’ x 8’ plywood sheet, the long dimension is 96” [244 cm], and the lines may extend this full distance. The lines will be the *centerlines* of the bore (indicated by the combined C & L symbol in the diagram on page 2), and will be used for several critical measurements and cuts during construction. Make sure that the lines are far enough apart to allow for the tapering width of the sections (see above). Make sure that the centerlines are accurate, straight and clearly visible.

- At one end of the lines, make small marks 0.25” [0.6 cm] to either side of the centerline. At the other end of the lines, make similar marks 1.75” [4.4 cm] to either side of the centerline (because of the gradual taper of the trapezoids, the second, larger dimension of 1.75” may be made at either the full 96” width of the plywood sheet, or at the actual bore length of 93”). Using a straight edge (use a carpenter’s straight edge, or use the unblemished long edge of the plywood sheet), draw lines between the small marks to define the trapezoid shapes for all four sides of the tube. The diagonal lines define the edges of the *inside* of the bore.

- To define the actual cut lines for the trapezoids, draw additional lines parallel to the first diagonal lines and outside the ‘bore’ lines (see “Detail of Typical Trapezoid” on page 2). On one side of each trapezoid, draw the line ‘A’ (remember dimension ‘A’ from above?) distance outside the bore line; this will be for the rabbet cut. On the other side of each trapezoid, draw the line ‘B’ distance outside the bore line; this will be the ‘no varnish’ zone that will be glued into the adjacent trapezoid’s rabbet cut. The drawing on page 2 shows how the rabbet joints and cuts work out.

closeup of rabbet cuts in trapezoids, actually a little too deep (more than half the plywood thickness)

- Cut the 4 trapezoids from the plywood sheet, being careful to make the cuts clean and accurate. Do not allow the saw to wander; the cuts must be straight. Measure along the centerline of the trapezoids, starting at the small end, and mark the 93” point. If there is any wood beyond this point (usually 3” if cut from a 4’ x 8’ sheet), cut off this excess.
- Varnish the unmarked side of the trapezoids. Avoid varnishing the ‘no varnish’ (B edge) zones; you will be varnishing the *unmarked* side, so the work does not need to be precise; it is better to get some varnish in the ‘no varnish’ zone than to leave part of the wood unprotected.

- Cut the rabbets along the ‘A’ edge of the trapezoids, making sure to cut on the varnished side of the wood. The cuts will be ‘A’ wide and ‘B’ deep. A router works best for this process, but successive adjacent shallow cuts with a table or circular saw work well, and other methods (including razor knife cuts) may also be used. *Save the fine sawdust from routing; if routing was not used, save sawdust from cutting out the trapezoids.*

varnishing the inner (unmarked) sides of the trapezoids

Jigs

The four trapezoids, now rabbet cut and varnished on one side, will be glued together into a tapered box, henceforth called the ‘tube’. The rabbet joints will help by keeping the edges locked together, will provide for a greater gluing surface, and will help keep the glue in place for the best quality joint. However, it could still be difficult to align the eight edges of the four trapezoids before the glue runs or begins to set. Making a set of jigs will help. Note that some people have built Squarpents from the website version of the plans *without* using the jigs; it is possible but potentially much more difficult to do it that way.

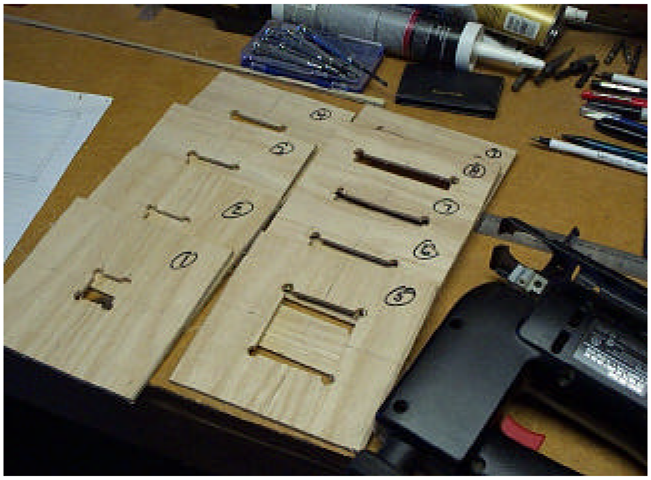
From the remaining plywood, cut nine squares, each 6” x 6” [15 x 15 cm]; these will be for the outer jigs. Mark a smaller square on each of the nine, with progressively larger sizes (see chart on page 3), and centered in the jigs (see photos). Drill a 3/8” [1 cm] diameter hole at each corner of each marked square (this will help prevent excess glue at the outside of the rabbet joints from touching these jigs), and saw between the hole centers to remove the unwanted wood. Mark the jigs 1 through 9.

From the remaining plywood, cut three squares each of sizes 2” x 2” [5 x 5 cm], 3” x 3” [7.6 x 7.6 cm] and 4” x 4” [10.1 x 10.1 cm]. Glue the same sized squares together to make thicker squares; these will be for the inner jigs. Optionally, use thicker plywood and cut a single square of each size. Use a wood file or sander to round the corners of the inner jigs, this will prevent excess glue at the inside of the rabbet joints from touching these jigs. Drill a hole through the center of each of the three inner jigs, big enough to easily pass the nylon cord.

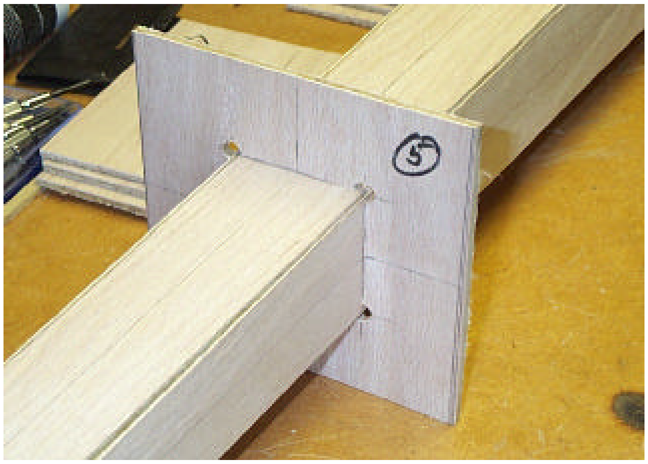
outer jigs with marked square and corner holes

Cut a length of 1/2” 1.3 cm] diameter wooden dowel, about 1.5” [4 cm] long. This will be a fourth inner jig, already rounded at the ‘corners’ so to speak, and will subsequently be part of the mouthpiece receiver assembly.

Lay one of the trapezoids down, with the inner (varnished) side facing up; the rabbet cut will also be facing up. Place the three inner jigs at the point where they exactly touch the inner edge of the rabbet cut on one side, and the ‘B’ line (as viewed through the wood) on the other. Staple, or nail, them to the trapezoid in such a way that they will not fall off or shift position, but can be readily removed by pulling the staple or nail at a later time. Pull the nylon cord through the



outer jigs with cutouts



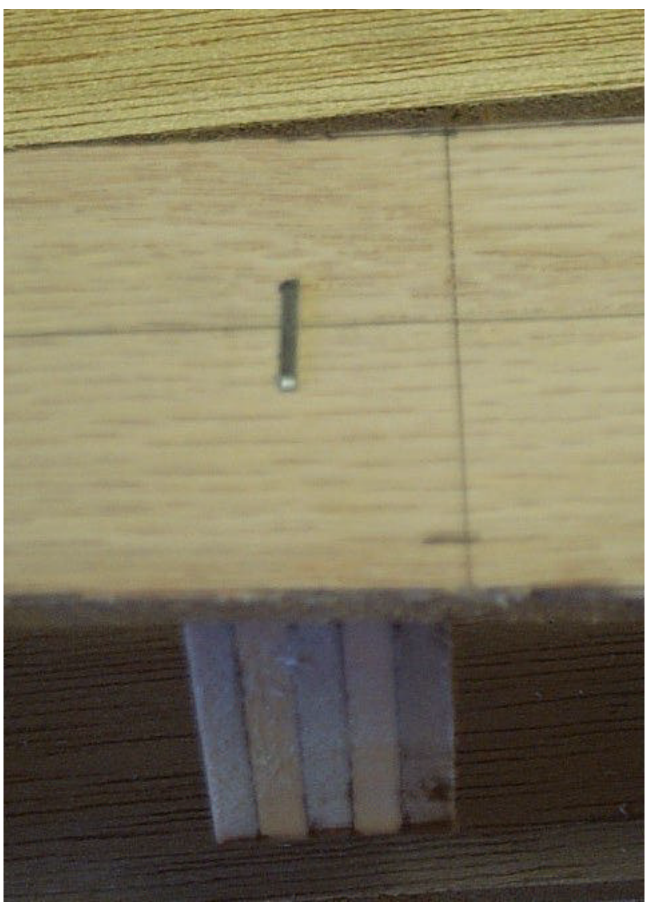
outer jig shown during test fit of trapezoids into tube shape

holes in the jigs, making a large knot (large enough that it cannot pull through the holes in the jigs) on the side of each jig that faces the small end of the tube. Leave a loop of a few inches of slack cord between each jig; Tie the excess cord between jigs into a slip knot, so that the cord is loosely suspended between the jigs and cannot get in the way during tube assembly; the knots must pull out easily when the end of the cord is tugged later on - check this before gluing up the tube! The free end of the cord should extend beyond the end of the large end of the trapezoid.

inner jigs stapled to one of the trapezoids; this photo shows a scrap of plywood, instead of the dowel, at the small end

Mark the 1/2” dowel at a point 1/2” [1.3 cm] from one end; this will be the insertion mark during gluing. Use pieces of adhesive tape to loosely hold the dowel in position (as shown in detail on page 3), similar to the positioning of the other inner jigs. Test fit the trapezoids and outer jigs, to make sure everything fits and to practice the assembly. Take the assembly apart and reassemble it a few times until the process is quick and smooth. Experience has shown that

an inner jig, in position on the first trapezoid; the cord hole is shown off-center, but it should be centered on the jig



inner jig stapled to trapezoid

outer jigs & wires at small end of tube

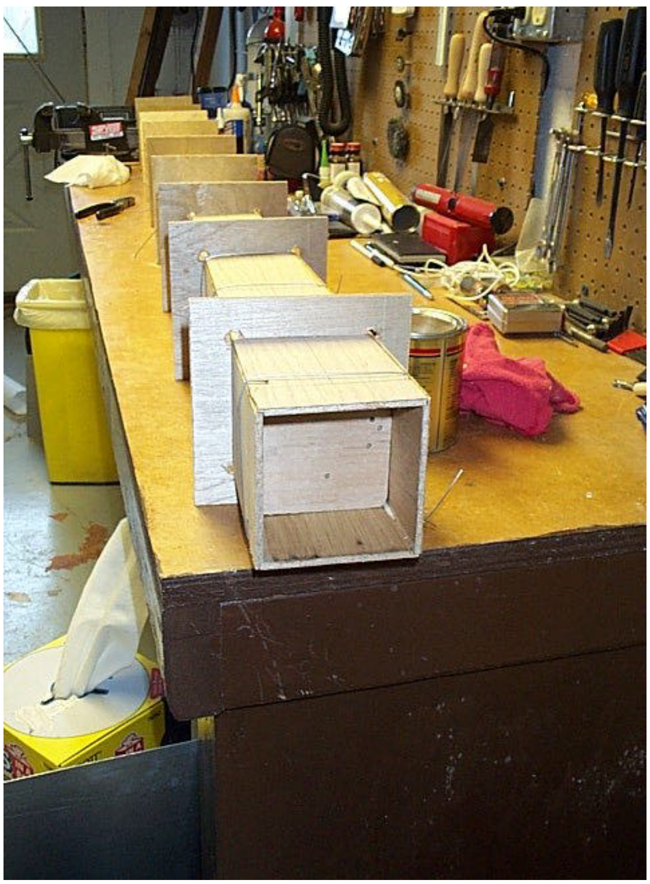
quickly playing the trapezoids loosely together against the inner jigs, placing all outer jigs together at once over the small end of the tube, and then sliding the outer jig ‘stack’ towards the large end, with each jig stopping where it fits, is a fast and easy procedure; fine tuning of the jigs and rabbet joints is always necessary once this initial rough assembly has been completed.

outer jigs in place during gluing, with wrapped wires visible; besides the outer jigs, about two wire wraps are required between each jig to adequately hold the rabbet joints tightly together

Assembling the Tube

Lay the four trapezoids down on a flat table, varnished side up, parallel to each other; the trapezoid with the inner jigs should be the second closest one to you. Lay a bead of wood glue in the rabbet cuts of each trapezoid. The glue should be positioned so that it is roughly in the center of the overall width of the cut, including the vertical and horizontal surfaces, so that when the wood is pressed together at the rabbet, the glue will have an equal area in either direction in which to squeeze. Also, the objective is to put down exactly the right amount of glue to fill the rabbet joint once assembled, without either squeezing out too much or being insufficient to fill the joint.

With the inner-jig-equipped trapezoid as a base, lift the adjacent trapezoids to vertical and position their edges so that the edges and rabbet cuts fit together. The tackiness of the glue should temporarily hold these two sides in position, resting against the inner jigs, although it is inevitable that not all the entire length of the trapezoids will stay in position due their flexibility. Quickly turn the remaining trapezoid over, glue side down, and lay it onto the inner jigs and the top edges of the two sides of the tube assembly. Make sure that all sides are even and the ends of the trapezoids line up. Slide the outer jigs over the assembly and put them in their best position, given the rough fit of the rabbet joints. Recheck the alignment of all the trapezoids, and start fine tuning the rabbet joints, working the outer jigs into better and tighter fits, working from the small end of the tube to the larger end. The tip of a small screwdriver or knife blade may be used to lift 'sunken' or sagging edges into their respective rabbet cuts.



inner jig shown just inside large end of tube

Working quickly, wrap lengths of wire around the tube assembly and twist tight with the pliers. The number of wire wraps may vary, and depends entirely on how well the pieces are fitting together; the joints must be held tightly together, and at least a tiny amount of glue should squeeze out at at least some places. Pay extra attention to making sure the rabbet joints fit correctly at the small end, this was not done on the prototype and the fit ended up being quite sloppy. Using a damp (not wet) rag, wipe up excess glue

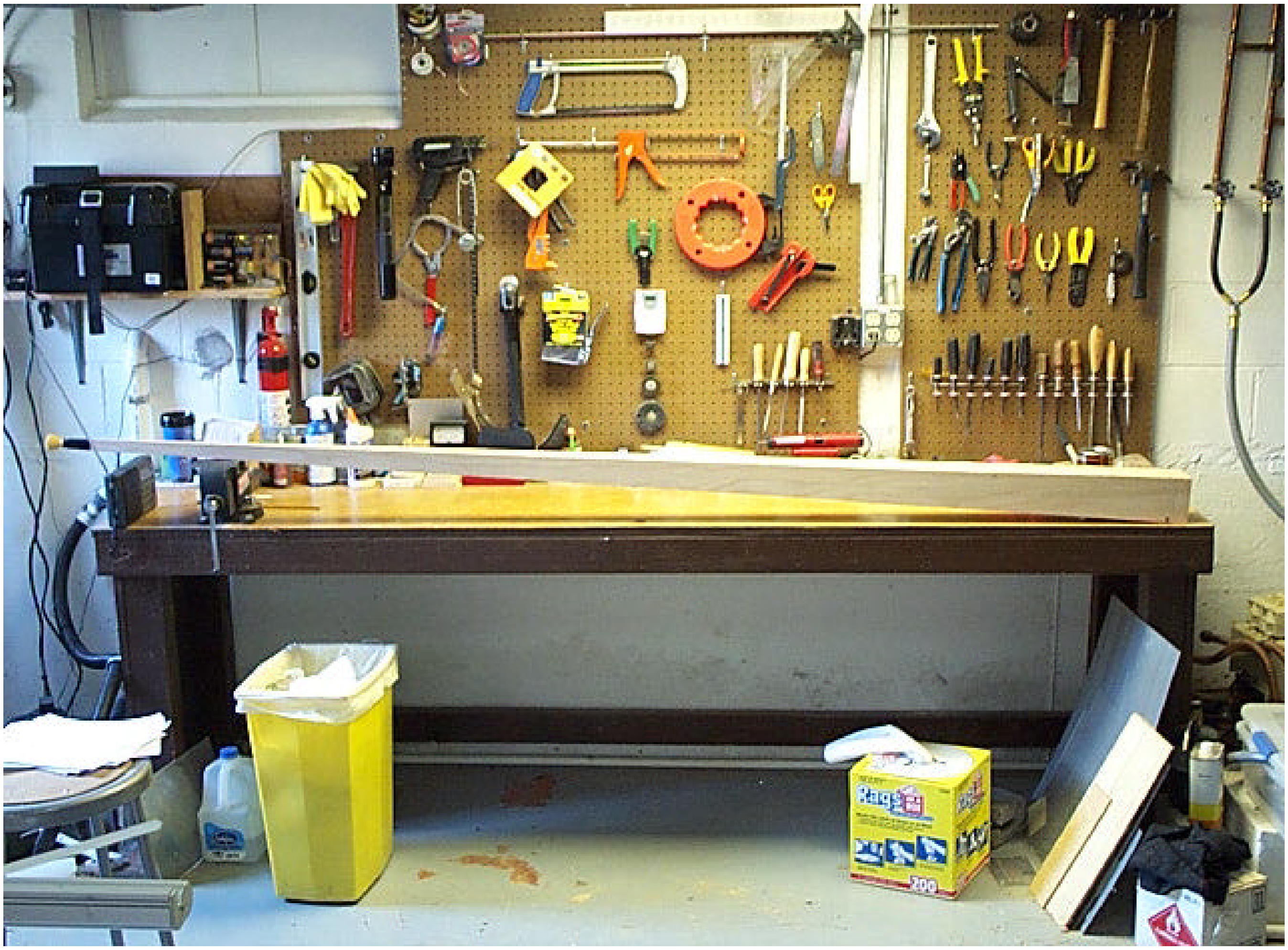
tube with all outer jigs in place, as glue dries; the outer jigs must sit flat on a flat surface, to be sure that the tube will end up straight and true

from the outside of the rabbet joints. Pull the dowel out of the small end of the tube, wipe off any glue, use cotton swabs to wipe excess glue from the inside of the rabbet joints at the small end, and then re-insert the dowel. The dowel must not be glued to the trapezoids, as it will need to be removed later! Make sure that the outer jigs are sitting evenly on the flat table top; this will make the tube straight and true when the glue dries. Allow the setup to dry overnight.

Remove the dowel from the tube. Remove the wires and outer jigs; it may be necessary to knock some of them loose by tapping on them firmly with a hammer. Mix previously saved sawdust with epoxy to make a wood-filled paste; it should be about 50% wood. Smear a thin coat of epoxy (not the wood-filled mixture) around the dowel for all of it's marked 1/2" insertion length and then wipe off all but a film; this will help the wood-filled epoxy to stick to the dowel. Use a small spatula or screwdriver blade and fill the inside corners of the small end of the tube with the wood-filled epoxy, to a point about 1/2" inside the tube. Liberally coat the epoxy-treated part of the dowel with the wood-filled epoxy, and work the dowel into the tube, using a back and forth twisting motion, to it's marked depth of 1/2". Pack more wood-filled epoxy into the corner gaps between the dowel and tube, and also work plenty of the mixture around the point where the dowel exits the tube. Allow the epoxy to fully cure.

Pull the staples or nails that hold the inner jigs in place. Pull the nylon cord at the large end of the tube until it is tight, then tug to dislodge the largest of the inner jigs. Take up the slack to the next jig and repeat the process until all inner jigs are removed. Rub wood glue or epoxy into the staple holes, and wipe off any excess on the outside of the tube.

Select a point about 1/16" [about 2 mm] from the small end of the tube, and using a hand saw, cut off the very end of the tube, including the projecting dowel section; be careful to



completed tube, with mouthpiece inserted, ready for test blow

make the cut clean and square. Inspect the cut end, and fill any gaps or holes with epoxy, allowing to cure before proceeding.

Carefully mark the exact center of the dowel's end at the cut surface. Drill a small hole through the dowel at this point, as a guide for the larger drill. Working carefully, drill out the dowel with a 1/2" [1.3 cm] drill (use high speed and slow feed); only a smooth round hole through the wood-filled epoxy should remain, with perhaps a tiny amount of the dowel remaining. This is the mouthpiece receiver.

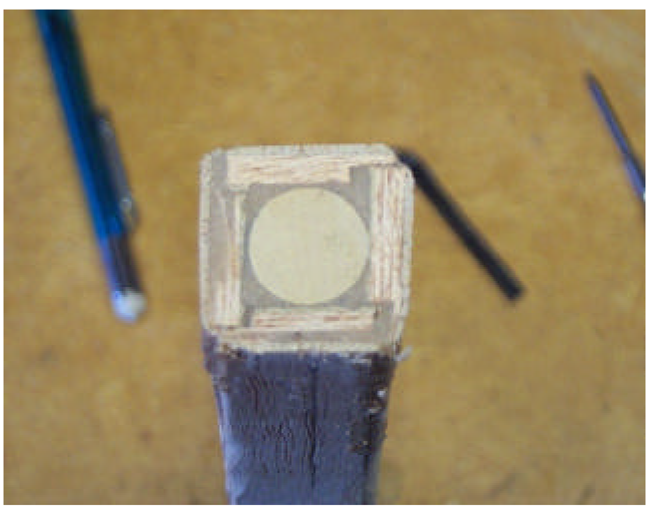
Check with a flashlight to see that excess epoxy has not obstructed the tube beyond this 1/2" point in the small end of the tube. Small tools or bits may be used to remove any such excess.

Sand or file away any lumps of dried glue from the outside of the rabbet joints. Thoroughly sand the outside of the tube, being careful to avoid sanding all the way through the outer layer of the plywood. Do not remove the line that defines the center of the bore; it is OK to sand in this area, but leave some hint of the line so that it can be restored in the same position after sanding. Sand the corners of the tube to remove the sharp edge, but do not round them too much.

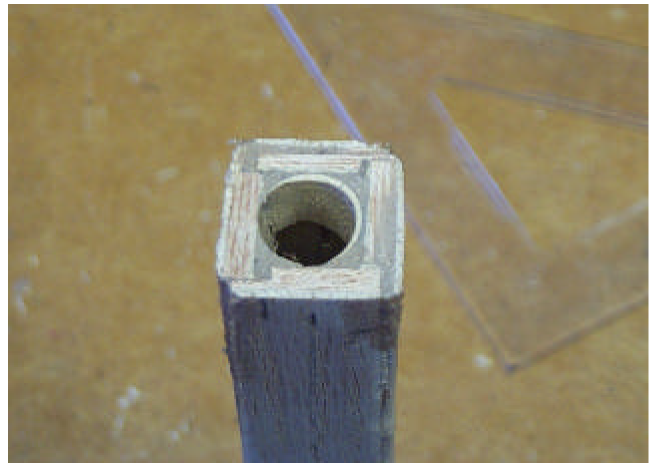
Testing

Fit the mouthpiece into the receiver; it may be a typical trombone or euphonium type, but the most representative serpent sound will be obtained with a true serpent mouthpiece. With either mouthpiece style, the other playing characteristics will be essentially the same, although minor differences in intonation may be observed. Test the tube by playing a series of notes; only a few pitches will be possible at this point, but is should be easy to play bugle calls such as "Taps". If problems are encountered at this point, check for tight mouthpiece fit at the receiver, and make sure that there are no leaks in the rabbet joints. If in doubt, smear more wood glue onto the joints, work it in, and wipe off the excess. If you suspect a leak at the receiver, try tightly wrapping the mouthpiece-receiver junction with a stretchable tape such as friction tape or electrical tape. If taping the mouthpiece improves the sound, check the receiver hole for roundness and absence of irregularities and air pockets; these may be filled with epoxy and the receiver re-drilled. The fundamental pitch at this point will be a (very?) flat C, two octaves below middle C. Do not proceed with the next steps until the integrity of the bore has been proven by playing.

closeup of small end of tube, with dowel glued in place with wood-filled epoxy



closeup of small end of tube, after cutting away end to form smooth receiver face with inside comprised of dowel and wood-filled epoxy; note that on the prototype the trapezoid ends were not well secured during gluing, and are not fitting properly at the rabbet joints - extra epoxy was used here to fill these extra gaps (the original error was due to sloppy measurements prior to cutout of the trapezoids, with the result that the ends were too narrow to fit around the dowel)



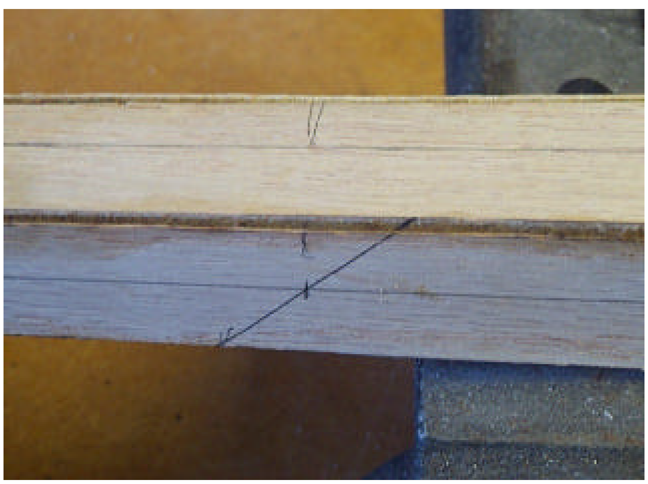
closeup of small end of tube, after drilling out the dowel with a 1/2" bit; note that the bit was not exactly centered, with the result that excess dowel wood remains to one side - this is not important except for appearances

closeup of small end of tube, with a trombone mouthpiece inserted; the mouthpiece shank will cause the mouthpiece to extend further from the receiver than with a proper serpent mouthpiece (which has almost no shank); several important characteristics of a modern mouthpiece are different from a serpent type; the edge of the rim has a different degree of sharpness, the cup depth is deeper on modern types, the serpent type has no 'backbore' while the modern type does, and the throat of the mouthpiece is likely a different diameter

closeup of small end of tube, with serpent type mouthpiece inserted; compare with photo of modern trombone mouthpiece on page 10

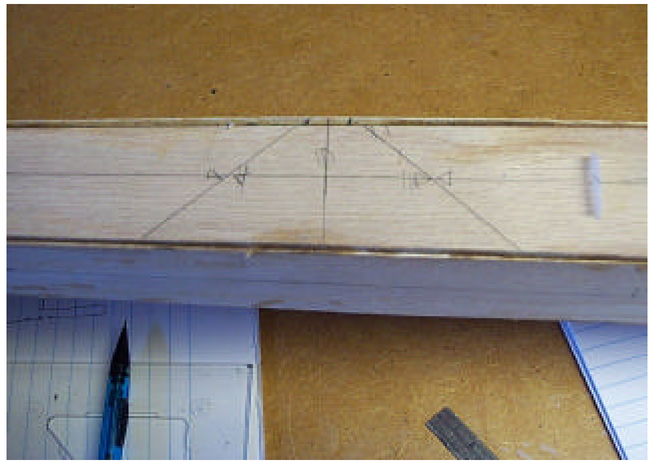
Shaping

The tube will now need to be shaped into the final Squarpent configuration. This is done by making five angled cuts and then rotating the separated tube sections to new relative positions and gluing them back together. Start by measuring and marking the cut lines; all measurements will be made using the bore centerline that is already marked on the tube.

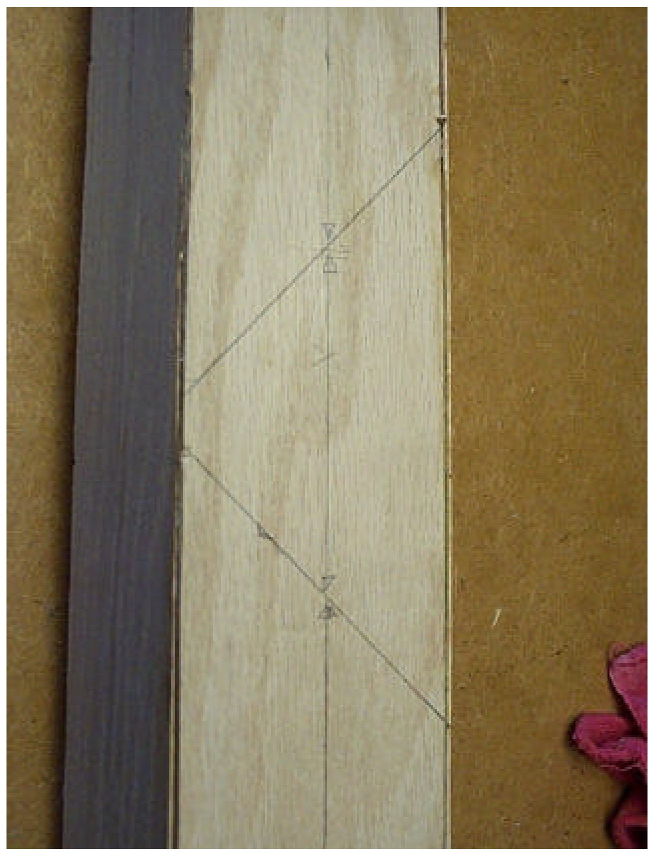


cut 'A' mark, intersecting with bore centerline at marked position; actual angle should be the other way (see page 3)

Using a tape measure, secure the 0" end at the small end of the tube (with the mouthpiece removed), and align the tape measure's marked edge with the bore centerline of the tube. The five cuts are called by letter names A through E, with the following measured locations: A = 10" [25.4 cm], B = 26.375" [67 cm], C = 28.375" [72.1cm], D = 71" [180.3 cm], E = 74.625" [189.5 cm]. At each of these measured locations, make a mark on the centerline.

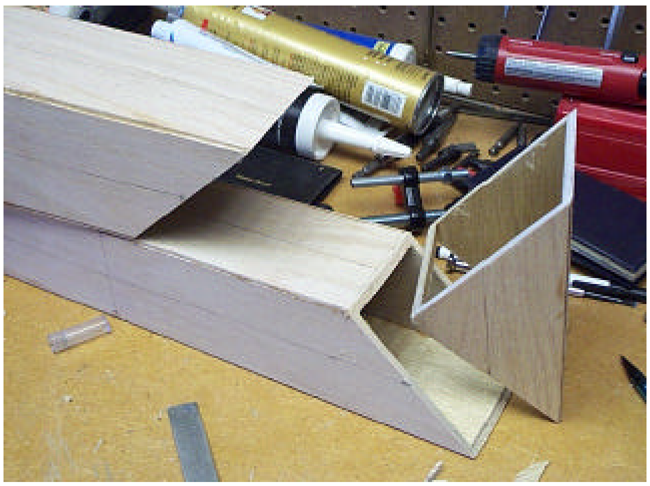


cuts 'B' and 'C' marks, intersecting with bore centerline at marked positions



cuts 'D' and 'E' marks, intersecting with bore centerline at marked positions

All cuts will be either 45 or 90 degrees relative to the centerline, *not* to the side of the tube! Refer to the “Mitre Cut Detail” on page 3 and mark the tube with the cut lines as shown; note that all diagonal cut lines cross the centerline at the measured marks. It is necessary to mark the diagonal cut line at each position first, then make the non-diagonal cut lines on the two adjacent sides; there is no need to mark the fourth side of the tube. Also note that cut ‘A’ is on a different ‘plane’ than the other cuts, so study the diagrams carefully and make the cut lines accordingly. Always use a drafting or carpenter’s angle, carefully aligned with the centerline, to make the cut lines; if the lines are not marked accurately, the cuts will be off and the repositioned tube sections will not align correctly.



tube sections after cutting at cuts ‘D’ and ‘E’

Use a mitre saw, or a hand saw with a wide blade and fine teeth, to make the five cuts. Do not use a power saw or mitre *box*, as it is too difficult to control the angle of the cuts. Best results will probably be achieved by just carefully following the cut lines by hand and guided by eye.

Take the two small ‘bow’ sections and fit them to the two larger sections that follow them (i.e. “Top Bow” to “Down

all tube sections after cutting

typical glue joint where a ‘bow’ joins a tube section

Tube” and “Bottom Bow” to “Bell Tube”). Note that precise alignment will not be possible. This is because angled cuts on a tapered tube will result in different cross-section widths across the cuts. When the ‘bow’ sections are rotated to make the corner, a larger cross-section of one piece of tube will be placed against a slightly smaller cross-section of the other piece. The resulting irregularities are of minimal importance, and will be compensated for by glue fillets. However, the pieces must align straight relative to the centerline, and there must be almost no gap between edges where they meet. Careful observation of gaps and subsequent filing or sanding can correct for small errors due to inaccurate marking of the cut lines or sloppy sawing.

some tube sections being glued together; the sequence of assembly suggested by this photo is different than what is indicated in the text, and a short length of tubing is shown glued to the “Bocal” as a repair caused by incorrectly marking the ‘A’ cut on the prototype

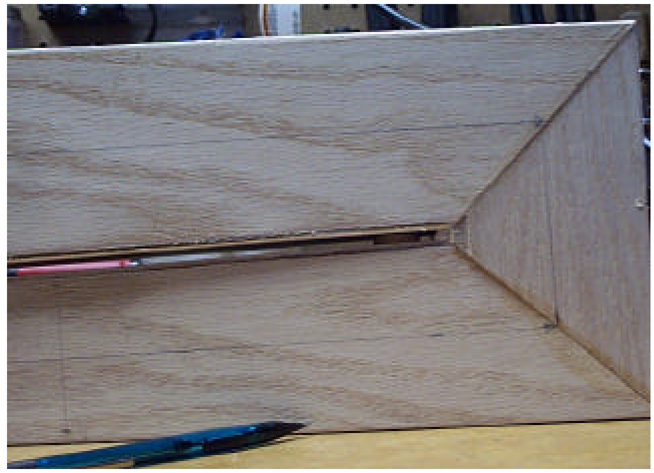
Apply wood glue to the edges of both sections at each corner, checking for optimal alignment by keeping the marked centerlines lined up. Block the sections with heavy objects and allow the glue to dry.

Using the same methods, join the previous two subassemblies where the "Down Tube" meets the "Bottom Bow". After making any small adjustments to the edges for proper alignment, and before gluing, carefully cut small sections of 3/4" [1.9 cm] diameter wooden dowel, for use as spacers between the parallel sections "Up Tube' and "Down Tube". There should be four spacers between the "Bell Tube" and "Down Tube" subsections. The spacers provide mechanical strength and take the strain away from the weaker glue joints at the angled cuts. Use wood glue on the ends of the spacers, and block the sections to hold them firmly together while the glue dries; use cotton swabs to wipe off excess glue. Repeat this spacer and gluing process, adding the "Up Tube" in parallel to the "Down Tube", joining at the "Top Bow"; two spacers are required here.

dowel spacers barely visible between parallel tube sections

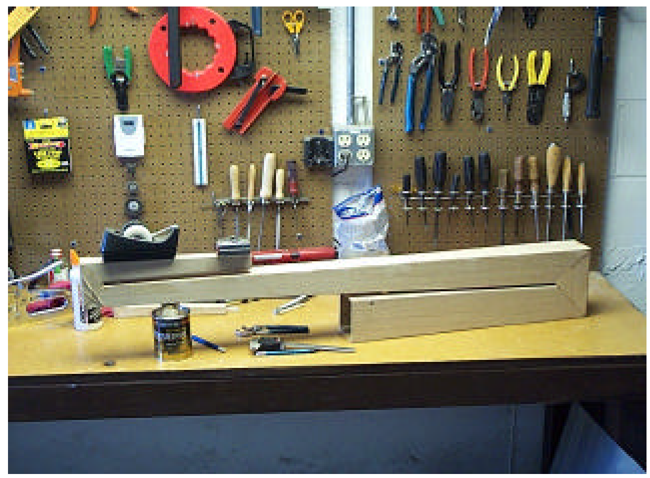
Stand the instrument vertically against a firm object. Glue the bocal section onto the rest of the instrument, joining at the "Up Tube". Clamps, wires, tape, etc; may be used to hold this joint together while the glue dries. Make a small piece of wood from scraps, shaped to fit in the angle where the "Bocal" meets the "Up Tube", and glue it in place to reinforce this joint. A metal bracket may also be used for this purpose.

With all glue joints dry, add another layer of wood glue to all joints, filling any holes or dips in the first glue layer.



dowel spacer barely visible between parallel tube sections

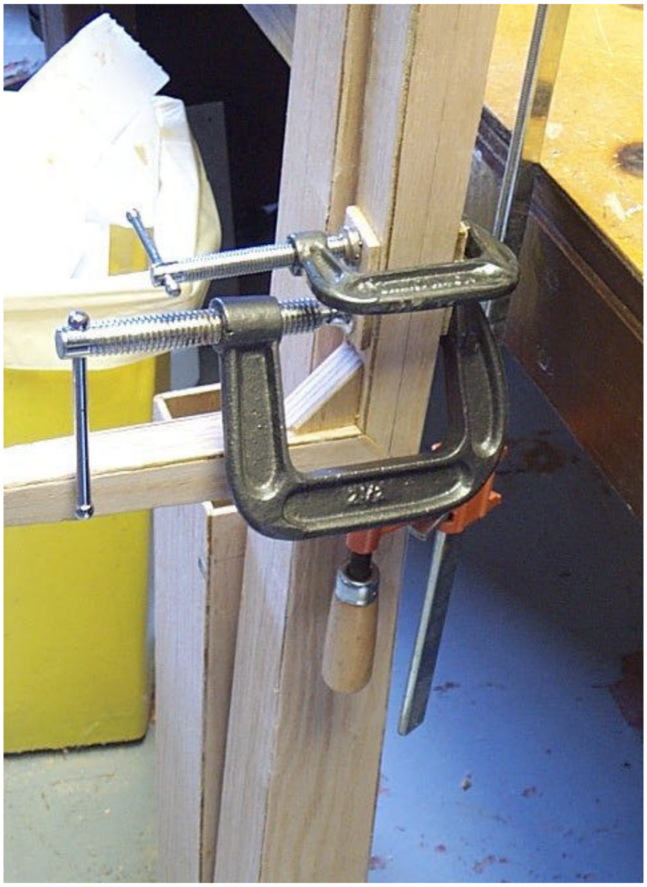
Allow to dry. Insert the mouthpiece and repeat the earlier tests to verify the integrity of the tube. If leaks are encountered, rub more wood glue into the problem areas and allow to dry.



"Up Tube" being glued and blocked to "Down Tube"

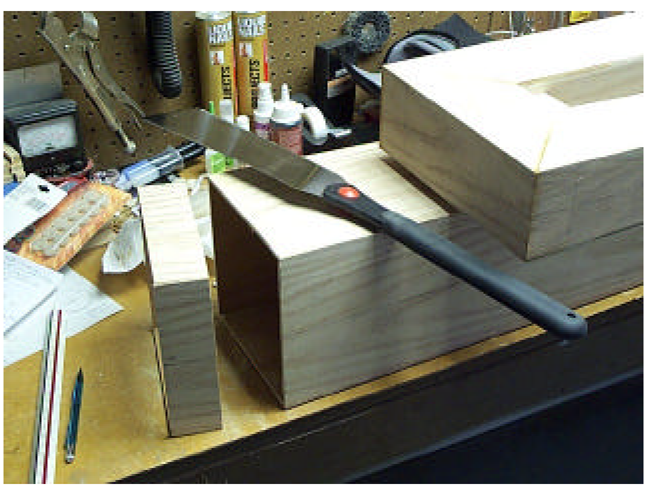
Tuning

Play the lowest 'C' pitch, which should be two octaves below middle 'C' on a piano; the note will be flat. Using a piano or other instrument, or an electronic musical instrument tuner, check to see how flat the sounded pitch is. Use a hand saw to carefully trim away a short section, perhaps an inch [2.5 cm] from the large end of the tube (the bell), and try again. Be careful to play a bugle call each time before playing the tuning note; the serpent related instruments have very flexible pitch, and if the tuning note is played 'cold', without finding a pitch center first, the instrument might end up being tuned sharp or flat. Repeat the trimming until the tube is in tune, assuming a pitch standard of A=440 Hz (or other standard as required); when the pitch gets close to being in tune, trim a smaller amount such as 1/2" [1.3 cm]. In theory, 96" [244 cm] makes an 8' tube, and it should provide a C, but in practice the actual length will be between 91" [231 cm] and 93" [236 cm].



gluing "Bocal" to "Up Tube", with reinforcing piece inserted at corner

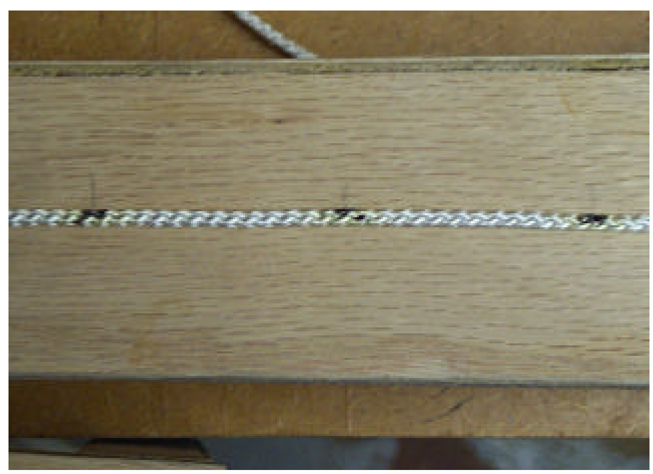
Only the fundamental pitch of the Squarpent can be tuned; all other notes are tuned by varying lip tension in combination with various shortened tube lengths as controlled by opening various finger holes.



tuning the tube by trimming small sections from bell; no photos were taken of this step during construction of the prototype, so this photo shows the same procedure being done to the contrabass Squarpent "Patrick"

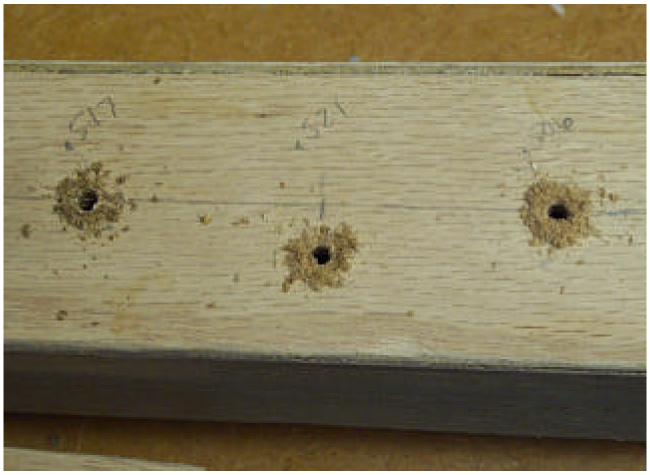
Finger Holes

Using a tape measure and starting at the small end with the mouthpiece removed, measure and mark the locations of the six finger holes. This measurement will be more complicated than with the cut marks, because the instrument is no longer in a straight form. However, since the reshaping of the tube into the final Squarpent form removes wood from the overall length, it is desirable to mark the holes only after the reshaping is complete. Refer to the "Finger Holes" chart on page 3 for the hole locations, and mark them on the centerline, on the side of the instrument opposite the player (opposite the side with the bocal). Initially, begin measuring along the side of the bocal, and take note of the measurement where the centerline crosses the joint at Cut 'A'. Move the tape measure around to that it extends up the "Up Tube" section, and position it so that the noted tape position from above is at the same centerline-Cut 'A' intersection. Continue measuring up the tube until reaching the "Top Bow" area. Make a mark on the centerline of the side of the "Up Tube" being measured, at the point where the centerline intersects with Cut 'B' on the front side of this tube (this can be done visually, and serves to relocate this point in the lengthwise measurement from one side of the tube to the adjacent side, without losing track of the measurement). Take note of the current tape measurement and transfer the tape around to the front of the instrument, and continue measuring down the front of the "Down Tube" section; this is the side where all six marks will be made, along the centerline.



marking the finger hole locations; on the prototype a string was marked as it was held alongside the tape measure, then the string was used to mark the instrument, as shown in the photo - this was not as good as marking directly with the tape measure, as the cord had some stretch and it was hard to accurately measure this way

Hold the instrument with the left hand on the upper set of three marks and the right hand on the lower set. Place the tips of the three middle fingers of each hand on the points where the hole marks intersect with the centerline. Without



pilot holes drilled at finger hole locations, with middle finger hole offset sideways from measured mark location

changing hand position, extend the middle finger of each hand, finding where the fingers are the most comfortable. Look to see how far from the centerline these two fingertips are, and make new marks for these two holes in the new positions; the lengthwise position will not change, only the sideways position moves.

Drill small pilot holes at each location, then carefully bore out the holes using the 1/2” bit. Keep drill speed high and drill feed slow, to avoid punching through to the inside and breaking the wood fibers of the inside plywood layer. If a drill press is available, using it for these holes will allow easier control of drill feed. Use a rotary wood cutting tool to undercut all finger holes as shown in the detail on page 3. A ‘Dremel’ type tool works well for this, but a ‘rat-tail’ file or even a razor modeling knife can do the job. During this process, the holes can be made slightly larger than 1/2”, as long as the finger tips can easily cover them with an airtight seal.

rotary wood cutting tool used for undercutting finger holes

Sand the outside surfaces of the instrument, removing all pencil marks including the centerline. Also sand inside the finger holes, using sand paper wrapped around a small dowel, drill bit shank, or round pencil. Shake and blow all sawdust and wood shavings from the instrument. Wipe the outer surface with a damp cloth and allow any moisture to dry. Apply a coat of polyurethane varnish to the outside of the instrument. Use cotton swabs to apply varnish to the inside edges and undercut surfaces of the finger holes.

The Squarpent is now complete.

Squarpent prototype in it’s finished form; other Squarpents should not have the patches near the Bocal on the Up Tube

LA MONICA / UNE JEUNE FILLETTE

SERPENT

TRAD. FRENCH

freely transcribed: P. SCHMIDT

- TRANSCRIBED FROM MEMORY - MAY DIFFER FROM ORIGINAL
- PROPER TITLE NOT CERTAIN - MAY BE EITHER, BOTH OR NEITHER

- ASCENDING E'S WHERE MARKED BY FICTAS (♮) CAN BE EITHER FLAT OR NATURAL, WHICHEVER IS EASIER TO PLAY

- ALTERNATE MEASURE AVOIDS D♭, WHICH CAN USUALLY BE PLAYED BY LIPPING THE C UP BY A HALF STEP.

- THIS TUNE IS A FAVORITE OF SERPENTISTS, AND LAYS WELL ON THE INSTRUMENT IN THE WRITTEN C MINOR

Playing the Squarpent

Fit the mouthpiece to the instrument and experiment with fingerings, using the C serpent fingering chart found on the Serpent Website as a starting point. All chromatic notes are possible, some by using published fingerings, others by using the player's newly discovered fingerings, and some by fingering an adjacent note and lipping to the desired pitch.

As with any keyless serpent, there are good notes and bad notes on the Squarpent. Some notes must be lipped quite a bit up or down, and one or two will probably never quite be there except in spirit (an experienced player can fudge these notes, getting them close enough to count). This is typical serpent behavior, and each player must come to grips with each individual instrument, finding a way to optimize the playing characteristics and resulting sounds.

The trombone/euphonium (modern) mouthpiece will make the sound bigger and brighter, but will actually make some of the bad notes even worse. Using a real serpent mouthpiece will result in a muddier, breathier, less distinct (i.e. 'Traditional') sound, and will allow more flexibility when trying to improve the bad notes by means of lip technique. The 1/2" diameter receiver is typical of historical instruments, so most real serpent mouthpieces will fit.

The inventive builder might attempt to figure out a way to make the bocal section removable. Doing so will make the instrument easier to store and transport.

The only real acoustical difference between the Squarpent and a real serpent is due to the square corners at the bends. This can be corrected somewhat by figuring out where to place a diagonal line, perpendicular to the original cut marks at the bends, so that the bore cross-sectional area inside the new mark is the same as the bore area to either side of the bend. Then, a hand saw can be used to cut away the square corner, followed by gluing a small piece of plywood over the resulting opening, making in effect a beveled corner. Excess plywood around the outside of the plywood patch can then be trimmed away. In practice, the acoustical reflections caused by the original square corners are insignificant, but the adventurous builder can optimize the instrument by trying this kind of modification.

Don't stop with the Squarpent! If you find you like the challenge if playing an instrument with these characteristics, ***move on to a real serpent.***