

Construction of the Shinken in the Modern Age



By

Erick Nelson

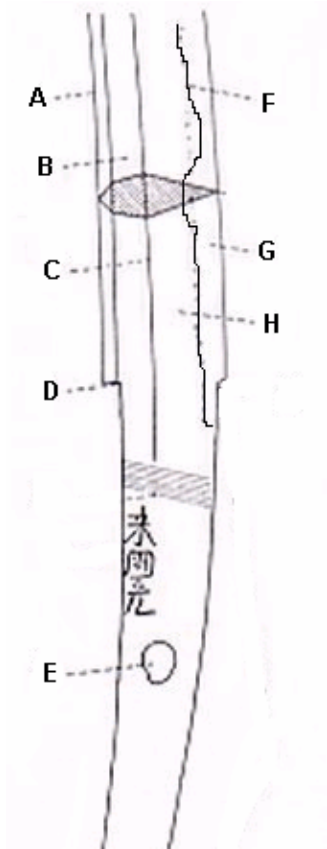
October 1, 2004
Revised January 20, 2005
August 29, 2005
May 1, 2007
v.5

Construction of the Shinken in the Modern Age

Terms used in this article

To simplify in the understanding of this article, the first section included is on terminology. Refer to this section when you encounter terms you do not recognize.

- A. Mune (the ridge)
- B. Shinoge-ji (flat part between the ridge and the line that parallels the ridge.
This is the area where the Bohi resides, a cut-in groove)
- C. Shinoge-suji (the line that separates the Shinoge-ji from the edge side;
also the widest part of the blade)
- D. Mune-machi (the end of the ridge)
- E. Mekugi-ana (hole for the mekugi pin that holds the tsuka to the blade)
- F. Hamon line (shows the edge of the tempering)
- G. Ha (the edge)
- H. Ji (the part of the side below the Shinoge-suji that comprises the edge)



Kissake - The blade point

Tsuka - the handle.

Same - the skin of a Sea Ray

Menuki - decorations used on the tsuka

Mekugi - a bamboo peg used to secure the tsuka to the blade

Tsuba - the hand guard

Seppa - a spacer for tightening the fixtures around the tsuba

Habaki - a brass fixture that seals and reinforces the area where the blade joins the handle

Fuchi - the ring that secures the front of the wooden tsuka

Kashira - the end cap for the tsuka

Ito - the silk wrapping for the tsuka

Sageo - the cord that affixes the saya to the obi, or belt

Shitodome - the decorative liners that protect the silk ito that pass through the kashira

Saya - the sheath

Koiguchi - the end of the saya where the sword is inserted. Usually made from buffalo horn

Koijiri - the end "cap" of the saya. Usually made from steel, silver, or buffalo horn

Kurigata - the fitting on the side of the saya that the sageo runs through

Ura - the "palm" or right side of the tsuka when the edge is facing downward and away from you

Omote - the "finger" or left side of the tsuka when the edge is facing downward and away from you

The Blades

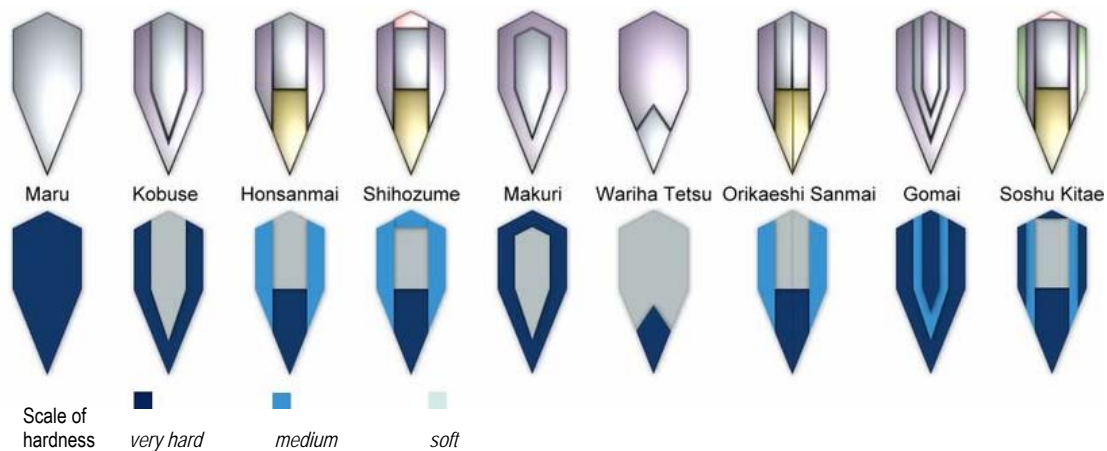
None of the blades in the original or successive articles was manufactured by the author. The blades used in construction of the Shinken in this article have all been made by competent, professional blade smiths.

The blades used in the original article was a *Bingo Mihara* with habaki installed, obtained from Cecil Quirino at Kris Cutlery. In the successive revisions of the article, additional blades were obtained from blade smiths in the USA, Indonesia, and Japan; the last of which (included in the May 2007 revision) was a traditionally formed shinken in the *Wariha Tetsu Kitae* method, with habaki, obtained from Cecil Quirino at Kris Cutlery.

PLEASE NOTE: Before you obtain a blade and attempt to complete it, consult an expert about the blade you intend to use. Please, please, please. This will keep you from injuring yourself, and more importantly, an innocent bystander.

About the blades

This illustration shows how various blade constructions uses various hardnesses of steel.



As you can see, varying layers are combined to create blades that have specific characteristics. For example, the *Kobuse* method of forging a blade wraps a softer core in a very hard layer. The *Wariha Tetsu* style inserts a very hard layer of steel for the edge, into a softer, more flexible steel body.

This article does not discuss in detail blade smith work, nor does it include recommendations on forging methods or application. Please consult an expert for selection of a blade.

Blade Preparation

Sometimes, blades have no visible hamon. There are a couple of ways to enhance it. On the last blade I mounted I polished the blade sequentially from 600 to 2000 grit, and then doused it in a light ferric chloride solution (1 part FeCl_3 6 parts H_2O) and then polished with a black iron oxide/clove oil solution. As this step is optional, for more information, see the special blade treatment section in Appendix 1.



Making the Tsuka

In order for the tsuka to be strong enough, it must be constructed so that the blade sits in a solid piece of wood, and be capped by another. Therefore, I begin with two pieces, one $\frac{2}{3}$ the width of the completed tsuka, the other $\frac{1}{3}$ the width. I selected the closest wood to traditional Japanese Honoki or Magnolia, which is Yellow Poplar. Select wood that is evenly grained—it's best if the grain runs straight down the length, or is sympathetic to the curvature of the nakago. When looking at the end, the grain should not be rounded much, it should also be straight. It may be hard to find good wood grain, but consider it.

Shaping the Tsuka

Over the years, I've learned a lot from cutters, Japanese artisans, dojo leaders and their teachers. What I've learned has really only convinced me that there is no "way" to shape a tsuka, but that tradition holds certain guidelines that vary from authority to authority. My more meaningful training I have received from Shozo Kato Sensei, 7th Dan Kyoshi Kendo, 7th Dan Kyoshi Iaido. What I can verify is that tsuka shape follows two primary rules: that it follows the geometry of the blade, and that it's length is related to the style of the user. I'll go a bit into the geometry issue, but the length issue is another story—it's highly individual, and anyone who uses a sword a lot will tell you how long a tsuka he or she wants and why. If you are making one for yourself, and you're not sure about the length, there are two general guidelines to consider, the first being that it shouldn't be more than a couple of inches (5 cm) longer than the nakago (for safety of neophyte users) and that it should be around 10 to 11 inches (25 to 28 cm) long, which is traditional in the bulk of styles.

Sometimes the blade is not a continuous arc, and it's not symmetrical. This is where things get interesting. The bottom line is, the more you curve the tsuka, the more aft you shift the weight of the shinken. Be careful in making assumptions at this point because as you alter the curvature of the tsuka, you are moving the location of the blade relative to where the hands are, and thus messing with the cutting stroke. This will be much more sensitive to people who cut a lot, or are higher ranking swordsmen. I have usually kept within traditional Japanese stylistics as those support the style of teaching by all my Sensei. The end note here is that you can do whatever you want. I'm just explaining why I do what I do.

I begin by tracing the arc of the blade, and continuing the arc to the extent of the tsuka. Once the basic curvature of the tsuka is established, I trace the nakago onto the paper. Sometimes, I'm surprised here that the curvature I want is not supported by the nakago. Once, the nakago was too straight for the rest of the blade. The solution? Cut the nakago so it fits. I'll draw some flack here for saying that, but that's the only way to get it done.

A graphic showing the amount of steel I removed from a nakago.

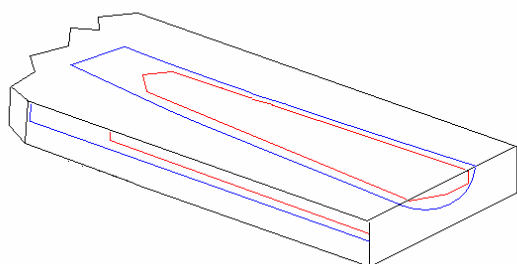


There are some reasons I would not do this, one being that the sword is a collectible. I've heard that there is a safety "ratio" of not having the tsuka longer than $1\frac{1}{2}$ inches (4 cm) longer than the nakago. However, if you've seen many real Japanese swords, that rule was seldom followed. I've seen tsukas from centuries old Nihonto that were as much as 4 inches (10 cm) longer than the nakago. If the tsuka is made correctly, it should be strong enough to be 3 inches (7.5 cm) longer than the nakago. Knowing this up front can give you the edge you need to make sure it's strong enough, like adjusting the nakago circumference, or wrapping it in same rather than using panels to aid in strength.



Once you know what the general curvature and length is for the tsuka, trace the dimensions to a piece of wood you will use to make it. I make two every time. Making two has saved me many times when I went back to the one still on the wood that hasn't been cut yet to re-confirm dimensions when final shaping of the tsuka.

Trace the nakago onto the wood in all dimensions. Measure the attributes of the tang, and copy them onto the wood—the profile, the ha, mune, and ends.



The red lines represent the outline of the nakago, and the blue outline represents the approximate outline of the tsuka when cut out. Keep close track of these areas.

I determine how deep I want to chisel by measuring the nakago and then drilling a series of holes nearly that deep in order to not remove too much wood too soon. I account for additional sanding to smooth and "finish" the fitting area for the nakago—generally about 3mm.

When laying out the outline, make the tsuka about $\frac{1}{4}$ inch (6 cm) longer in front than it will be when finished. You may need the buffer zone later when adjusting the fit to the tsuba. Cut the edges with a narrow chisel in order to keep from accidentally removing wood from this part. This must be done in several stages. Use a sharp thin blade, and don't drive too deep or you may crack the wood. The first stage of edging will only go several millimeters deep, and as you chisel, you will have to repeat edging many times.



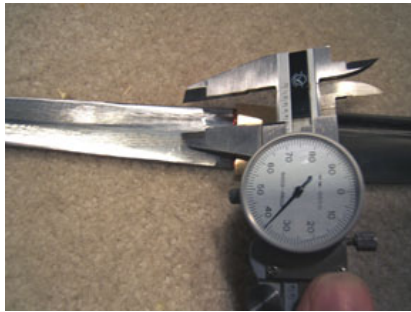


Considering chiseling, above all make sure they are sharp. Take the time to learn how to sharpen them... it pays big dividends later. When removing wood, I use a wide chisel to get the bulk of the tsuka hollowed out. I also shape the chisel so it's the same width as the shinoge-ji. If your chisel isn't, it will save you heartache later to grind the width of the chisel to the same width as the shinoge-ji.

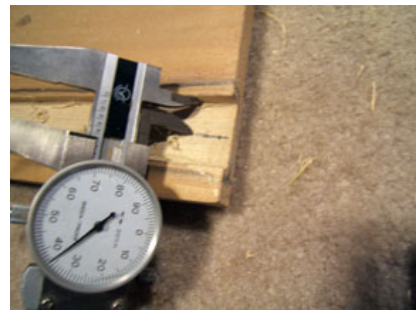
When chiseling, I don't recommend using a hammer. I used a small one on occasion but generally I use a round piece of oak. This will help you to not hit the tool too hard, and cut too deeply as this will gouge the wood. Keep the angle of the chisel low until you get the hang of manipulating it. Chisel small sections, and take your time. Be patient and continue until almost at the bottom of the pre-drilled holes that mark the stopping point for depth.

Edge the inside of the tsuka with a small tapered chisel. The point of the chisel will cut beautifully into the corner, cleaning up the edged sides. Be careful that you don't cut too far into the edges. Tap carefully, working up to harder hits of the chisel.

When at the bottom of rough chiseling, I sharpen and use the small tapered chisel by hand to define the line where the shinoge-suji will lay. Measure this several times throughout the effort to define it and transfer the measurements to the tsuka.



I measure the tang in a dozen places, and transpose those measurements to the inside of the tsuka. I then draw the lines onto the tsuka from the nakago. Consider the angle of the shinoge-ji and ji, and take care to sand the tsuka accurately.



You'll have to retry the fit very frequently, twice as frequently as you think you should. Move greater amounts of wood with a sharpened chisel by hand.

I measure and mark frequently, so I minimize errors this late in the game.

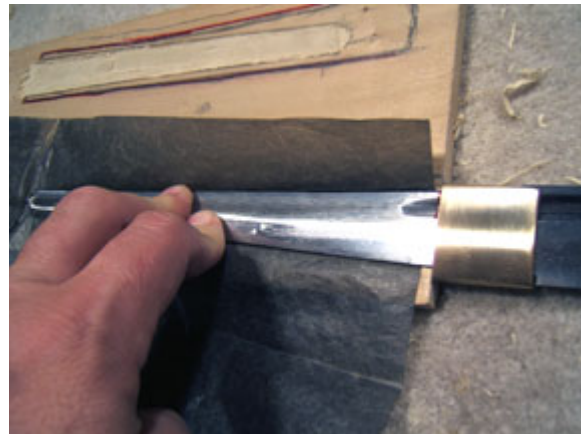
After lots of additional hand scraping with a small chisel and working on the edges, the shinoge-suji, the curvature of the ji, the width, and generally evening out the bottom, I get close enough to test fit. Of course, the nakago usually won't fit the chiseled out tsuka. However, it usually is close enough to sand it the rest of the way with sandpaper. The tsuka must fit tight enough so that the sword does not move inside at all, but not so tight that it won't slide in and out when the tsuka is put together.



To determine where I needed to sand, I use a variation on a technique used to gauge variances in a level surface when machining automotive parts. For this I used carbon paper. If you don't have it, you could just rub the tang with a soft-lead pencil or art charcoal first.

The technique entails laying the paper in the hollowed out tsuka, and then placing the nakago in over the paper and sliding the nakago back and forth slightly to transfer carbon to the areas where the steel hits the wood.

The first "rub" looked like the picture below.



You can see where the only places the steel is resting on the tsuka is at the front and at the rear. Hardly as level as one might think it could be gotten. They almost always look like this the first test.

After a bunch of hand scraping with a sharp chisel and some rough sanding, I can get a much better "rub" like the picture on the right. You can see that most of the "bed" of the tsuka is in contact with the steel. Most importantly, almost the entire line of the shinoge-ji is in contact with the tsuka.



Once I get a good rub, I use a jig and sand the opening smooth. Test fit the sword and work with fine sandpaper until you get a good fit.

For sanding, I use four grits of paper, and three sanding blocks: One, is the same shape as the sword's shinoge-ji, and two that are thinner, one to edge with and one that is tapered.

I use 120 grit to remove wood initially and quickly, then 180 and 220 to smooth it over.



It usually takes me about an hour of constant sanding and lots of measuring to get the tsuka just right.

Be determined to have the sword tang fit perfectly.

After getting the tsuka down to where it is about a millimeter or so from finished, I attach 320 adhesive paper to the nakago, unless the value of the sword prohibits this. In those cases, I actually make a duplicate of the nakago out of wood. Slide the nakago or the jig back and forth about $\frac{1}{4}$ to $\frac{3}{8}$ inch (6-8 mm) in the tsuka for a good long while, until the tang fits perfectly.

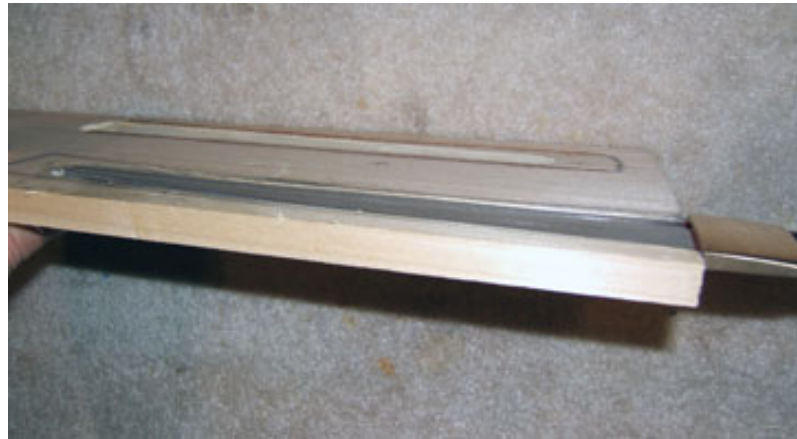
Once the sanding is finished, the tsuka should look beautifully straight and smooth. The smoother the finish on the inside, the longer the tsuka will fit well.





Using a straight edge assures that the nakago sits deep enough in the tsuka. There should be NO space between the straight edge and edges of the tsuka. NOTE: For forming the cap for the tsuka, it will be extremely helpful to have the shinoge-suji level with the edges of the tsuka.

Be patient and careful to make sure the nakago fits all the way into the tsuka, and doesn't move. To make sure the fit is tight enough, remove the sandpaper from the nakago, and slide the blade into the tsuka, and carefully pick up the blade with the tsuka. The blade should stay in the tsuka, if you handle it carefully enough. Be concerned about the fit if it's too loose. It should fit tight, but not so tight that it won't slide back out without excessive pressure when capped.



At this point, I determine where the habaki ends in order to know where to cut the tsuka after final fitting. I always allow a few millimeters extra when final cutting.

The Tsuka "Cap"

Once the fit is correct, I prepare for the second part of the tsuka. The theory here is that as the first part of the tsuka is cut *out* of the wood, the "cap" has to be *left in*. If we used a piece of wood equal in size to the one I just got done with, I'd need to remove all the wood that exists in the first part, leaving only the void for the steel. That's a Hell of a lot of chiseling and sanding! The solution is to fill the gaps that exist between the sword and the level wood cap with something that is hard enough but not too brittle.



Years ago, when creating a model with an epoxy resin that would show me the shape of the piece that needed to be cut to fit inside the first tsuka half, I determined that a better quality filler than what I was using would suffice for the wood that would have to be left on. The technique ended up fitting more accurately, was stronger than wood, and impervious to oils and water.

I originally left out the formulation that I use, but I think I've used it long enough to include with little thought that it will ruin someone's tsuka who follows my technique. The recipe is in Appendix 3. I used to use a simple epoxy, but it's not strong enough. What's worse, is that when normal epoxy dries, it contracts a bit and the "fill" effect is ruined. My formulation doesn't shrink or swell, and for the last several years has (so far) been superior to wood. A tsuka I made in 1982 is still holding up. Once you've familiarized yourself with the formulation, test it out and make some in order to learn about it's attributes or you'll be chiseling again!

When I'm ready to apply it, I insert the nakago or jig, and carefully line the inserted nakago and tsuka half with aluminum foil. One must take extra care to fit it into all the recesses without tearing it, or the nakago gets glued to it!

Once that's done, I mix up plenty of the solution, and place it into the foil-lined void. Here, one must be very careful not to put too much in.



If too much is put in, it will compress the tang and the nakago will not slide in when it's dry, or you may split the wood, or at the least, the "cap" won't fit on, and you'll have a mess from Hell trying to clean it all out and start all over. On the other hand, enough must be used or the result will be voids in the mix, and that means a weak substrate. I carefully level out what I put in with a straight piece of wood.

I also install additional pieces of wood that spread the force of the clamps out across the entire width of the thin cap. It's also important to have the depth of the tsuka half that was cut out the right depth so the "cap" rests on the shinoge-suji and can't be pushed inwards too far. An error I made several years ago came when I had the wood "cap" tightened too much and not well fit to the hollow part of the handle. The cap was bent inward, and when completed the wood was warped inwards a tiny bit. Over the course of a year afterwards, the wood returned to it's original shape, and the handle was so loose, I had to make another tsuka.





When the mixture is dry, slide out the blade, and this is what you should see. A nice cross-section of the nakago geometry.

In the picture to the left, you can see the line that the shinogesuji formed where the nakago was touching the wood cap piece.

The next thing to do is take the tsuka apart, and peel off the aluminum foil. If you were careful enough, none of the filler will have stuck to the other part of the tsuka. I've split the wood trying to get it off when that happened.



As you can see in the picture above, the exact imprint of the nakago is left on the other tsuka half after it's removed. You can even see the bump on the right side where the bo-hi resides on the nakago. This will have to be sanded off the tsuka, as the blade won't slide into the completed tsuka with the bo-hi bump left on.

Peeling off the aluminum foil. After all this is removed, the mixture must sit for a few days to cure.

Once the mixture cures, the tsuka half (we can sort of call it the tsuka half now) must be cleaned up for final fitting together. In this process, the wood must be carefully tended to in order to be glued. We wouldn't want it coming apart!

Here I am always sure that the tsuka fits very easily, but not loose! After putting same on, it will tighten a bit.





Test fit the two halves with clamps and the blade. When clamped to the point that all edges are touching (don't over clamp it—consider the fit when glued and released) the blade should slide in and out fairly easily, without forcing it and especially without being loose. If it's too tight, keep sanding it to shape it until it does. You may need to use the carbon paper technique to find high spots again. For problems here, see Appendix 4.

If it's too loose, make a sanding block that's wider than the tsuka, and sand the edges of the big piece until it's tight. Clamp it and trim it where you

marked it to be cut earlier, allowing several millimeters extra to be final trimmed after finishing, and the fuchi, tsuba and two seppa can be accounted for.

After any final sanding to loosen up the fit of the tang, and lots of blade fittings and minor adjustments, glue the tsuka together.

A note about this: If the tsuka is too tight, the horrific task of sanding it while it's together with a special jig will be the only way to make it fit right without splitting it open again. If it's too loose, you may lose the blade in practice! For more see Appendix 4.

To comfort myself, I insert the blade when gluing it. I believe this will assure that it doesn't take a bad "set" while drying. If there's a time to yank it apart, it's NOW!

After it's dried, the tsuka will need to be unclamped to see if the blade can slide out relatively easily. It shouldn't come out too easily, but it shouldn't be forced. It shouldn't slide out on it's own, and probably not even by shaking it. It should slide out without cutting through a towel while holding the blade.



Once the tsuka is dry, it's time to shape it. I begin by tracing the dimensions of the fuchi, and kashira on the ends of the tsuka, and the dimensions of the nakago on the side and edges. I then draw the shape of the tsuka I want over those in a different color. Once assured of the dimensions, I plane off the corners with a small



carpenter's plane, or use a table/belt sander for the bulky areas and sand the rest by hand. I generally do more hand sanding than I probably have to because I don't want it messed up at this point.

I start with 150 grit and a belt sander or whiz wheel attached to a hand sander. It is important to continually check the progression and retrace the dimensions as they are sanded off.

When I get close, I use only a sanding block and 150 to 220 grit paper to avoid taking too much off at a time.

When I'm confident that the dimensions are reached, I start trying the fuchi and kashira.

The difficulty in fitting these is to account for the *same* sharkskin that will be wrapped over the tsuka, but reside under the fittings. I've seen tsuka with

the same fit right up to the fittings, but not under them. It greatly strengthens the tsuka to wrap the same under the fittings. However, it's personal



choice. Sometimes, there isn't enough wood to sand it that far. If there is, I always put same under the fittings.

When I fit a tsuka, I allow for a layer of same, which is sanded to the point where it is completely smooth at the point the fittings are placed over it. I don't allow for the space that the nodes or "bumps" of the same take up.

On wrapping same: I have searched for methods of wrapping the same onto the wooden tsuka for quite a while. I have spoken with sword smiths, Japanese sword authorities, and read quite a bit on Japanese sword construction, including *tsukamaki*, or the art of Japanese tsuka wrapping (including Thomas Buck's stuff). The bottom line is, the art of same wrapping is a relatively protected process, and it's not easy to penetrate to the artists who do it. I remember hearing years ago that there were special people designated in Japan to do just the same wrapping, to which I scoffed, thinking *How hard could it be?* Well, I've been trying it for years, and it's freaking hard... at least it's hard to get it right. That which I've figured out so far has been on my own, and largely by trial and error. Traditional same wrapping is done by an expert in the art, and is "glued" on with rice paste. If you want to do it that way, good luck. I have had mediocre results doing it that way at best, and it's too important to me to have a tsuka that's good and strong when I'm swinging a shinken. I use marine epoxy so that it can dry when the same is damp. One word of warning. If same is put onto a tsuka while wet, it will shrink, and tighten the fit of the tsuka to the sword. It must be just right, not too wet, but pliable enough to bend. It's a reason to use 2 same panels rather than wrap the entire tsuka. Almost every time, a full wrap of same tightens the tsuka a bit, so be prepared to make a sanding jig to sand the inside of the tsuka with prior to final fitting.

I start with a full sheet of same. Traditionally, the largest nodes on the spine of the skin are for the "omote" side of the tsuka, exactly opposite the menuki on the "ura" side towards the rear. Center the big nodes around where the 2nd and 3rd wraps will lie on the tsuka. I select the best looking part of the same and cut it so that when wrapped around the tsuka, the nicest parts are visible through the openings in the tsuka ito.

Same has to be soaked for a while to get soft, but not too long, or it expands too much. I think about 6 or 7 minutes is sufficient. Place a towel over and under the same and soak the towels.



Cut the same a bit long in both dimensions, and pre-wrap it and let it dry to measure the shrinkage (which is uneven). Tape it with the edge straight, and wrap it right over the tape, and pull it tight. This, you will find quite frustrating. Don't give up. It's tough to work with but just be patient. If you are using panels, it's much easier to situate, and will look nice as long as the panels are appropriate sized.

For securing same, I use a method that dries and contracts with the same (cotton banding or cotton ito), which works very well because it's easy to pull tight. It mustn't be over-tightened, only tight enough to hold the same on with no gaps.

Wrap it several times if necessary, re-wetting the same more or less, until you get it just right, and properly wrapped and tightly secured. Once you do, mark it where it should be cut when it is dry. This will allow you to note the peculiarities of how the same dries. Then wet it as before, and cut it again.



When you're ready to wrap the final time, wet your same only as much as necessary to get it to shape. I mix up enough marine epoxy (it dries when used with wet stuff) to coat the tsuka with a very thin coat. I use a very slow drying epoxy as I want the same to dry as much as possible without compressing the tsuka more.

One of the biggest challenges is to be careful to keep the same lined up properly. Resituate it as necessary until it's correctly positioned. Wrap it only tight enough so that there are no spaces in between the tsuka and same. After all the test fitting, you should by now have an idea how to do that.

On a fully wrapped piece of same, (and on a good day), there is no space showing between one end of the same and the other. On a bad day, there is a gap. Tsuka I make for others never has a gap. Two of mine do. If you end up with a gap, it's not the end of the world. It's probably going to be covered with rice paper anyway.



If you have a space that cured between the same and tsuka, it is *almost* the end of the world... Just remember that you are going to cover the tsuka with ito eventually, so it's not impossible to wet, cut, and repair bubbles in same... it's just a pain in the butt.

The last thing you need to do once it's dry is to brush a sealant on the edges of the same so it won't take up excessive water, and trim the edges (usually with a small dremel tool). Be careful to not cut into the tsuka wood as this will provide a nice place for the wood to crack later.

As you can see in the lower picture, the nice large bumps from the same spine are on the side of the tsuka, opposite the back menuki.



The fuchi and kashira are fit by measuring the space they would take up on each end, mark it with a pencil, and hand sand or file the ends to the appropriate size. I measured the progress many times, and despite that, still manage occasionally to sand too much off. Sand or file less than you think. That seems to be a rule.

The end of the kashira where the shitodome fit can be problematic. I use steel fittings, and the slots where the shitodome fit are intentionally under-sized. Also, the kashira are sometimes low profile, and require cutting through the end of the tsuka. A very small rat-tail file should be used, and file delicately until the shitodome fit with no excessive space.

Once the kashira is fit, the shitodome are permanently installed by placing a tiny bit of epoxy on them, and slid into the slots, wiping off any excess epoxy. Once the epoxy is dry, I expand the inside slightly with a tapered punch so the silk ito slides through without snagging.



Lastly, I sand the same at the fuchi end of the tsuka, and install the fuchi where I believe it should be. I NEVER GLUE IT YET. Keep in mind that even though all the parts are assembled, the end of the tsuka will probably need to be trimmed so the tsuka fits on the nakago all the way and all the fittings are nice and tight. This means that the same at the fuchi end will have to be sanded back a little more later. When in the future the tsuba loosens, a thicker seppa will have to be added to tighten it up.



The last thing to do is to temporarily wrap the tsuka with ito and mark the spot where you want the hole for the mekugi to be. It's generally between the second and third folds. The tsukamaki does not have to be pretty for this, just accurate enough to establish the drill point. See the tsukamaki section if necessary.

Sword Fittings: Tsuba, Seppa, Fuchi, Kashira, and Shitodome

When I build a blade for an individual, the parts are very intricately selected. Most of the time, I end up using the blade owner's choice of antique parts. Those occasionally need *some* fitting, but I try very, very hard to get those which can be included with no changes to them at all.

When I build a practical blade, I only use steel parts. Sometimes, I use gold plated bronze, such as for seppa. I've used Herculoy before, as it's easy to work with and polishes up nicely. For this example, I selected a "Rice" theme tsuba, and plain fuchi and kashira with a simple cherry or pear blossom symbol (which were the most plain I could find that were steel). The seppa were also steel and very plain, having only straight finely cut edges. In this example, I refinished the fittings, so I'm including that here in case you're interested.

Prior to finishing the fittings, fit them to the blade. The seppa are the first and easiest to fit. Try them on the blade, and grind them little by little with a small flat file or dremel tool. After 5 or 6 attempts, they will fit perfectly. Occasionally I make my own seppa. I start with bronze oversized seppa that I sand flat and to the thickness I want, shape the outside edge of, and either scallop with a round file or leave plain.



The tsuba will be more time consuming to fit. Be very careful to not take too much metal off each time you file it. It is surprising that a little bit of metal removed will make a lot of progress as to how much farther it will slide onto the blade. It will take less filing than you think, and you will be happy you take your time and fit it so many times. It will slip right on when you are convinced it needs more taken off!

Final fitting of the seppa and tsuba. Now it was time to re-finish them.

For this sword, I had selected a blue theme. I had purchased blue silk ito, and decided that the blackened finish that came with the other fittings would be easy to alter. You can do this with almost any color, just find out what chemical will turn it the color you want. Be mindful that when using chemicals, you may need to properly neutralize it when you're done, so it doesn't ultimately destroy the integrity of the part.



To change the black fittings, I polished all the parts as much as possible, bringing the highlighted areas up to a nice shine.



I then treated the polished parts with selenium dioxide for 30 seconds at a time to make them "Blue." In case you're thinking, "That chemical sounds familiar..." It probably does. It's the active ingredient in gun bluing.

For most of the fittings, I only had to treat them twice. For the tsuba, the steel was good quality, and contained a lot of carbon. I treated it five times to get the desired effect.



After all the effort treating the tsuba, the finish I ended up with was a rustic matte, bluish hue that includes traces of violet, gold, black, and lighter shades of blue.



The rest of the fittings had a nice variance of coloration.

From left to right: fuchi, kashira, and two seppa.



The final element was to fit the fuchi and kashira to the tsuka, and trim the tsuka to account for the space taken by the rest of the fittings. Once the tsuka is complete, it will be fit to the blade, and then finally, wrapped with ito by tsukamaki. But now, we are at the last and most demanding task in construction of the tsuka—to drill the hole in it and through the blade for the mekugi.



A whole page with no pictures

The most important thing that must be done before the mekugi-ana hole is drilled in the tsuka is to assure that the tsuka is properly installed on the nakago. One wouldn't want to go to all the work of making a tsuka and drilling a hole through that and the nakago that would yield a loose fit—at which point would necessitate drastic action. The best way to get a hole through both, the tsuka and nakago depends on the limitations of and the techniques used by the person making it. Long ago, I had to hand-drill tsukas. Once I got tired of "less than desirable" results, I started drilling the blade first and the tsuka half when it was properly fit to the nakago, *before* I glued the second half on. After final fitting and shaping of the completed tsuka (and prior to wrapping with same) I drilled the *other* half, through the initial hole once it was lined up. Keep in mind, that doing it that way (fitting half the tsuka to the nakago, and drilling through the tang and tsuka half) means that all the fittings and same must be fit afterwards, and you won't be sure of the placement of the hole and mekugi relative to the ito, until you wrap it. Making adjustments then mean buying more ito that is thicker or thinner.

I choose, given my technological abilities, to complete the tsuka and drill the hole when everything is properly fit. This way, I can pre-wrap the tsuka with ito a few wraps to assure that the hole (and mekugi) will be in the right spot and then mark the drill point with a small marker. On a tip from Cecil at Kris Cutlery, I place the mekugi tightly at the very back of one space in the ito on the placement side, which allows it to fall tightly in the front of the space on the other side.

Fitting the tsuka to the sword is a very precise task, and you must do it right. My methodology goes like this: (1) mark the location of the end of the tsuka on the nakago *without* the fuchi installed; (2) mark the location of the end of the tsuba, and two seppa on the nakago in a different color; (3) remove from the tsuka the amount of wood equal to the area of overlap between the two; (4) install the tsuka with fuchi removed and nothing else on the blade to drill the hole; and (5) put everything together and fine fit the tsuka.

More specifically, I take the completed tsuka, and remove the fuchi. I slide it on the tsuka, and draw a very accurate line (do not scribe it—use a marker) on the blade where the tsuka ends. Make sure the tsuka is all the way on the sword! Then I remove the tsuka and install the seppa, tsuba, another seppa, and mark that location with a different colored line (so I don't confuse them). The difference between the two lines is the amount of the tsuka that needs to be removed. I take the measurement of the difference, and transfer about 90% of it to the tsuka end with all fittings removed. I cut that off, paying *particular* attention to any difference between the angle of line of how the tsuba and seppa fit and the end of the tsuka. Remember that when installed, the fuchi will require a bit more of the end of the tsuka to be cut off when fine fitting later with everything installed. When I'm ready to drill, I install the tsuka, and tape the very end of the tsuka to the blade very tightly so it doesn't move. I place the tsuka and sword on a drill press (yes, you really should use a drill press if you can, although I've drilled plenty without one), making sure that the hole is straight up and down, and pre-drill a 1/8 inch (3 mm) hole through only half (the ura, or palm side) side of the tsuka on the mark I made where the hole should be that hits, *but doesn't go through the nakago*. I only want the location to be marked with a partial hole through the nakago. I then remove the tsuka, and note the place on the sword's nakago where the drill hit it. I put the sword on the drill press, make sure it's level and clamp it quite well. Then, I drill the correct sized hole through the nakago. The size? It depends. Some people like 1/4 inch (3 mm), some 3/16 inch (5 mm)... some like two smaller holes and two mekugi. It depends also on the width of the nakago. Don't make it too big as it will weaken the nakago. Japanese nihonto mekugi-ana varies. The idea is to hold the blade in so... I usually drill them 1/4 inch (6 mm) or 7/64 inch (7 mm) (which is between 1/4 and 3/16 inches). The larger hole in the tsuka and the other side will be done later, after everything is fit and just before wrapping the tsuka with same.

Note about drilling hardened steel: When trying to drill the sword tang the first time, the titanium drill bit I used screeched like a Banshee after three seconds of contact. After a look, sure enough, the bit was a nice shade of purple at the tip. I called Cecil at Kris Cutlery, and he told me to use a tungsten carbide bit. These are found at higher end hardware stores, and not usually the sort of thing you can find at Home Depot. Almost any size of tungsten carbide bit is accessible on-line. Once I chucked these into my drill press, they sailed through the steel like it was butter. If the first attempt to drill the nakago doesn't work and you need another bit, don't remove the sword... you'll likely never get it back on the exact same place.



Once the main hole is drilled through the steel, I remove the blade from the drill press and clean up the area on the nakago around the new mekugi-ana with 320 and then 600 sandpaper and oil.

Make sure the blade slides nicely into the tsuka still. If it doesn't, don't force it. Continue dressing the area where the hole was drilled. That's definitely the problem.

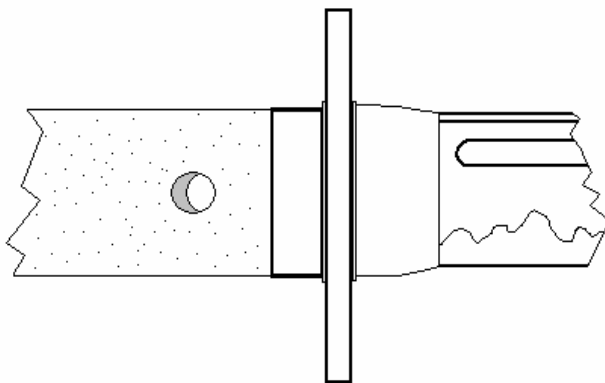
Now it time to make the finished hole in the tsuka. I do not just drill the hole all the way through anymore. I used to, but found a better way to do it that can fix small fitting errors. Basically, the hole will be completed last, after everything else is done. What I do is drill one side (the side I just drilled with the $\frac{1}{8}$ inch (3 mm) bit) with a slightly smaller hole than the one I drilled through the steel nakago. When I drill a $\frac{7}{64}$ inch (7 mm) hole through the sword nakago, I drill a $\frac{1}{4}$ inch (6 mm) hole through only half the tsuka. From here, you'll fit the tsuka, and last, before you wrap it, cut the other side.

Fitting the tsuka to the nakago is simple, but you should take care. Messing this up can put you back in the chiseling and same wrapping business. For errors that occur in this process, see Appendix 4 for a few possible emergency remedies.

Fitting the tsuka

First, I finish the ura side hole. I install the tsuka onto the sword with all the fittings off. Making sure the tsuka is all the way on, I insert a chopstick or a punch with some 220 grit paper on it and "ream" the hole in the tsuka until it's almost exactly the same as the hole in the nakago. I still don't yet cut the other side of the hole in the tsuka. Then, I install all the fittings on the sword: the habaki, seppa, tsuba, and second seppa. Now is when I install the fuchi on the tsuka. Making sure the fuchi is all the way on, I slide the tsuka onto the nakago. What I'm looking for is a small discrepancy or overlap between the holes. They usually won't be lined up, because the tsuka has been left a little long, and hasn't been fit yet to the fuchi.

The overlap usually looks like this:



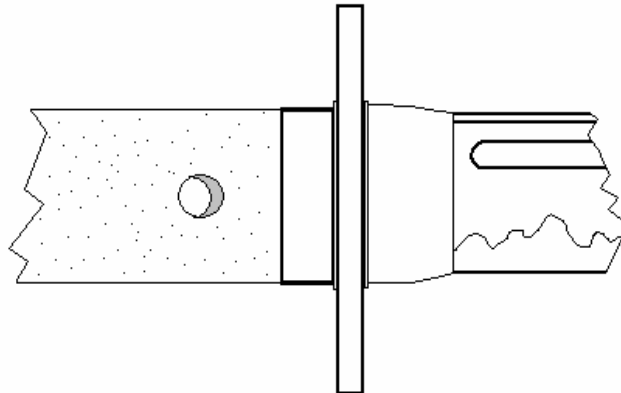
The mekugi-ana is not lined up with the nakago, and the steel overlaps slightly at the rear of the mekugi-ana. This is good. This is adjusted by removing the tsuka, Taking off the fuchi, and sanding off *almost* the amount of the overlap. It should be pushed on reasonably hard as to not allow any movement of the other components.

With this fit, the thing to do is to remove the tsuka, remove the fuchi, and sand the end of the tsuka little by little, until you get it lined up perfectly. Remember when fitting, to make sure the tsuka is slid on all the way, and pushed with some pressure to keep fittings tight. To seat the sword into the tsuka well, you can TAP lightly the bottom of the tsuka (leave the kashira off) on a

hard surface to seat the sword into it. Don't hit it too hard, as you can damage the tsuka. Take care when sanding the end of the tsuka to cut squarely, and not put a taper on it—something that will assure that you get a loosening over time... seemingly over and over.

What I *really* don't want to see is the overlap to look like this:

This means the tsuka has gone on too far. The only way this can happen is that the hole was drilled in the wrong spot, and the tsuka was not all the way on. In this case, the sayashi is in trouble because we can't slide the tsuka back—then it will be loose throughout the fit to the nakago. I've actually had this happen, and I cover it in Appendix 4. Basically, the only remedy is to re-drill the tsuka in another spot, and fill this with a dowel and cap it with a small round piece of same.

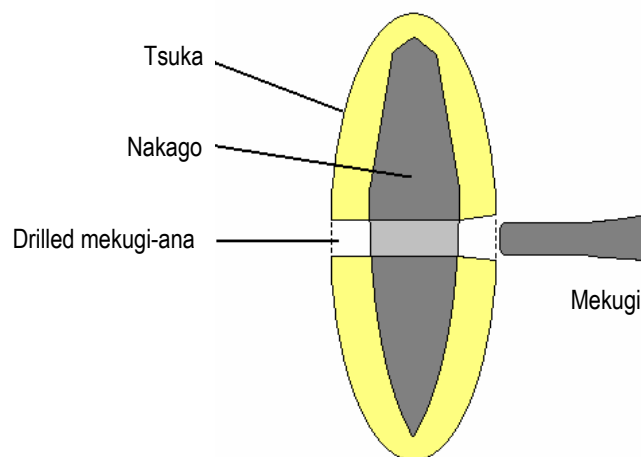


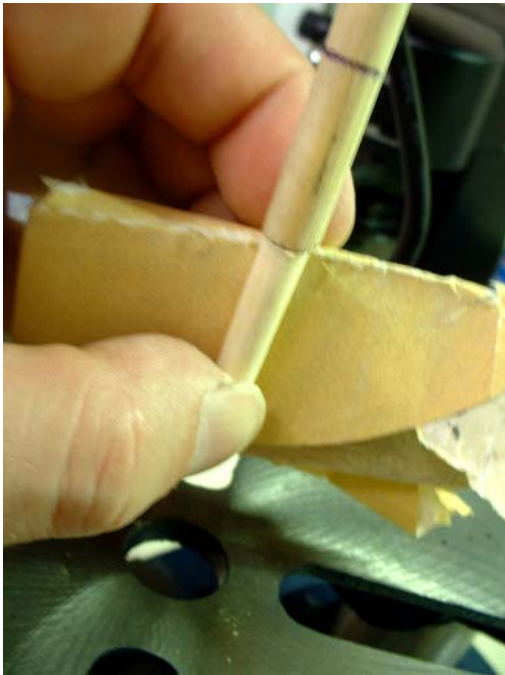
Once I get the tsuka fit, it's time to cut the other side of the mekugi-ana and make a mekugi pin. To put the hole all the way through, I select a drill bit that is $\frac{1}{16}$ inch (2 mm) smaller in diameter than the hole. I tape the area very well where the hole will come out, and drill it very slowly, without forcing the bit. Once the hole is all the way through, I enlarge it through the mekugi-ana and the sword, to assure it's not made too large. The omote side mekugi-ana should be smaller than the ura side, so a tapered pin fits well.

Mekugi

To make the mekugi, one must start with high-quality bamboo. Never use a piece of a chop stick, or a piece of bamboo of questionable quality. I recommend getting good materials for mekugi from a reputable sword repair establishment. I get mine from Ben Krieser Sensei in San Antonio, Texas (www.japaneseswordsltd.com). Another source for mekugi is Fred Lohman in Portland Oregon (www.japanese-swords.com/). When you order the ito, shitodome, or other part, ask him to throw in a piece of bamboo for mekugi.

The bamboo material comes to you much larger than you will want it, so to fit the mekugi, the task is to decrease the diameter of the bamboo. This is complicated by the need to taper it slightly so it goes in one way, but not the other, and to keep it straight so there is full contact of the mekugi through the tsuka and nakago.





To sand the mekugi, I chuck the bamboo in my drill press, and at a marginally slow speed, run the drill while holding a sanding block with 220 paper on it against the bamboo. You must measure often, like every ten or twenty seconds of sanding. It's important to leave it both longer and bigger in diameter than the hole size by a wide margin because when checking, you will almost always find that you'll have to sand it some more to smooth it or straighten it.

I leave the mekugi 10-15% bigger when "finished" than the measurement of the hole because the bamboo mekugi will "consolidate" when pressed into the hole.

This means if the inside diameter of the hole measured by micrometer is 0.1878 in., I adjust the micrometer to about 0.2065. It usually won't fit easily if it's any bigger, but it will fit better after "fine fit sanding" by hand. I actually sanded one to the proper dimension, and it felt way too loose when I inserted it into the hole in the tsuka. I cut a second one and left it a little bigger. It was initially too tight, but ended up feeling very secure after hand sanding it ever so slightly.



Of course... when sanding anything that is in a drill or drill press, make sure it's turning slow for God's sake. One could easily injure oneself.

One way to make sure I am getting a good fit, and actually have a round mekugi that has full contact throughout the nakago and tsuka, is to sharpen a pencil and rub the inside of the hole of the tsuka and nakago with the freshly sharpened graphite. You can also use a charcoal drawing pencil or charcoal on a pipe cleaner. Fit the mekugi to the tsuka and see if you have a complete rub-off of graphite from the pencil onto the mekugi.



I feel that it's worth making another one if I have a poor fit--this retainer is important! Once the diameter of the mekugi is proper, I insert it and mark where I want to cut it down to. I always leave some excess on either end, as the mekugi edges should be nicely rounded off on each end. Hand sand the ends, and be careful!



Mekugi fit should be tight, but not too tight to insert it by tapping gently with a very small hammer or small block of wood. The picture below shows about where mine get too tight to push in easily with a finger.



Finishing the tsuka--Tsukamaki

This entails wrapping the tsuka with ito, adding menuki, and tying off the finishing knots. Obviously, tsuka ito is necessary. I don't use cotton. It's terrible compared to silk. Silk is definitely worth the extra \$15.00. The formula I use is "get a lot." I don't mind having 25% too much. I have nightmares about not having enough. My formula is to convert the length of the tsuka in inches to feet, and add 4 feet (11 inch tsuka means 11 plus 4 feet... I'd order 15 feet). Or in metric, for every 2.5 cm of tsuka length, plan 30 cm of ito, plus 120 cm. For a 28 cm tsuka, use this formula $(28/2.5)(30) + 120 = 456$ cm (4.5 m). This has always done it for me, never leaving me short, and generally only costs me \$5.00 more than I'd pay to be nervous.

Also required, is menuki, a glue mixture (either diluted Elmer's or rice paste) and rice paper. I made my own menuki for my Bingo Mihara. I took plaster casts of another pair I have that I really like, and poured these out of a complex molten mixture of selenium, bismuth, and another metal I picked up out of the arroyo while hiking in Roswell, NM that I can't identify. --I'm kidding of course. But seriously, I really did cast them myself. I did it a while ago, so I didn't think to take pictures. However, I generally buy good quality gold menuki, (I like Fred Lohman's menuki) or use menuki given to me by the owner of the sword.

The more complicated aspect of tsukamaki is dealing with rice paper strips, and triangles called *hishigami*. I was given a great tip from Cecil Quirino from Kris Cutlery about how to deal with the rice paper. He saw an old tsukamaki-ist wet the paper before placing it by wetting it in his mouth. I have settled on a newer, less traditional but very sturdy alternative to rice paper *hishigami*: pressboard (like the back of a notepad). It has held up to the cutters I've wrapped handles for very well.



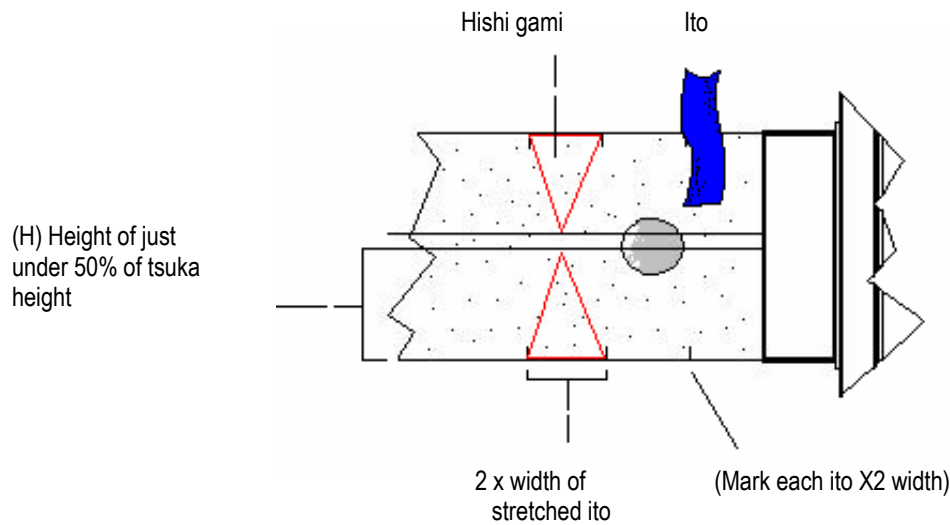
Rice paper (it can be gotten at craft stores such as Michaels or Pearl Arts and Crafts), needs to be built up to shape the edges of the tsuka. It also serves to protect the ito from catching on the rough same and wearing through prematurely.



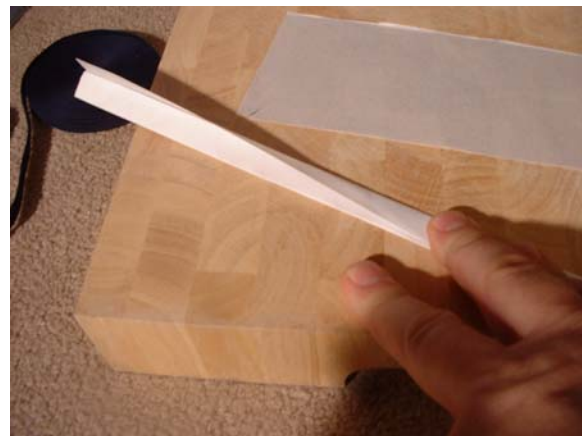
The strips are glued using boiled Japanese rice mashed into a paste (with a little water added). This glue can be made easier by mixing Elmer's glue with a touch of water.

Let this dry, then mark the rice paper starting at the fuchi, all the way back to the kashira, in increments equal to the width of the ito (as it is stretched and will reside on the tsuka).

The next task is to make hishigami. I'll cover both the traditional way, and the new way I do it. The first task is learn the formula about how to size the hishigami. I figured this out by trial and error, and it works pretty well.



When I use rice paper hishigami, I do the following: take a sheet of rice paper, about 7 inches (17.5 cm) long, and fold it 7 to 10 times the size of (H) above, and trim the excess off. I fold it up, cut it into pieces equal to the marks on the tsuka (two times the width of the stretched ito). Then, fold them into equilateral triangles.



What I end up with is lots of hishigami. And a lot will be needed... one for each fold. I used about sixty of them. This is somewhat tedious, but nothing compared to putting them in as the ito is wrapped!



The second way I make hishigami is my favored way. It's more sturdy, easier to get a good tight pull on the ito, and doesn't crush near as easily. Following the formula above, simply cut your hishigami out of pressboard—like what backs a notepad of paper. Once you get one cut the right size, you can trace that one to form the rest.

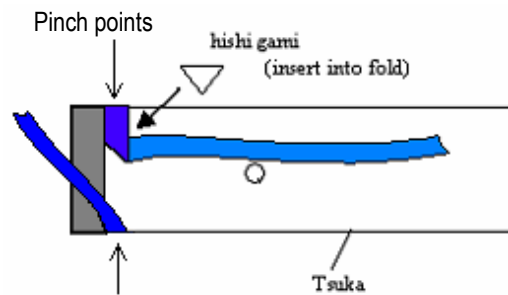
Wrapping the ito – tsukamaki

While wrapping the ito, you really need some sort of a stand to put your tsuka on. Here is a picture of David McDonald's stand (who is one of the best domestic sources for Tsukamaki), which is rather elaborate. I simply use a piece of wood that has a "tang" protruding from it that I can slide the tsuka over, and rotate it as I choose. It sits close to the floor so I can rest my elbows when I get tired. One of these days, I'll build one of these.



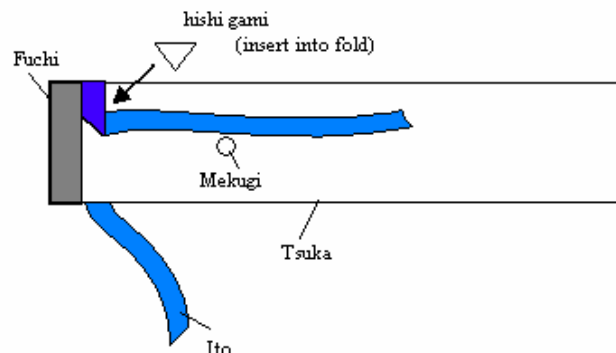
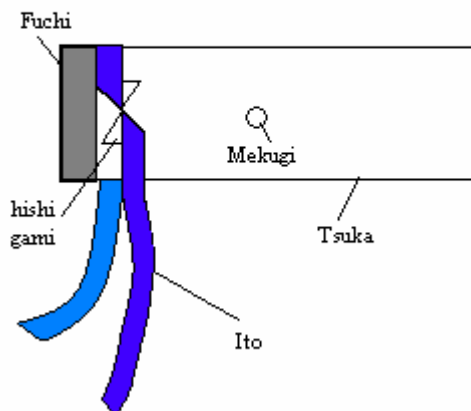
The tsuka should be contained in some way so the ito can be pulled tightly and evenly stretched. Traditional tsukamaki mandates starting with the ito positioned the center next to the fuchi on the *omote* side, which is the side of the tsuka that faces outward when being worn. In other words, the opposite side from where your palm contacts the tsuka. It is then pulled around to the *ura*, or the "palm" side. I place a piece of two-sided tape on the ito at the starting point, which helps hold it. Don't glue it.

Pull the ito around tightly, and pinch it on the top and bottom of the tsuka with a clamp of some sort at the pinch points shown in the graphic to the right. I use the big orange-handled clamps you can buy at a hardware store. Only pinch it on the ito because you will have to pull the ito around again right next to where you are pinching it.



Next, fold the piece of ito that comes from the bottom to the top of the tsuka first. How it's done requires some practice, and no one should expect to be able to do it the first time. The technique is like a fold under, insert a hishi gami, then another fold continuing on over to complete a full twist... ..yea... right.

OK... as the ito is pulled around, it's folded under toward the back end of the tsuka, and a hishi gami is inserted into the fold.

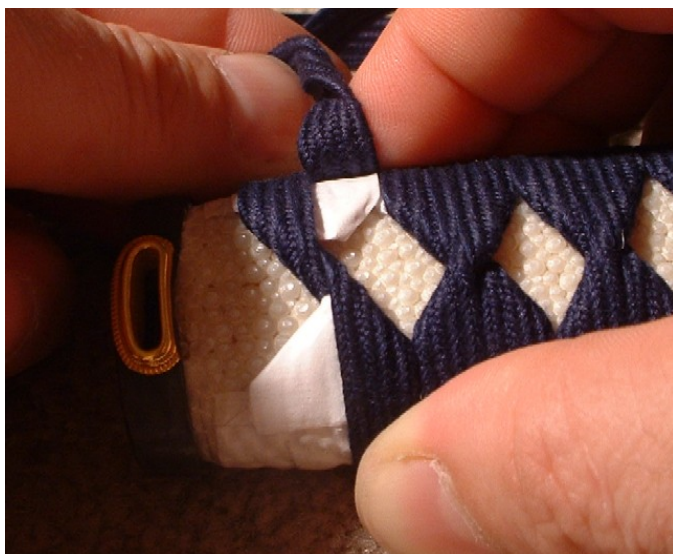
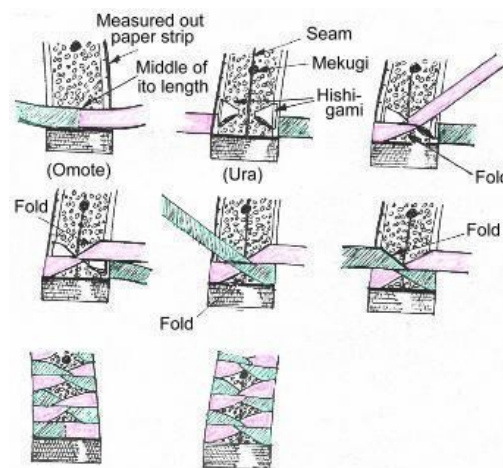


Then, after the hishi gami is inserted in the first fold, the fold is continued on over and another hishi gami is inserted into the new fold, under the ito.

Here is a graph that further illustrates the technique that was made by Thomas Buck :
(<http://pages.prodigy.net/tlbuck/tsuka/tsuka.htm>).

The trick in making these folds is that the ito that is folded over the top (above, it would be the green strand of ito) is higher than the ito that is on the bottom. That makes the overlapping piece of ito more difficult to hook onto the hishigami. I figured out that when you fold the hishigami to get the "triangle," to fold the paper under, so when placed it stands away slightly from the tsuka. Further, if you twist the hishigami slightly, the left side stands up higher than the right, making it easier to "loop" the ito around it.

The folds should be alternated each time around, meaning the first time, the upper section overwraps the lower section of ito, the next pass, the lower section should overwrap the upper section.



This can be learned very easily with patience and a bit of tenacity. The picture to the left is a good rendering of how the ito is folded around the hishigami. Note that in the picture to the left, all the folds overlap from the bottom to the top. Traditionally, they should alternate.

Once the two strands of ito are crossed, properly folded, and tightened, they must be adjusted before moving very far. I've unwrapped and re-wrapped enough of these to tell you that it's important that the tightness and fold alignment is right before going too far.

To adjust the folds, I use tools. I use an array of fine punches, cut-to-size coat hanger pieces (that have been fine sanded so they won't damage the ito), and clamps. I clamp the tsuka ito with a "C" clamp (or a thick rubber band if I'm near the end) after each turn of the ito while rotating my stand.

After each turn of the two strands of ito, I adjust the folds slightly to assure that the folds were all lined up, and there was no hishigami sticking out.





It can be said about the adjustment that the goal is to make sure the ito is all the way around the hishigami, each piece of hishigami is straight, and the folds all break in the same place. For me... if I'm pretty close I feel good about it.

Clearly one of the most difficult aspects of the wrap (at least for me) is making all this work over the menuki. You have to do it the same way, except for placing the hishigami is complicated by the uneven surfaces of the menuki.

Nevertheless, be downright determined to work at it until it goes right--the hishigami is straight, the folds are lined up, and everything is tight. The folds you see in the picture at right took me five attempts to get right.

Generally, the menuki are placed after the third set of folds from the fuchi on the omote side and three sets of folds from the knot on the ura side.

The final part of the tsuka-saga is tying the knot at the end.



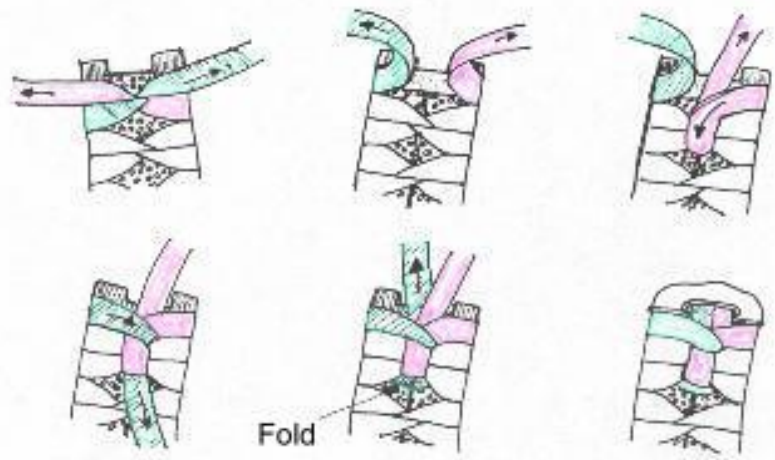
This is done in two parts, the first is finishing the ito on the ura side, and the second is tying the knot on the omote side. The picture on the left is of the ito finished and run through the shitodome. I will break this picture down and try to show you how to complete this side.



Note first that before even attempting to tie the knots at the end, that *the last folds of ito must be clamped* in order to remain tight. Working with the ito at the end is frustrating enough... I certainly don't want to add to the mess of trying to keep the last folds nice while tying the knot with ito unclamped, because I can't do it.

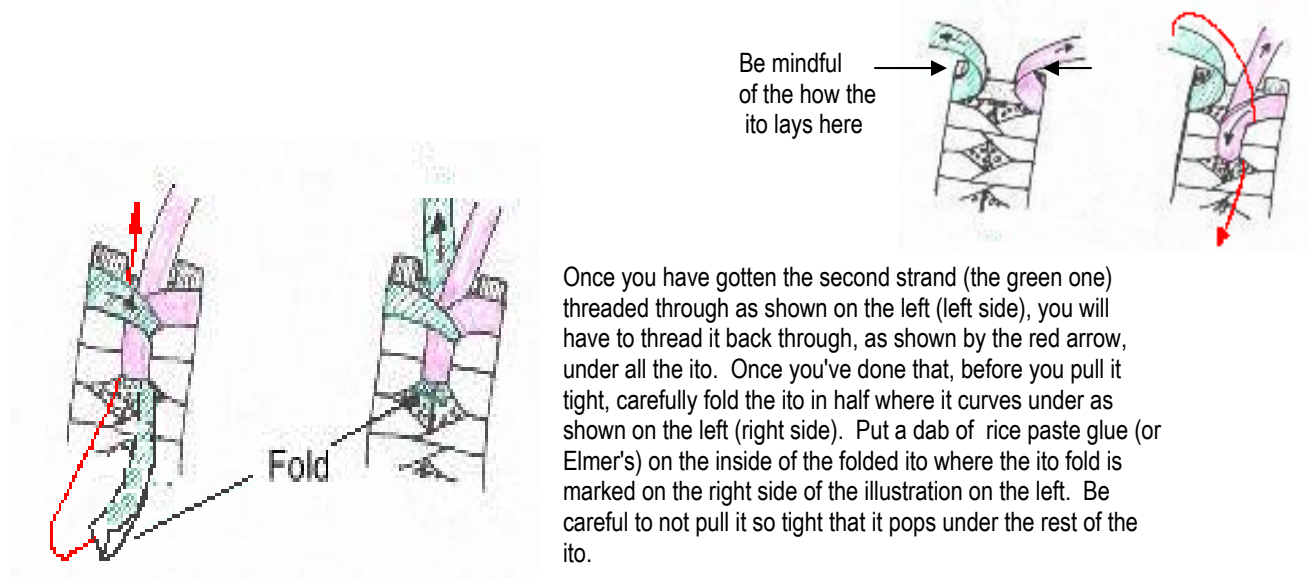
As you can see from the excellent picture drawn by Thomas Buck, the last folds are started on the ura side, or palm side.

It all starts when you take the ito strand from the bottom of the tsuka (the red ito in the center top picture at right) and loosely wrap it under the last folds from the outside towards the inside. Leave it loose because you will have to run the ito from the top of the tsuka (the green) over it, and then under the folds (as shown by the image below and to the right).



T. Buck

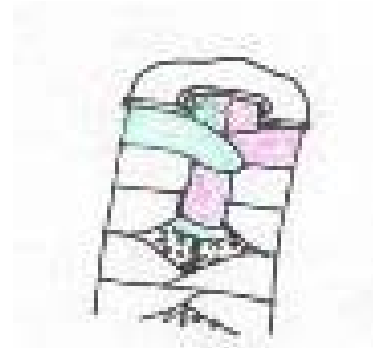
Be careful to keep the ito in place where it wraps around the tsuka.



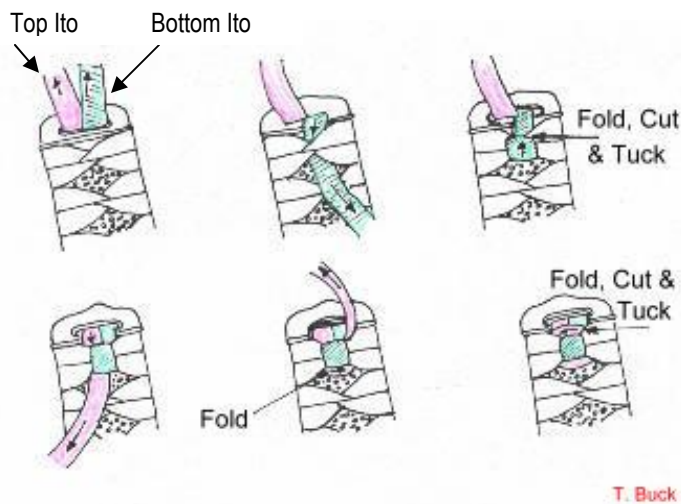
Once you have gotten the second strand (the green one) threaded through as shown on the left (left side), you will have to thread it back through, as shown by the red arrow, under all the ito. Once you've done that, before you pull it tight, carefully fold the ito in half where it curves under as shown on the left (right side). Put a dab of rice paste glue (or Elmer's) on the inside of the folded ito where the ito fold is marked on the right side of the illustration on the left. Be careful to not pull it so tight that it pops under the rest of the ito.

When tightening the ito, you have to work it around corners with tools... don't just pull it. It has to be "brought along" carefully, and tightened consistently--meaning it can't be tighter around the bottom of the tsuka than it is at the folds. Pull the ito tight from where it wraps around the tsuka to where it passes under the last folds. Be careful not to pull the ito too tight, as to make it bind or collapse.

Once you have the above accomplished, run the two strands of ito through the shitodome. If the ito is wide enough, they will overlap.



When finished, your knot should look something like the one in the picture to the right. Once your rice paste or glue dries, you can adjust the ito where it runs through the shitodome so that it's centered, or it occupies the entire space. In order to do that, you may have to insert a thin tool to move the ito over. Don't pull too tightly or push it so hard with a tool that you fray the silk!



The complexity of the final knot is about the same. As you can see from Thomas Bucks graphic on the left, the first thing to do is to take the ito that is on the bottom, and run it under the last set of folds. After that is done, wrap the ito upwards and tuck it back under the folds. At the point that you can determine how much ito exactly is needed to complete this, the ito can be cut. After cutting, and before tucking it under the fold, dab some glue on the end of the ito so it doesn't unravel. Let it dry before you tuck it in.



Here are details from my final knot. As you can see, I use tools to raise up the folds slightly away from the tsuka, so that pushing the ito under them doesn't upset things too much. When you do this, be careful that you don't lift the ito up far enough that you stretch it, rendering your painstaking tightening process worthless.

The ito on the bottom is pushed under the last folds.

Then, the ito is pulled back over the folds, and trimmed so that it is the right length to make the final loop inside.

Then, the ito is looped under the folds again, making the first part of the final knot as indicated on the left.





When you get to this point, you must carefully tighten the knot by working the end of the ito all the way around so that is underneath the folds. Very fine needle nose pliers are good for this. Reach inside carefully, and rotate the knot, tightening it. If you have too much ito, pull it out carefully, and trim it again.

Prior to tightening the knot completely, work the rest of the ito underneath the folded ito on the left side like shown below.

The final part of the knot is to pull the long piece of ito around the knot, run it back under the folded ito, over the ito that runs through the shitodome, and under the other side.

Fold the ito in half below the first knot. After it's run under the ito and prior to folding it over the top of the knot, fold it in half again. Tuck the ito that runs over the top under the folds on the left side, and put a dab of glue on it.



YOU'RE DONE WITH THE TSUKA!

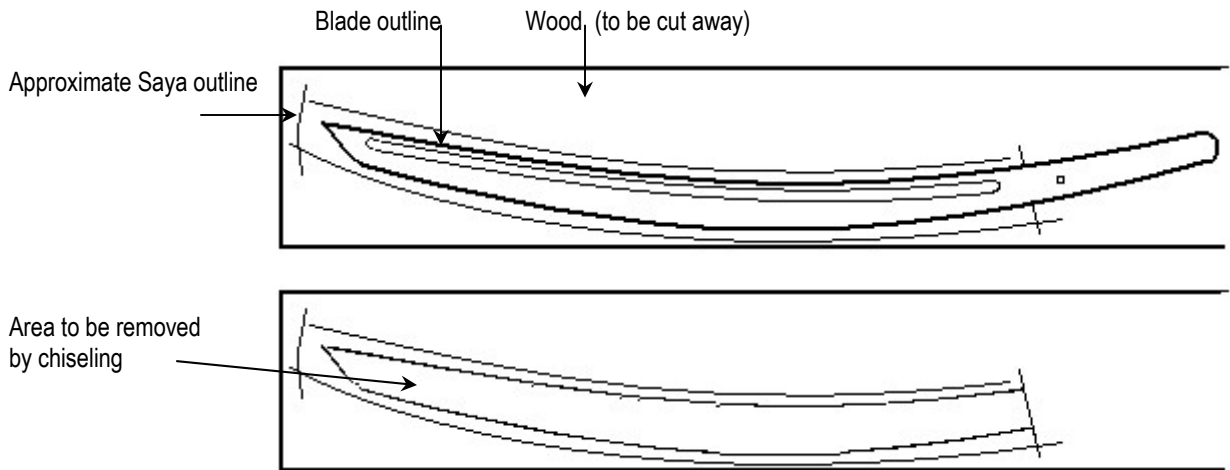
Hopefully, your tsuka will fit on the nakago perfectly.



Making the Saya

The saya is made very similarly to the tsuka with the main difference being that the saya requires less precision in chiseling. However, the saya has to be very smooth on the inside, like at minimum, 320 grit smooth. The sword should also fit easily and not be loose or rattle very much. The first thing I do is to trace the blade on the wood the saya is to be made from. I use poplar, as it is a very light hardwood, and readily available from Lowes, or Home Depot. I selected two pieces that were 4 inches (10 cm) wide, and ½ inch (1.3 cm) thick. I took these dimensions from a Togugawa-era wakizashi I own.

I traced the outline of the blade on the wood by laying the raw blade without any of the fixtures or tsuka installed. I placed it so that one side (the ha side) was approximately ¼ inch (6 mm) from the edge. The point and the areas where the tsuba would be (plus additional safety space of ¼ inch) were placed about equal to the other edge. I then traced the outline of the blade, and another outline about ¼ inch bigger than the blade.



When removing the wood from the inside of the saya, one must follow (for the most part) the blade geometry.

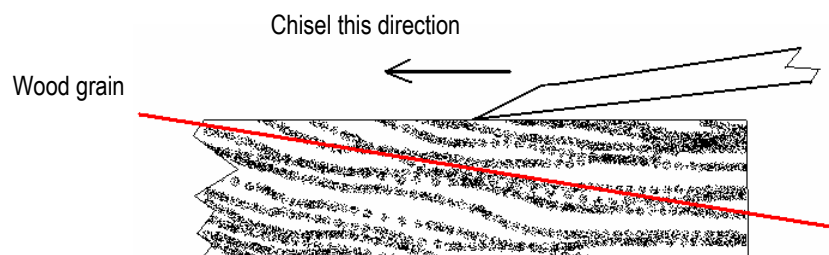
Use a razor knife to cut into the wood along where the mune (ridge) of the blade would be. The angle of the mune should be retained (it will probably be pointed). I use a chisel that is about the same size as the shinogaji. Remove the deep part first, and then simply angle the wood toward the ha section of the saya.

To gauge the depth, I simply measured the diameter of the blade in several places, divided that by two, and placed a number of marks on the outside edges of the wood. I then drew a line connecting all the marks, and used that as a gauge for setting the micrometer.



Start chiseling from the center, and take the wood out of the deepest part first. Work the wood out as smoothly as possible to the end, and then work back the other way.

If there is a grain to the wood that isn't straight, chisel against a descending grain like in the following graphic.



When I am "pretty much" finished with whatever stage I'm on with one half, I work on the other. I try to keep them as much the same as possible. I only mark the saya where the wood is to be cut away when the inside is finished on one half. After cutting the one half, I put them together and glue them before cutting the second half to make sure they were cut the same.

I consider myself done with basic chiseling when the depth of the cut out is half the diameter of the blade of the shinken. At this point, I sand the two halves, until they are very smooth, and start testing the blade fit.



When I get to the finish sanding of the saya halves, I start fitting the habaki. In order not to cut too much off, I put the two sides together over the blade, and wrap carbon paper around the habaki, and slide it in until it strikes the wood. The mark where the habaki strikes the inside of the saya when the blade is slid in is where I carefully chisel away until the blade and habaki fit correctly.

The habaki must fit very precisely any time a horn koiguchi is planned. There will only be 3 mm of wood left on the saya!



Next, cut the excess wood off the saya half that was marked. I did this with a hand-held jig saw. Leave plenty of extra space, which you will sand down to the right size by hand.

After sanding the saya, Leave about $\frac{1}{4}$ inch (6 mm) of space on either side of the blade. I'm not really sure if there's a specific amount that should be left, although it will depend on the width of the blade. It appeared to me that my other saya were about $\frac{3}{16}$ inch (5 mm) here, so that's what I left. The next thing I do is to place the saya on the second half and mark where it should be cut to match the first one.

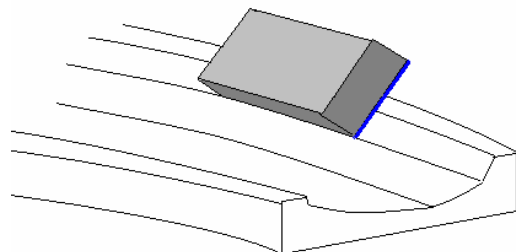
The saya on the right is basically ready for fine sanding and shaping the top to match the mune of the shinken.



When I mate the two halves and mark the second for cutting, I take more care doing this than one would think necessary. I insert the blade, and make sure the space is equal inside at the mune and ha. Insert the sword, and "work" the two pieces of saya back and forth until I'm satisfied that it is centered. Then I draw the lines on the second half, and take them apart and examine it to make sure I have enough space to glue the saya together. I NEVER just cut it. Cutting into the area of the saya that I chiseled out will require starting over.

When the two halves are ready, I turn once again to the inside, and working from 220 to 320 grit, smooth the inside to where the sword slides in with silky smoothness.

Also before gluing halves together, I assure the angle of the saya where the mune rests is similar to the angle of the mune. I usually do this by eye, and use a block of wood with sandpaper on only one side. I work the paper gently until the angle of the mune emerges. I test fit the shinken to verify it's adequate.



The last thing I do before gluing it together is to check the fit of the blade in the saya, and make sure when the two halves are together, that they aren't too tight, or too loose. If they're too loose, the sword will rattle when moved inside.

If the saya is too loose, it can be sanded on one of the saya halves where it fit against the other in order to close the gap of the void. A large piece of wood wider than the saya is best for this.

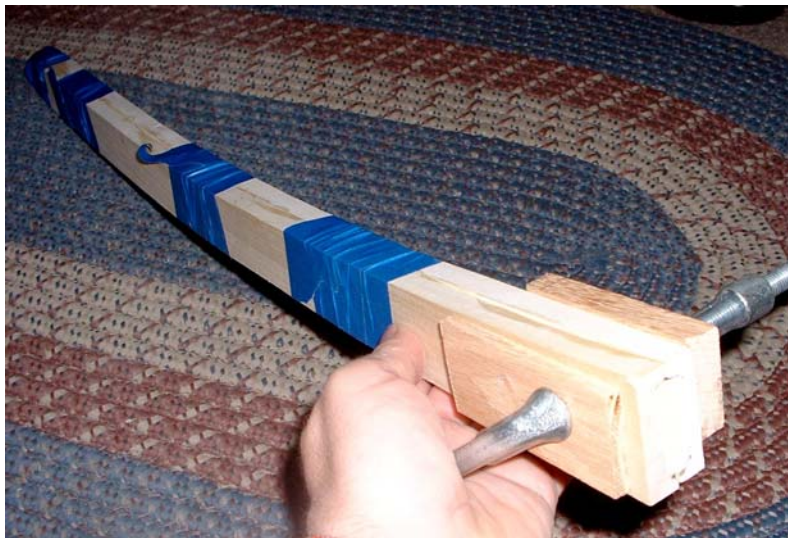
NOTE: Before the saya is glued together, here are some things that should be considered:

First, the two halves must be fit together the entire length of the saya when testing the fit of the blade.

Second, the part of the opening of the saya, where the habaki seats, must be shaped appropriately to accept the habaki. It can be made a little smaller, but it's hard to shape it on the inside after it's assembled.

Third, the end of the saya where the tsuba will touch must be properly cut, straight relative to the tsuba when the blade is inserted. Finally, the saya should be put together like it will be glued and the sword tried. I clamped mine with "C" clamps, and tried the sword in it a number of times, not only while inserting the blade correctly, but when holding it inverted and while the saya was on it's side. The sword should move smoothly and not ding or catch on anything.

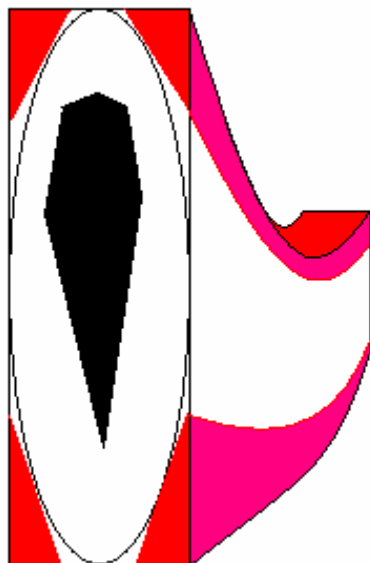
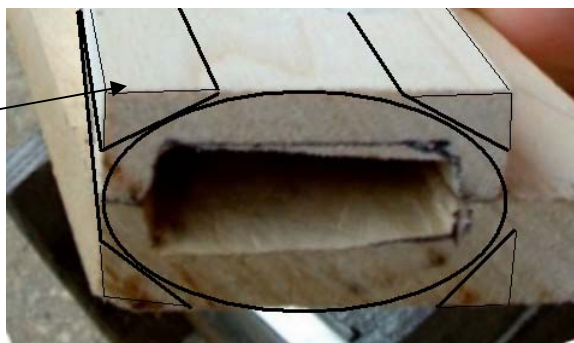
Only when I get a fit that the blade traveled inwards from every angle smoothly, and was also not loose enough to rattle with the blade inside, do I glue them together.



I'll cover installing a koiguchi and kojiri at the end of this section.

When shaping the saya after it's been glued, I mark the areas of the wood that you want to cut off. As you can see from the picture below, I marked the corners in order to cut them accurately.

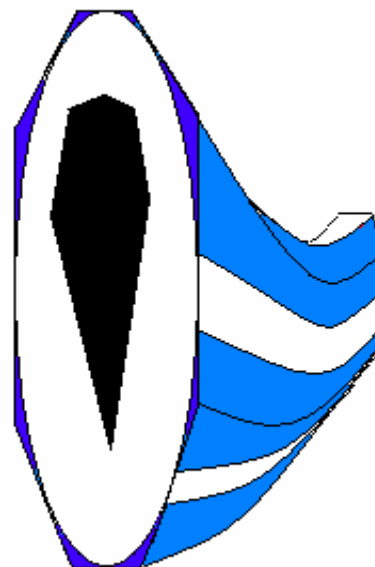
All four of these sections were marked with a sharpie marker, and then cut off.



The rest was also marked, but sanded off carefully.

As you would look at the saya from the front, from where you would insert the sword, it appeared like the graphic on the left. First, I cut off all the red colored areas, then mark it once again where the cutting limits are in blue, as shown on the right

Then I sand the secondary areas off, then round the saya carefully with a hand-sander.



This is what the saya looked like after final sanding with a hand sanding pad.

At this point, I make the kurigata, or the piece that attaches to the saya that the sageo (saya cord) runs through.





Traditionally, the koiguchi, kojiri, and kurigata are made from buffalo horn. Buffalo horn is harder to work with than wood, but I highly recommend using it for the koiguchi and kojiri because of its tough characteristics.

Whether it's made from buffalo horn or wood, they're made the same way. I cut my kurigata from the leftover saya wood that was cut away. I made it thirty percent deeper than I thought it should be so I could sand it to fit the curved saya.

Traditionally, the kurigata is either dove-tailed and fit to the saya, or put in like a mortise joint. I install mine with a set pin, and glue it so it's strong and won't come loose.

I attach mine to the saya with a bamboo peg after forming it. In order to form the kurigata to the saya, I wrap sandpaper around the saya where the kurigata is to fit, and slide it back and forth so it would be the same shape as the saya. It's best here to use two jigs to hold them more securely.



The last thing I do after "fitting" the kurigata is to make a peg that fit into the saya that assures the strength of the kurigata when glued on. I made this out of the same bamboo I used for the mekugi, so it would be strong.

Once everything was lined up and fit correctly, I glue the kurigata to the saya and clamp it relatively tightly.

Once the kurigata is dry, I used some spot putty to fill in any small spaces between the kurigata and the saya. I usually get the fit close enough that I don't have to put much in.





I generally always install a koiguchi made from buffalo horn. First, I trim the saya opening exactly as I want it when it's finished. The opening for the habaki must be perfect at this stage. If it's not, the koiguchi can not be made yet. Once the sword fits perfectly into the saya, I take the saya, and turn it opening down on a piece of buffalo horn, and outline the outside of the saya onto the buffalo horn with a scribe or a sharp pencil. I also measure the thickness of buffalo horn, and transfer that to the side of the saya opening so I know how far down to remove wood. I account for about 3 or 4 mm extra, in case I screw something up.

Then I draw a line very carefully around the opening of the saya leaving only 3mm of wood. I then very, very carefully file away the wood, until the saya appears like the one in the picture at left.

Much care must be taken to assure that the cuts are straight. A good file works wonders here.

The buffalo horn then needs to be cut out in the oval shape I marked it. I always leave 5 or 6 mm extra space on the buffalo horn in case I get it crooked. Once it's cut out, I once again place the saya opening down on the buffalo horn, and trace the area of wood in the picture at left to the buffalo horn, and drill a small hole in the middle of the area. I very carefully work with a file to remove the area from the middle of the buffalo horn, test fitting many times until it fits relatively well.



I fit the piece to the saya over and over, removing tiny bits each time until the fit improves. Eventually, it fits very precisely. A tip here is that where about 3mm of wood is left on the saya, some can be removed as the fit is tuned. The koiguchi on the left had a good deal of adjusting done at the mune (top) of the saya.

The last things I do before painting is to install and finish the koiguchi, the kojiri, and cut the hole in the kurigata. The kojiri, which is simply a piece of horn cut to the same size as the saya without the opening the koiguchi needs and glued to the end of the saya. Sometimes I install an iron or silver kojiri on the end of the end of the saya, and that takes a good deal more fitting. I fit a horn kojiri by gluing it to the end, and then sanding it to match the shape of the saya.



When I fit an iron kojiri to a saya, the kojiri must be fit, then the saya must be finished, such as lacquered, and then when the saya is done, the kojiri needs to be put on. This means the space the finish takes up must be accounted for prior to fitting the kojiri.

Otherwise, the kojiri won't fit, or the finish will be marred when installing it. The key to making the saya smooth and perfect is simply take your time. This is definitely not an art for the impatient.



The final steps are filling of the little knicks and imperfections in the saya, and sanding the opening in the kurigata (whether wood or horn). Sometimes, I put a shitodome in the opening.



Generally, these are for older style swords and I avoid them as a practice because of the problematic nature of them loosening over time.

Note on painting: Traditionally, you use Japanese lacquer called urushi that is brushed on, and takes a long time to dry, which is how the finish becomes so smooth. I recommend doing it this way. However, if it can't be obtained in a particular color, an automotive lacquer with a hardener added will work although it's less adequate. Conventional automotive lacquer will not dry hard enough to keep from becoming dented and dinged. Enamels are even worse and should be avoided like the plague.

For the purposes of this article, I'm going to discuss the use of Japanese urushi. In America, urushi is not legal. It is poisonous and can not be imported. However, a synthetic Japanese version is available, brand-named *Cashu* lacquer, and can be obtained from Michael Crampton at Shadow of Leaves http://www.shadowofleaves.com/Lacquering_finishes.htm

Once the saya is prepared for urushi, an appropriate place is required to do the finishing. Although not poisonous, Cashew is strong smelling. Of course, I've gotten used to it and the smell of it tells me I'm almost done with a very long project.

I made a stand that sits on a table, clamped in a vice that goes into the opening of the saya that supports the saya in a vertical stance, and can be turned around 360 degrees. Good light, a good brush and good quality thinner are all you need.



The first coat of Cashew I put on is thinned 50%. All subsequent coats are thinned 25%. After the first coat, leave the saya to dry for a week. Then, remove the saya from the stand, and with a very light amount of water, (don't get it inside the saya!) wet sand the lacquer on the saya with 600 grit wet/dry paper enough to smooth it as much as possible *without sanding through the lacquer*. Put the saya back on the stand, and leave it for any residual water to dry for three more days. On day 11, you can coat it with 25% thinned lacquer. Leave it for another week, then repeat the wet sanding. It is imperative that the coats are as smooth as possible, and they dry completely before moving on.

The saya must be lacquered as many times as necessary to sand it completely smooth, and then generally I put two more coats on, sanding each smooth between coats.

Most saya take at least 5 coats, some have taken me as many as 10... that's 3 months. I usually don't promise saya out in less than 3 months. Ask anyone I've delivered one to though... they're beautiful.



The saya above has seven coats of urushi on it and has been sanded for the last time. It's ready for polishing.

Once again, after the last sanding, I leave the saya on the stand for three or four days. The final step is to polish the saya with polishing compound. What kind doesn't matter I don't believe, as long as it's very fine grit. I use several different types, but mainly I use a fine paste polish that is good for metal or plastic. Automotive compound will probably work fine too, although you'll have to clean the wax out of the recesses when it absorbs water with a old toothbrush. I rub on the compound with a soft cotton towel and lightly work it into the lacquer by hand, until movement of the towel smooths out. I then buff it lightly until the shine starts to come through. I plan to rub out the entire surface of the saya at least 3 times to get it real shiny. I then use an ultra fine paste on a clean soft cotton towel and do it two more times. The finished product is like a mirror. That's it! add a nice sageo, and you're done!



End Notes

I really enjoy learning about *sayashi*, the art of sword fitting. I especially appreciate the Japanese cultural instruction I've had that really adds to the mental part of the art. I've improved my skills a great deal over the last several years, thanks to lots of help from not only people who I've worked with, but other kind folks who have read things I've written such as this article, and offered encouragement and advice. Each time that happens, they have helped me to expand the limits of my knowledge a little farther. Each shinken I work on, I learn more, and become a little more proficient. I especially want to thank the leadership and members of the Shidogaukiun, namely, Shozo Kato, Head Sensei; Isabella Church Sensei; Debi Farmer Sensei; Pam Parker Sensei; James Yan Sensei, my personal model of Zen mastery; Rod Faghani Sensei; Jeff Ellis; Ben Krieser Sensei; Akira Kondo for language classes and many translations; and all the people out there who allow me to work on your priceless swords.

Over time, I've repeated many times that the most important aspect of doing these sorts of things is patience. You need it in practicing the sword arts and in working on them. I can absolutely guarantee you that without it, you will screw something up and not be satisfied with the end product... and you'll regret it.

The overall complexity of all the tasks shouldn't dissuade someone from learning about these arts, it's really the reason that one should practice them. It is possible to learn as you go, just be patient. However you conduct your own personal project should you choose to, I hope this article can give you some ideas that you can improve on, if not show you a better way to do stuff. So for everyone who uses this as a guide or reference for your own project, good luck, and feel free to send me improvements, new ideas, corrections, or your own story about making a shinken. Don't forget to see the reference pages that follows in the Appendices.

ネ
ル
ソ
ン

E Nelson

Eriknelsonart@earthlink.net

APPENDIX 1.

Bringing out the Hamon on a carbon steel sword blade.

As you may notice, the title includes the word "carbon" in it. This is because if you are using a piece of stainless steel, this tutorial won't work. You can only sort-of differentially temper stainless steel, and at that, only certain types of stainless. Even carbon steel that has a high amount of chromium in it will give you a terrible fit trying to get the hamon to show up, if you even can. The bottom line with stainless steel is that it shouldn't even be used as sword steel unless it is shorter than 24 inches (61 cm) and you are using 420 or softer steel. If you want to use stainless steel for a sword that will only grace your living room or office wall, I will include instructions at the end of this Appendix on how to "draw" a nice hamon onto stainless with acid, or by burnishing it on with a wire wheel, which is my favorite way of doing it.

This appendix is for light polishing of a blade that doesn't need to be sharpened and/or reshaped, or polished much. It's mainly intended to help someone who has a blade with a poorly defined hamon bring it out a little. To reshape or polish a shinken by traditional means, one needs all the appropriate whetstones, and the sword is moved on the stones, which are stationary. That traditional technique requires a lot of skill to not screw up the blade geometry. This technique, on the other hand, is all about lightly polishing the blade using sanding blocks and fine wet sandpaper.

What you need

You will need the following supplies:

1. Wet sanding paper in at least the following grits: 600, 800, 1000, 1500, 2000. You may find that you have difficulty obtaining some of these grits at the local Home Depot, in particular those over 1000. I got all of them at an auto parts store, except 3000 which I substituted a paste rubbing compound for. If you do that, remember that you must clean any wax off the blade that the polishing compound may leave after final polishing.
2. Sanding block. I used a wooden and a hard rubber block. I used the rubber block for almost all the sanding. Wood can scratch the blade after a nice finish, so be careful with wood.
3. Ferric Chloride (FeCl). This is circuit board etching compound, and can be gotten at Radio Shack for \$3.99 for (approx) 10 oz. bottle. Be careful with this stuff, because it will instantly turn metal gray, and severely corrode aluminum and stainless (like your kitchen sink!). If you plan to "draw" or etch stainless steel, you'll need this as well. You'll also need a cotton ball or two.
4. Baking soda. This is to create a "base solution" to neutralize the FeCl.
5. Clove oil. You can get this at health stores or from a Japanese sword care kit. I wouldn't use Johnson's baby oil as it has other stuff in it that could mess up the process.
6. Black iron oxide. I got mine on the Internet from an ceramics supply house. Make sure it's real iron oxide and not powdered pigment that's just named "black iron oxide." This should help: Fe_3O_4 = ferrous ferric oxide, magnetite, and black iron oxide (CAS no. 1317-61-9)
7. A place to sand the sword blade that you don't mind getting really black with metal-saturated water. I used a big plastic pan that was as big as the blade, and deep enough to put a half-quart of light mineral (or synthetic) oil in.
8. If you plan to etch or burnish stainless steel, you will need some pin-striping tape which can be gotten at an auto parts store. The key with this tape is that you need tape that can be bent smoothly into the hamon shape you desire. Masking and scotch tape won't work (at least for me).

The Process

First, you must realize that you can not skip the progression of grits, like from 400 to 800... nor from 800 to 2000. It may look like you can, but if you do, this will not work as well. Chances are, based on the typical person's inexperience with polishing, it won't work as well as it could anyway, so don't skip any steps! Start with the finest grit you can, and then go to each successive grit. I've only named what I believe to be the minimal grit-progression, you can certainly add 5 grits in-between what I've listed, and you'll get better results. You'll also sand less with more progressions.

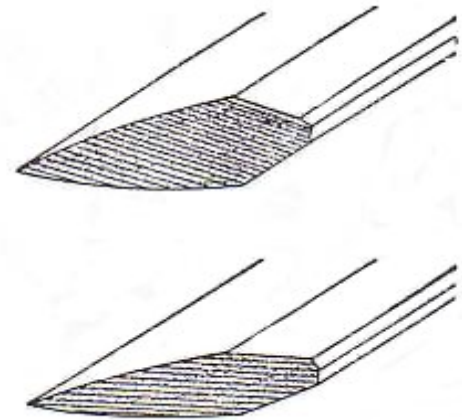
Prepare your area so that you can rest the sword on something that won't scratch the down-side (the side that lays on the table or edge of the pan) while you're sanding the up-side. For this, an anti-slip mat works well. Keep apprised of the down-side as you work on the up-side. The first naginata blade I polished I found to be pretty scratched up on the first side I polished after finishing the second side and flipping it over. Obviously, I polished the second side again...



The Technique

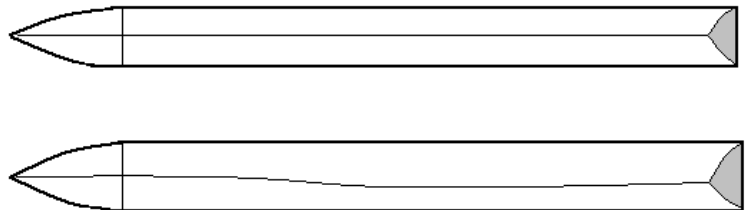
WARNING: Understand that by polishing your own blade, you may be damaging the geometry of the blade. A Japanese style *shinken* is very particular about what makes it work, and too much sanding can change the geometry to the point that it's no longer sharp or worse, it is weakened.

As you can see from the picture at right, the edge is comprised of the "ji" or the entire side of the blade from the shinoge-suji (ridge on the side and widest part of the blade) to the ha, or edge. Sharpening a dull sword, or working with the ji requires extensive skill as to not cause the cutting edge to be thrown out of line.



The diagram below is a portrayal of looking at the blade as the cutting edge is facing you. You can see that the geometry is supposed to be equal on both sides as illustrated by the top figure. The gray area at the far right is the inside of the blade, the same area as illustrated above by the shaded middle of the blade. Improperly working the ji of the blade can move the "ha" (or edge) in places, (making it wave like in the bottom figure) and severely limit or ruin the cutting ability of the sword.

The reason I'm telling you this is so you can be aware of the problems with doing anything to the blade that may diminish its use or value. I believe that if you approach polishing your sword in order to enhance the hamon from a perspective of knowing these things, you can avoid the ha to enough of a degree that you won't have to worry about sanding too much off of it.



Therefore, the technique of sanding should be that of starting at the shinoge-suji (the widest part of the blade) and working your way evenly down to the ha, without too much pressure on the ha itself. In fact, I make an appoint to stay $\frac{1}{32}$ inch (2 mm) away from the actual ha. I can't always do it but I try. One good way of avoiding the ha is to mark it the $\frac{1}{32}$ inch of the very edge with a red sharpie marker, and don't polish it off!

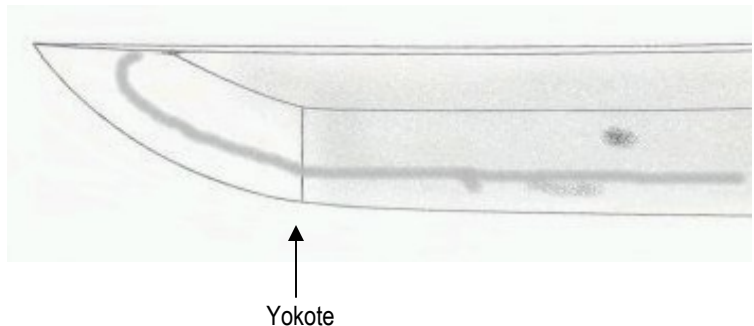


Polishing the Shinoge-ji

Once you have your area set up, start with the finest grit that will yield progress over wherever the finish of the sword is at beginning. For example, a Kris Cutlery naginata was probably polished to 600 grit when I got it. I started with 400 and it dulled considerably. The only salvation to my ego was that there was a scratch (that I likely put in it) on it that I worked out. The opposite side I started with 600.

Before you sand the blade, you should cover the kissaki with plastic tape or something that won't easily be sanded through. I used old smoothed out sandpaper, put it paper-side down, and put plastic tape over that. When the tape starts to wear out, change it! The yokote, or line that separates the kissaki from the shinoge-ji, is where you should place the cover to protect the kissaki. It must be polished on it's own so you don't ruin the separation.

In the picture at right, you can see the yokote line where the shinoge-ji meets the fukura, the point where the curvature of the kissaki begins.



Once you have the kissaki protected, and you begin on the shinoge-ji, sand the blade with as long a stroke as possible, without danger of slicing your fingers. Use the sanding block, and try to have no more than two sheets of paper between the block and the steel at any one time. More than that can put unwanted grooves in the steel or change the blade geometry. Use medium pressure... let the paper do the work. Move the paper around as you feel the strokes smooth out and the integrity of the grit diminish so you always have good grit between the block and the steel.



I found that folding the paper double allowed me to sand a single side of the blade in two sections, with a longer stroke at the rear of the blade, and a shorter more careful stroke at the tip of the blade, moving the paper on the sanding block frequently so that on each of the two sections I started with a fresh piece of sandpaper. When I thought I was finished with a side, I took the cleanest part of the paper I had left, and carefully did light, full strokes all the way down the blade to "even it out" as much as possible.

Sand each grit until a close examination of the blade reveals no scratches any larger than any other. You will have to look carefully, but check frequently, going back to areas that you are not polishing as well. Don't polish it any more than necessary.

When you are certain you have reduced the surface to the grit of the paper, move to the next finer grit. Do the same thing for the new grit. Use smooth strokes, keep the paper or stone lubricated, rinse the blade often. The water will start to get black, which means you are removing steel. When you have reduced it to the new grit, you will notice that the blade is getting shinier.

The more fine the paper you use, the closer you must examine the steel for scratches. Again, the test is that there should not be ANY scratches larger than any other scratch. The tiny scratches can be seen even with 1000 grit--you just have to look for them.



You will find that it won't take much longer than 10 to 15 minutes per each grit for each side of the sword. This means that working through six grits will take about an hour and a half provided you have the muscle to polish that long.

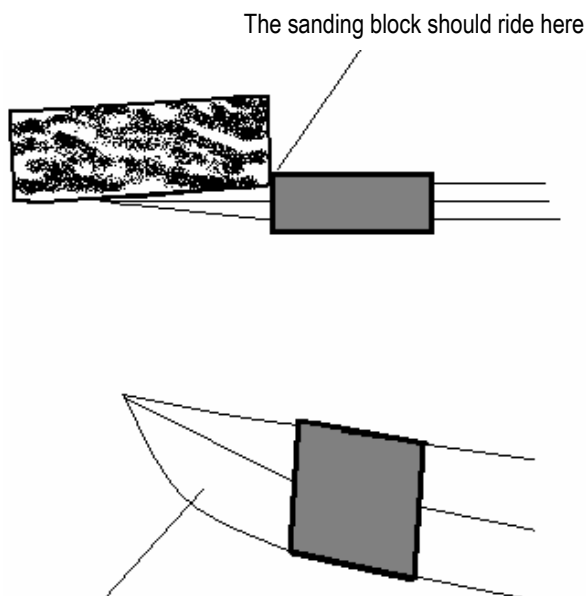
Don't polish long enough to screw anything up, such as hit the ha or cut the tip of a finger off. I found that the finer the paper I used, the longer it took. This could be that I didn't get each previous sanding session as smooth as it should have been. The entire process moved much quicker than I thought it would, so don't get in a hurry.

As you progress through the paper, watch closely so you don't have to repeat two grades or more of sanding because you didn't notice a scratch. Also be careful when removing the paper from the blade, as you can dislodge particulate from the paper and scratch the blade (boy, if I could have a dime for every time I did THAT). When you get to the point you are finished with 2000 grit, the surface should look like a mirror. Again, there should be no scratches AT ALL, that you notice.

NOT the end finish! Prior to the finest polish.



For swords, you'll want to create a contrast on the kissaki and make a crisp delineation at the yokote (my naginata didn't have a yokote). To do this, remove the paper and tape from the kissaki, clean it well, then apply it (non-grit side facing the newly polished blade!) along with some additional sturdy tape exactly on the yokote line across the sword, this time on the shinoge part of the blade. Apply enough to build up a ridge or small wall that gives protection to the shinoge-ji and also makes a wall for the polishing block to follow.



Polish only this part of the kissake

Polish the kissaki (across the sword, perpendicular to the length) first with 1000 grit on the block. Only stroke one direction and stroke from mune to ha, back to the edge. Make sure the block has a crisp enough edge and fold the paper tightly over it to be sure it gets down in the crack at the edge of the tape. You want a crisp, clean yokote all the way from the shinoge to the ha. You may have to re-polish the shinoge-ji to get rid of small, stray scratches that come from doing the kissaki/yokote. It will likely be frustrating so take your time. Fine, light oil works better and use fresh paper and even pressure.

The final steps are to polish it with 3000 grit, or paste polishing compound. I had heard that some folks were having good luck with FLITZ metal polish, so I had a try of my own. It's not bad, but the industrial polishes I thought were better. I think FLITZ is more of a cleaner, plus, it left a film on the blade. I used extra fine Miracle Glow polishing compound and had great results with that. *American Lapidary* also makes a plethora of diamond-based polishing compounds from 3000 to 50,000 (you read that right) grit in one-gram syringes, about \$6.00 per gram.



Finished polish



After Polishing—Bringing out the hamon

Once you are finished with the polish, it is time for the acid treatment and black iron oxide treatment. I would recommend resting up at this point, as frustration is easier thwarted when you're rested. As I pointed out before, you may or may not have good results doing this. Depending on the formulation of steel, it may be easy, tough, or impossible to bring out a hamon that a sword has. Just because it's differentially hardened/tempered, doesn't mean you can visibly enhance the harder part. In my experience, 1065, 1075 and 1085 steels are the easiest to do this with. Steels that have a high level of chromium are nearly impossible. I have a blade that was given to me that I believe came from Museum Replicas or Atlanta Cutlery (Windlass Steelcrafts) and it's supposedly 1095... I should be able to get a hamon out of it, although it's a delicate task....not even close. I soaked that dude in acid for 20 minutes, got a great visible base, and it polished clean off as if it was never there. After three tries, I quit. So anyway, prepare yourself.

The first thing is that if you remember, I mentioned that depending on what you polished the sword with as your 3000 grit, you may have wax on it. For this reason, you should clean the sword well with acetone or naphtha. Alcohol may work but I always use acetone. Second, ferric chloride (FeCl) is rendered inert by a base solution, not water. Water will only dilute it. If you don't want the acid acting on your precious blade after you put it away, you must neutralize it with the baking soda solution. Before you treat your blade with FeCl, get your blade in an area where you can quickly douse it in water or quickly wash it off. If your ferric chloride treatment runs awry, you'll want the blade doused fast. Make the baking soda solution and have it standing by. Put a couple of tablespoons of baking soda into a small bowl of water, and add 4 or 5 ounces of water to it. Mix it up well. Drop a cotton ball into the baking soda solution.

Once you have the blade in position, take a cotton ball, a soft napkin or a gauze pad, wet it and squeeze about half the water out of it. Open the ferric chloride and put several drops onto the cotton ball. Strive to make the FeCl mixture on the cotton ball about 70 water 30 FeCl. Immediately wipe the cotton ball along the edge of the sword *only where the hamon should be*. The blade should darken immediately.

Don't put so much on that it will run around to the other side. When you've covered the edge, immediately rinse the blade very well with lots of fresh water, and dry it off. Don't neutralize it yet. Turn it over and make sure that none of the FeCl solution ran to the other side and marred it. If so, polish it out. It has to be even to look nice.



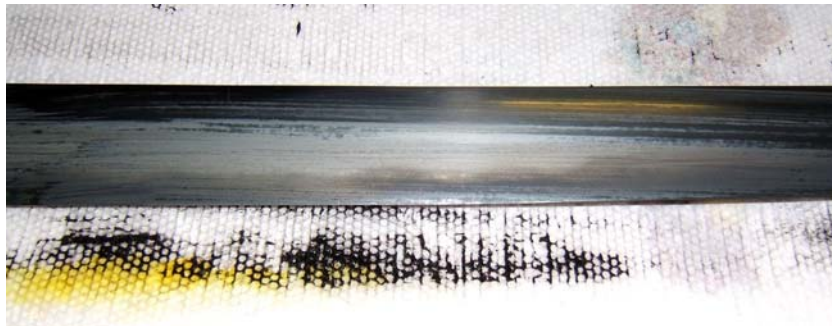
When both sides are done, dry the sword and pour about 2 tablespoons of clove oil into a small disposable bowl. Mix the black iron oxide with the clove oil until it becomes extremely inky, but not too thick. Take a fresh cotton ball or small soft rag and dip it into the mixture of black iron oxide and mineral oil, and start rubbing the hamon area of the blade.

I'm not sure how long the "optimum" rubbing time is, but I rubbed the naginata blade I was working on (you see in the picture at right) for about ten minutes.

After rubbing the hamon with the black iron oxide and oil mixture, wipe the blade off well with clean soft towel or a paper towel, and rub it with the cotton ball of baking soda to neutralize any residual FeCl that may be left on it. Finally, coat the blade with a fine layer of mineral oil.



Here are a few of the blades I brought hamons out of:



Drawing a hamon onto a blade by acid etching or burnishing

This is simple, but can go awry relatively quickly. Basically, what you will be doing is to either “draw” a hamon onto a blade with acid, or burnish it on with a wire wheel and a drill, hand sander, or dremmel tool. These both work with carbon and stainless steel blades. For alloy blades, burnish it.

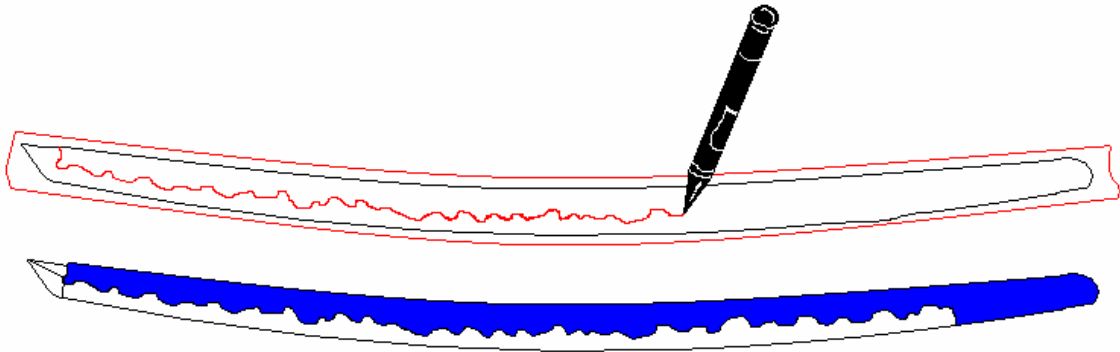
Acid Etching

You need an acid that will react with the metal but not eat into it too much. Hydrochloric acid is good for etching down into steel, such as to put designs in it, but it's bad for hamon since it eats away the metal. Vinegar was suggested to me by one person, lemon (or citric acid) juice by another. I used vinegar once, and swore off of ever touching it again. It not only discolored, by quickly oxidized the steel to such a degree, I polished the entire thing all over, and it too *longer*.

To discolor the metal, I recommend Ferric chloride (FeCl_3), which can be applied more consistently than the other choices, however, it's up to you to try whatever you want. I use FeCl_3 because it's good for carbon steel I can't get a hamon to come out of, and for stainless. You can get this at Radio Shack, because it's the same thing as circuit board etcher.

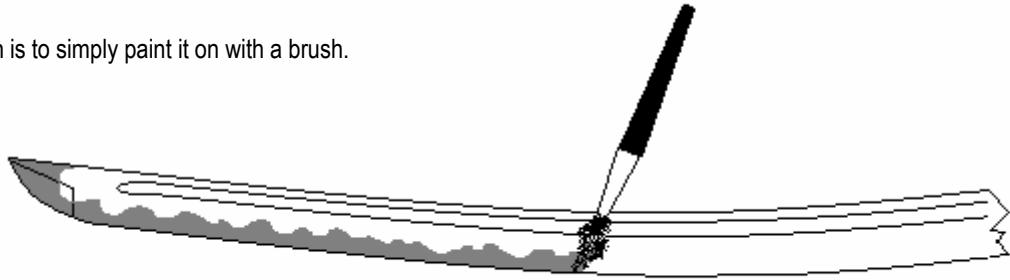
To make a hamon, you can either paint it on with a brush, or tape the area you don't want etched and wipe it on. You'll get a more even approach to wipe it on with a cotton ball, but it's harder to designate the area to be protected. In the graphic below, it shows how to use tape to outline the area you want protected—do both sides at the same time. Once done, just wipe the FeCl_3 on evenly with a cotton ball dipped in 100% solution, and let it stand for 10 minutes. Rinse it well with clean water, and then dip another cotton ball into baking soda paste and wipe the area to neutralize it.

Cover both sides of the blade with plastic tape (masking tape doesn't seal well enough). Draw the hamon you want on both sides of the blade on the tape.



Now, you can either carefully cut it with an exacto blade, making sure you don't push hard enough to scratch the steel, or you can do this by outlining the blade, removing the tape, placing it on a glass or similar surface, and replacing the tape. I cut it on the blade, taking care to not push too hard. Work it off slowly, and trim it if necessary more then. The tiny scratch that may get put on the blade will be polished off anyway... just be careful.

The other option is to simply paint it on with a brush.

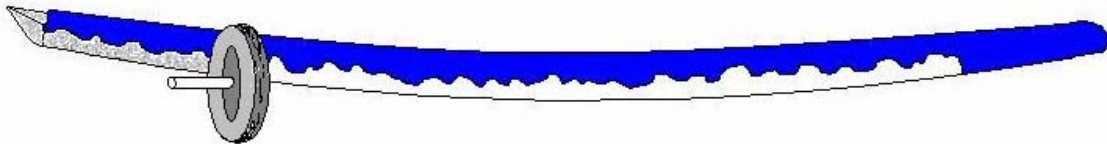


If you do this, be careful to keep the acid even as you paint it on... you'll have to re-dip your brush frequently, and take care to remove and replace the brush on the steel where you are planning a large area of acid, so you can adjust it. As above, leave it on for 10 minutes, rinse, and neutralize with baking soda.

Burnishing

If you want to know what a burnished hamon looks like, look at a iaito. Hopefully, you will be able to get something that looks a lot like that. Some people like burnishing because it's more even, and will last unless you polish it out. You can have more control over a burnished hamon, because after you apply it with a wire wheel, you can polish it until you get the desired result. If you want, you can polish it all the way off.

So at the point that you have the blade covered with tape, you'll take a soft wire wheel and affix it to a hand sander, drill, or a dremmel tool.



Run the wire wheel along the exposed part of the blade, while watching that you don't eat through the tape that's protecting the rest of the polished blade. You don't need much pressure at all. A soft wire wheel will haze the exposed area nicely, and when it's pretty uniform, stop. When you peel off the tape, you should see a slight difference between the burnished metal and the polished metal.

A word of caution: Don't remove the tape until you are finished with whichever process you choose. If you do, you'll probably have to start over. You'll never get it back on the same way.

Good luck!

APPENDIX 2

References

RESEARCH

http://www.hi-net.zaq.ne.jp/osaru/e_index.htm

<http://www.tsuki-kage.com/faq.html>

HOW TO

Bob Engnath's site, a foremost expert on everything about making steel and edged weapons.

<http://www.engnath.com/public/intable.htm>

Thomas Buck's tsukimaki page

<http://pages.prodigy.net/tlbuck/tsuka/tsuka.htm>

A great polishing tutorials

<http://www.ksky.ne.jp/~sumie99/togi.process.html>

<http://home.mchsi.com/~samonji/polishtutorial.html>

SUPPLIES

Good source for blanks for fixtures such as tsubas

http://sdksupplies.netfirms.com/cat_swordblanks.htm

Fred Lohman's place in Oregon

<http://www.japanese-swords.com/pages/terms.htm>

Ben Kreiser Sensei's place in Texas

<http://www.japaneseswords1td.com/frames.html>

Black Iron Oxide

http://www.claysupply.com/catalog/product_info.php?products_id=186

Blade Blanks

Kris Cutlery's site for excellent quality bare blades (Highly recommended)

http://kriscutlery.com/japanese/bare/index_bare.html

http://www.talonman1.com/new_page_2.htm

http://www.atlantacutlery.com/webstore/browseproducts.asp?hidSearchCriteria=__C__1512&ActionSource=1512&hidGroupId=1500&hidCategoryId=1510&hidSubCategoryId=1512&ActionSource=1512

http://www.texasknife.com/store/s-pages/TKS_MainframeStore.htm?TKS_WelcomeStore.htm~smain

<http://www.admiralsteel.com/products/blades.html>

(These are raw steel pieces--meaning you must learn how to make a blade)

APPENDIX 3

Mixture for filler for tsuka half

The point is that you need to create a situation where you're "making" wood that fills the hollow areas created by the flat tsuka half when placed on the hollowed out half. The best thing to use is wood, just like the rest of the tsuka. The problem is making it. You need something that's hard, but not too hard. It's got to be flexible enough to not crack under pressure, like hardened wood glue will. It also has to be sandable. If you mix sawdust with industrial wood glue, it will be much harder than the wood. What you need is something that's very similar in consistency.

With that said, I'll tell you how I do it. You might have a better idea. I will warn you that I've come up with this formula by ruining tsukas, or making them over. This is the only thing I've never made twice, always gotten back off the sword, and has appropriately filled the gaps.

Basically, I start with a two-part epoxy called "SP-3." However, it's not that easy to find. If you can find it, it's good because it dries exactly like it resides. I then add dust from sanding to it. The mixture I have used has varied, starting with pure epoxy, and then working it towards a thicker medium by adding the wood dust. The thickness of the epoxy depends on how big of an area that needs to be filled. I've also found that the hardwood sawdust makes it easier to sand. The best results have been gleaned from a mixture of poplar sawdust mixed to the consistency that the epoxy will approximate a paste, but still be a liquid... it will have to be leveled with a straightedge without pulling the project apart.

Another two-part epoxy that will work well is called "J.B. Weld." It's a little easier to get. The mixture of sawdust will be a little higher here because this epoxy is thinner than SP-3. This hasn't affected the two tsuka I've made with it—at least yet.

The rules with J.B. Weld are the same, just vary the amount of dust. I recommend mixing some up and trying it on something other than your tsuka first. Mix up an amount of epoxy, and then add different levels of wood dust to it and watch how long it takes to dry, and note the sanding attributes. Once you get something that approximates the wood when dry, and is workable enough to put into the tsuka like in the manual above, then go for it.

You can always sand it all out and start over....

APPENDIX 4

Correcting likely (hopefully you won't make) mistakes.

Tsuka

I chiseled too much off the inside. It's loose when I test fit the sword

To fix this, you are going to have to build up the base or reduce the depth. To reduce the depth, you will have to sand off the top edges. If you do this, make sure you are sanding it perfectly flat... or the top half of the tsuka will not fit well, and may break later. Make a sanding jig out of a flat piece of wood bigger than the tsuka, and lay it on the tsuka to sand. Don't use hand pressure as it's not accurate enough. Place a weight on the center of the flat sanding block, and work it without influencing the weight one direction or another.

Otherwise, you need to fill in the tsuka with wood and sand it back down. The best way to do this is locate and buy some wood veneer of the same type as the tsuka. You'll have to glue it in with wood glue. The thing to watch out for doing that is having to sand down below the veneer to where you'll hit the glue... avoid that because it's harder than the wood. If you haven't cut too much, and you are only concerned about a few places where you gouged down into the wood, you can use the epoxy technique to fill those.

If you've glued the tsuka together, and it's loose when you test fit it to the sword, the only way to fix it is to take a dremmel tool and a fine cutoff wheel, and cut it back open. That in itself may take enough wood off it to put it back together for a good fit. Otherwise, sand the 2/3 part down, and refit it.

I can't get the sword out after I glued it; or I glued it and can't get the sword in

You're likely in trouble here. You can either try to knock the tsuka off with a block of wood and hammer, or use a chisel to split it and start over. Chances are, if you can't get the sword out after you've glued the tsuka together, you've either gotten glue on the nakago, in which case you can probably knock the tsuka off of the sword carefully and salvage the project; or you've fit it too tight, and it's ruined. If you can't get the sword back in after you've assembled the tsuka, you will want to make a jig to sand the inside of the tsuka. It's not the end of the world, just the beginning of a long repair. To make a jig, you have to duplicate the sword nakago, and then make it thinner, so you can affix sandpaper to it. A flat piece won't work because it won't make the angles that the nakago will likely have. You have to make a duplicate nakago that will fit into the tsuka with sandpaper on it. Then... sand carefully until it fits. Otherwise, split the tsuka, and fix it by sanding it out more.

The same wasn't tight enough around the tsuka when I glued it

You're in trouble. Same is difficult to soften and work with, and once you've gotten epoxy on it, it's way worse so. The only thing I can recommend doing in this case is to cut the bubble as thinly as possible, wet it, and hopefully, you can get some epoxy under it and get it to lay down. If not, cut the entire section, trace over the void with paper, and cut a new piece and carefully install it. Once you've wrapped the ito, it may not be noticeable. This is why it's so important to wrap it several times before you glue it to make sure you know how to handle it. The final fix is to sand it all off and do it over.






I cut too much off the end, and now the fittings are all loose.

This is not too hard to fix, although it can ruin your choices of how the fixtures look. The first option is to simply add seppa. Old Japanese swords often have several on them. Otherwise, get a thicker seppa, which Fred Lohman can help you with. Otherwise, get a thicker tsuba. What you should NEVER do is to fill it in with something like cardboard, which is way too soft. You must fix loose fittings with a brass, copper, gold, silver, or bronze seppa.

I drilled the hole when the tsuka wasn't all the way on

This is tougher, but not the end of the world. Depending on how far off it is, you can work with the error, and add another hole for security, or you have to drill it again all together. If it's not too far off, you can widen the hole in the nakago, and fill in the void. This means putting another hole in it towards the rear or the tsuka because now the first isn't strong enough.

See the following graphic for repair by widening a mekugi-ana:

- 
- First, don't do this unless you have this much or less error.
- 
- Widen the mekugi-ana by hand sanding. Use a punch with sandpaper wrapped around it or a Dremel tool carefully.
- 
- Remove the tsuka and fill the void area with epoxy. Be careful to not get any inside the tsuka to where it will interfere with the sword going back in.
- 
- Re-drill the mekugi-ana.
- 
- Cut same to fit over the filler, and hand sand as above to shape it.

Remember, if you repair the mekugi-ana this way, you need to drill a second hole to assure it will hold. Put the rear mekugi-ana about four folds forward of the knot at the end of the tsuka.

To completely relocate the hole, and put a second in, follow the above directions, except cover the mekugi-ana all together, and drill another one at least two folds back.

Saya

I chiseled too much off the inside/it rattles when I test fit the sword

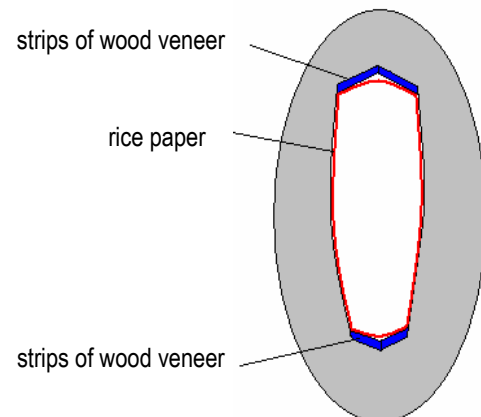
Two ways to do this, which are exactly the same as the tsuka. See above for chiseling too much off the tsuka.

The sword "rumbles" or "rattles" when sliding it in

Keep sanding. If it becomes too loose when smoothing it over, see above.

The opening where the habaki sits is too big

Build it up with Elmer's wood glue or Rice paste and strips of rice paper. If it's a lot too loose, build it up according to the following graphic, and sand it with a tiny block and paper or thin file after it's dry. NEVER put wood on the left and right sides. If you do, when you slide a sword in, you can split the saya in two!



Tsukamaki

The hishigami collapses

Hishigami are too weak, or you're pulling the ito too tight. If you're using rice paper hishigami, try folding them more, or brushing them with rice paste or Elmer's glue and letting them dry before you use them. If you're using notepad backing, try a harder backing. If all else fails, don't pull the ito as tight. Keep at it and be patient!

I can't keep menuki positioned while wrapping

Either have someone hold them, or cheat and use a small amount of epoxy to glue them and let them dry before you wrap. Keep at it and be patient!

I can't keep the ito tight enough

This is why a stand of some sort is helpful. Make sure you have a good tight clamp to secure each half-wrap with. Pull the next half tight before you release the clamps. Have someone help you if you can't do it all (or in the event you only have two hands...) Keep at it and be patient!

The knots are a pain in the butt

Tell me about it. Keep at it and be patient!

