Seamless Mokume-Gane Rings

Tools & Supplies Needed

- 6 strips of .5 x1.5" sterling silver & nickle silver.
- Torch, patience and time.
- Various files & hammers.
- Anvil & slot-opening drift.

Background

Mokume-Gane is a Japanese word meaning "wood-eye metal". It refers to the appearance of the finished material. It looks like wood-grained metal. There are several very similar ways to produce Mokume. They all rely on heat to fuse the layers of the laminate together, rather than using solder to join them. Most of the traditional Mokume production techniques are extremely tedious and exacting. The technique we will be using for this class is not as flexible in its range of materials to be joined as the traditional technique, but has the advantage of being much faster. Traditionally, the metals to be joined are clamped together in an iron clamp, coated with flux, and then fired in a reducing atmosphere. They are held at a temperature just below the melting point of the lowest metal for several hours. This allows the sheets of metal to start diffusing into each other, thus welding the whole billet together without any of the individual laminate sheets ever really melting. The drawbacks to this are that it takes a day to prep and fire a billet, and there is a high failure rate. Our technique will be a little more 'rough', but it has the advantage that a billet can be created and fired in under 2 hours. The difference between our technique and the traditional one is simply that we're going to use sterling silver sheets in between each layer of the nickel silver. We then wire the billets together, flux, and then fire them with a torch. We'll get them up to a temperature above sterling's melting point (1640 f°), and use the sterling as a kind of solder to bond the sheets of the laminate together. The advantage to this is that it's much quicker, and slightly easier than the traditional technique. The drawbacks are that every-other-layer needs to be sterling silver, and depending on what metals are used, the finished billet can be very sensitive to heat in further soldering operations.

Three finished Mokume-Gane rings.
The materials are sterling silver & nickel sliver

Procedure

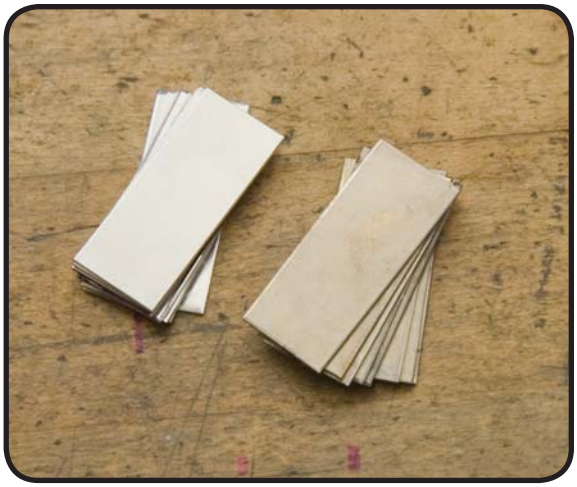
STEP ONE:

Prepare the sheet. Take your sheets of silver and nickel silver. Flatten them as required in the planishing hammer.

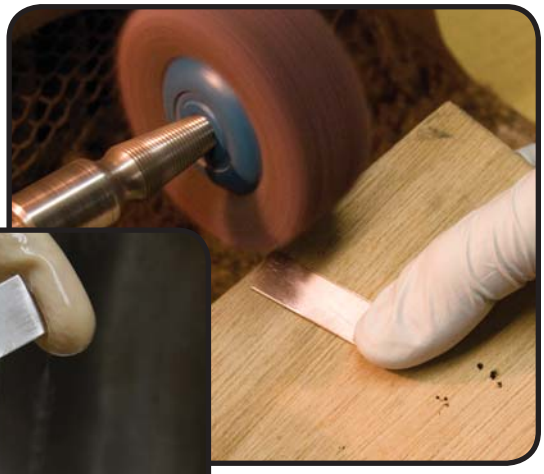
Next, take them to the buffers. Use a scotch-bright wheel to cut through the any surface contamination on both sides. I find it helpful to hold the piece to be cleaned against a clean piece of wood. Scotchbright generates a lot of heat, so I also find it helpful to wrap the thumb that's doing the holding with gatorskin tape to protect against the heat. The end goal is to have all the pieces flat, and smooth, with both faces cleaned by the scotchbright wheel.

After the buffers, move to the sink. At this stage, put on surgical gloves to protect the metal against re-contamination from the oils on your skin. At the sink, dump a little Comet powder out onto the sink flange, and mix it with some of the thick blue dish soap. Use a toothbrush to rub this slurry across your pieces of metal. The goal is to clean all grease and oil off the face of the metal sheets. Water will sheet evenly across clean metal. If it balls up or breaks into islands, there's still oil. Keep cleaning. After this stage, handle the sheets by the edges only, even with gloves. It's helpful to have a clean paper plate to put them on to make it easier to carry them around.

Once all of your sheets are totally clean, you have about 12 hours to fire the billet before the oxide layers will re-grow enough to interfere with the bond. You can't save it for next week. You need to finish firing it at least once today.



The two sets of sheet metal



Cleaning with scotch-bright wheel. Note thumb position and board for support.

Degreasing in sink. Note gloves.

STEP TWO:

Stack, Crush & Bind. Once you have clean metal sheets, find one of the special (clean) steel block sets. Stack your metal in alternating layers on the block, being careful to handle the sheets by the edge only. Use the other block on edge as a wall to push your layers up against to aid in getting them stacked evenly. If you have one or two sheets that are noticeably different sized than the rest, try to use those at the top or bottom of the stack. Take the stacked metal out to the hydraulic presses. Put the other block on top of your stack, and insert it into the press. Make sure the stack stays level and even. Use the hydraulic press to crush the stack to 6000 PSI. This will just crush the metal until the imperfections in the sheets match up with each other, making it easier to bond them.

After crushing the stack, remove it from the press. Be very careful to hold the stack in such a way that the sheets don't move relative to each other.

The billet crushed in the press between 2 steel blocks.

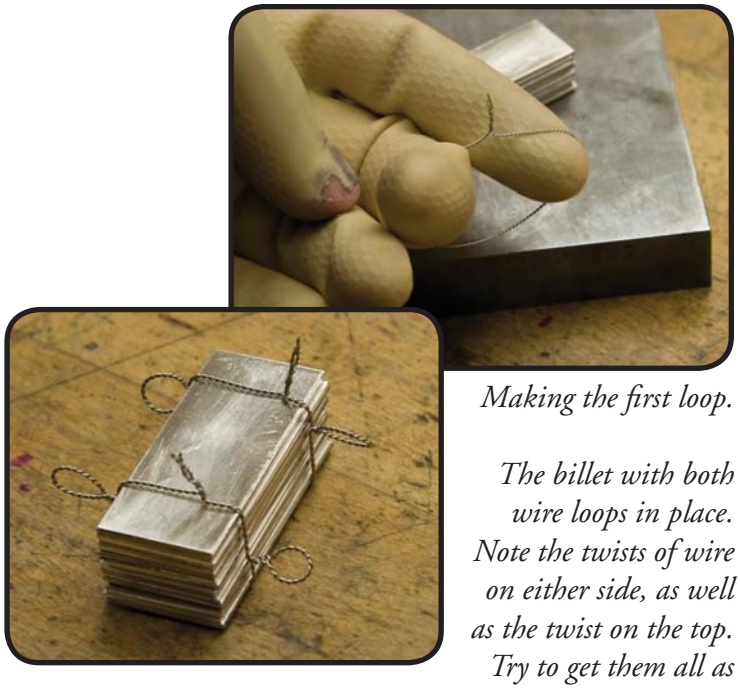
The gage reads 6000 psi.

Now you'll wire it up for firing. You do this by taking two five-inch lengths of the twisted stainless steel binding wire from my desk, and twisting the ends of each piece together to make a pair of loops. Open the loops out into wide "O"'s with the twist of wire sticking straight up out of the middle. Slip one of these around one end of your billet. Slide it down until it's about 1/4 of the way in from the end. You should have the top and bottom of the loops pressed against the top and bottom of the billet. This will leave two large loops of excess wire on the sides. Twist those

two loops until they tighten up into "mickey-mouse ears". Remember to pull back on the wire as you twist it tighter. The goal is to get all three twists as tight as you can without breaking the wire. Once the first loop is set, do it again on the other end with the other loop. The goal is to tighten down against the billet to the point where it can't move or shimmy.

STEP THREE:

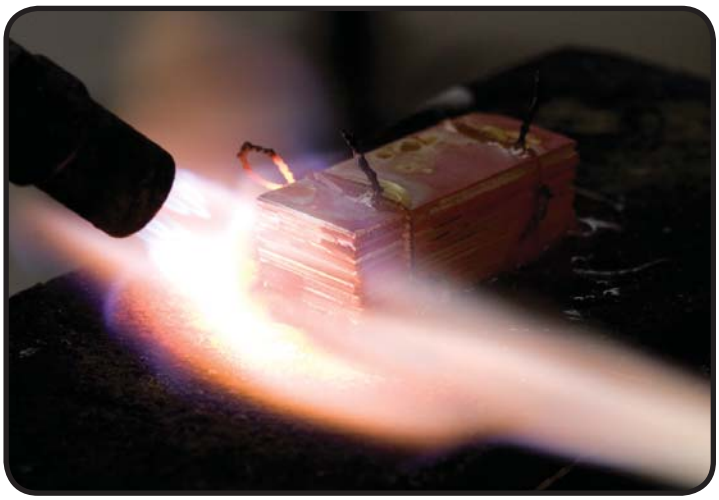
Fire Away. Once both sets of wire are tight, it's time to fire the billet. Place a lazy susan under a firebrick at one of the soldering stations. Put a charcoal block on top of the white firebrick, on the lazy susan. Flux the billet with white paste flux, paying special attention to the sides and ends. Use the thickest flux you can find, and use plenty. There's no such thing as too much flux for this job. Place the fluxed billet onto the charcoal block so that it sits flat and even. Use the big multi-orifice tip on the torch. Adjust it so that it's very, very large, and slightly reducing. It should be making noise, and the inner cones should be about 1/4" long.. This will be the biggest, hottest flame you've ever used, as we really ***are*** trying to melt the sterling. Heat the billet while spinning the lazy susan with your solder pick. Aim the torch flame at the point where the billet sits on the charcoal block. The hottest part of the flame is the inner cones, so heat the billet with the cones about one inch away at all times. Remember to keep the torch moving so that it stays at the same relative distance to the face of the billet as the lazy susan spins. As the block heats, nothing much will happen for the first 30 seconds or so. The flux will boil and turn white, but that's it. The flux will melt and turn glassy at about 1000 F°. That's about 2/3 of the way to the final temperature. It'll seem like nothing's happening. Be patient. Keep heating. Once you see the shadows starting to turn red or glow, you're getting close. At this stage, you should be able to see a clear difference between the sterling and the nickle silver. The sterling will be the lighter layers. Keep an eye on it as you spin the block. Don't worry if you burn off the outer loops of the binding wire. So long as the central loop doesn't burn away, you'll be fine. Keep heating & spinning. Watch for the sterling to start to look 'sweaty' on the edges. Before very much longer, you'll see it the silver flash to what looks like mercury running around the sheets. That's molten silver. Give the block one last spin to make sure that you've got molten silver showing on all four sides, and then get the torch out of there. (Go until you see molten silver on all four sides, but don't go any farther beyond that.) If you



Making the first loop.

The billet with both wire loops in place. Note the twists of wire on either side, as well as the twist on the top. Try to get them all as tight as possible without breaking the wire.

The wired billet.

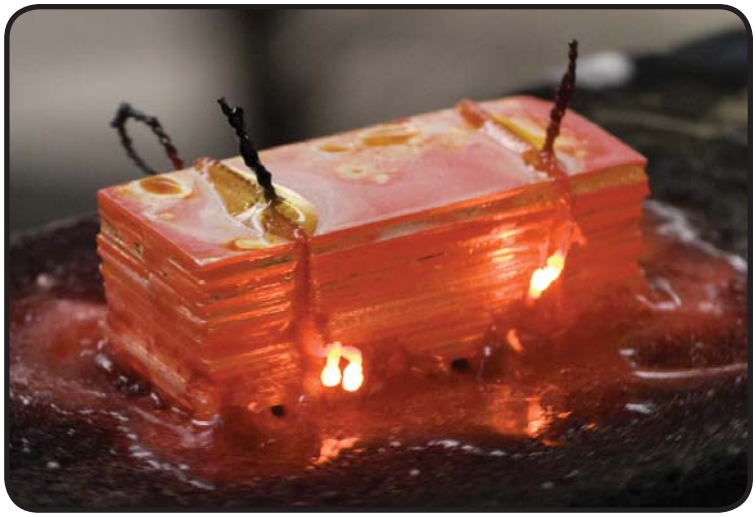


Firing the billet with the large tip on the torch. Note that the fire is directed at the lower corner of the billet.

overheat the metal too drastically, the whole thing will melt, and you'll have wasted an afternoon.

Turn the torch off, and give the metal a long, slow ten-count before dunking it in the quench water. Don't even attempt to pick it up until it's cooled back down to a dull red. If you still see any shimmering silver, start counting again. Don't touch it.

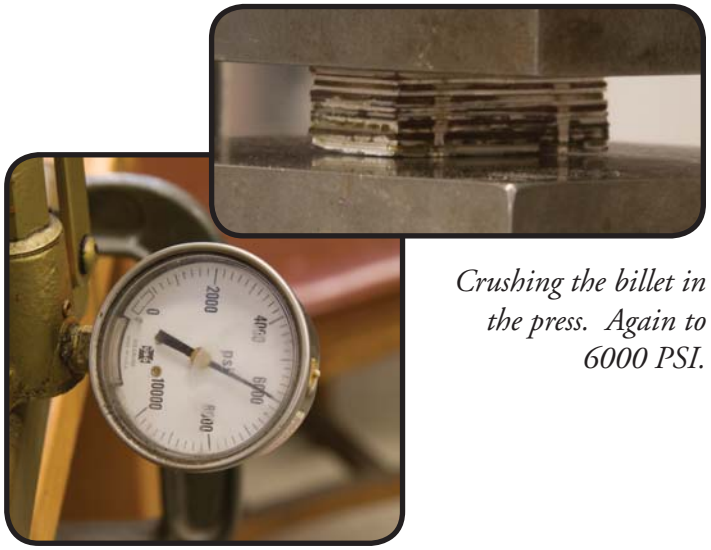
Once it's quenched, do your best to get the binding wire off. Chances are good that some of the silver will have melted onto it, binding it in place. If you have the right pliers, and correct karma, you can sometimes grab the wire and peel it out of the silver by rolling the pliers sideways and using the side of the jaws as a lever. If that doesn't work, file away at the block until all of the binding wire is gone. Then pickle it.



The fired billet.
Note the shimmer of molten silver at the top left of the billet.

STEP FOUR:

Lather, Rinse, Reheat. Once the block is out of the pickle, inspect the top and bottom plates. If they have uneven melted bits of silver on them, file them until they're flat again. Then go out to the hydraulic presses, and crush them between the steel plates, to 6000 pounds again. This is just to help consolidate the billet. Then re-wire the block, and re-fire it, exactly as before. The only difference is that you want to wire it up (and fire it) so that the side that was down during the first firing is on top during the second. Because of the charcoal block, the bottom doesn't get quite the same heat as the top of the block. So we're re-firing it upside down to make sure that both sides have received equal heating.



Crushing the billet in the press. Again to 6000 PSI.

STEP FIVE:

File. Once the block has been fired again, and pickled, the next job is to file off the melted bits of the edges. Clamp the block in a vise, and use a coarse file to file away at the edges of the sides and end until they are a solid block of striped metal. Clean the top and bottom until they're flat too. Make your last pass with the file go across the block. Across the stripes, not with them. This will make it easier to inspect the block to see if you have any open joints. Look at the stripes. Use an optivisor or loupe. Look carefully at all the joints between the stripes. You shouldn't see any dark hairlines between the stripes. If you do, you've probably got an area that didn't fuse completely. This means that you need to go through the whole procedure of wiring, fluxing and firing again. But better that than having the block fall apart on you later.

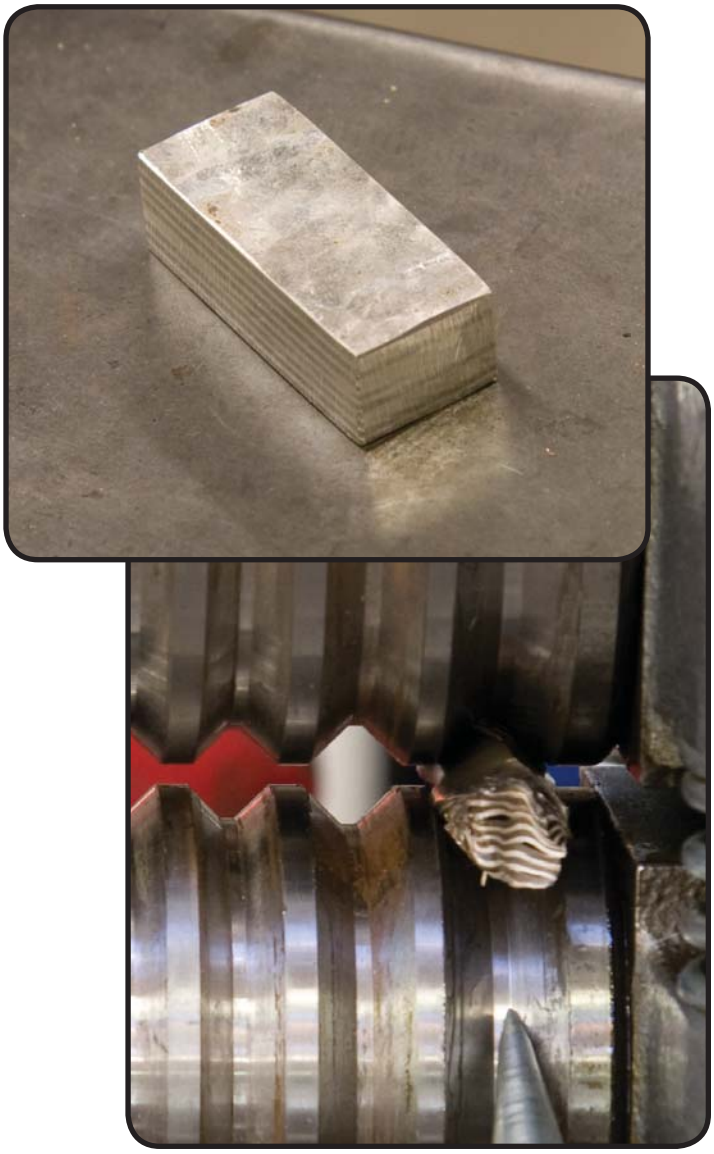
The billet held sideways in a vise.
One edge has been filed clean. Note the stripes.

Step Six:

Roll for effect. Once the billet has passed inspection, the next step is to turn it into a square bar. Use a gently rounded faced steel hammer to pound the top face of the block. The goal is simply to consolidate the block, so serious metal movement isn't needed. Strike it hard, but not so hard that you lose control. Go until you've covered the entire surface, then quit.

The next step is to roll it through the largest of the square rollers in the big grey rolling mill on the back porch. The wheel that controls the space between the lower rolls with the square wire grooves is on the bottom of the machine, not the top. Open it up only far enough to get your wire between the rightmost set of grooves. Roll the metal through, then rotate the block 90 degrees, and roll it again. Close the rolls slightly, and then repeat. The cycle is to roll, rotate the bar, and roll back through, then close the rolls a little, and repeat. In the first few passes, the metal won't be filling the groove completely, so you can probably get half to a full rotation out of the bottom wheel between passes. Once the rolls really start to bite, you'll be moving in increments of 1/8 to 1/4 turn per pass. Remember to keep rotating the wire. If you forget, there will be a flange of wire squeezed out into the open gap between the rolls. You can't roll this back into the wire, so you'll have to stop and file it off. If you go to far with the flange, it can turn into a very nasty serrated razor blade. Don't let it get that far.

Using the hammer to consolidate the billet . The goal is simply to hammer the whole upper surface.



The billet after being run through the largest groove on the squaring mill several times. Note the gap between the rollers. That gap won't close for several more passes. The pointer is to help you remember which groove you're using.

Keep rolling until the lower rolls close against themselves, and your wire fills the largest (rightmost) groove. You may have to anneal once or twice along the way. Stop and anneal any time the metal starts to feel stiff, or you have trouble cranking the mill's handle. You shouldn't have to lean on the handle to crank it around. If you do, chances are you got too aggressive with the size of the bite you tried to take off. Don't crank the lower handwheel so far around on the next pass. You'll go faster with lots of light passes than big slow heavy passes. (It's easier on the mill too.) The mill will roll square wire that has the corners angled off. Don't worry, it's supposed to do that.

Step Seven:

Do the Twist. When your wire has been rolled in the largest groove until the rolls are closed, it's time

to straighten it out and twist it. The wire probably got pretty bent when it was being rolled. Don't worry about it. Go anneal it, and then use a mallet to straighten it out on the anvil. Then clamp the bottom 1/4" into the big grey blacksmith's vise out back. Use a set of vise grip pliers to get a grip on the top 1/4" inch, and twist the bar as far around as you can. Chances are you won't make one full revolution. Nickle silver's tough stuff. Go anneal it again, and then put it back in the vise, and see how much more of a twist you can get on it. The more twists you get, the better it'll look in the end. Try to end up with the square faces of the top and bottom aligned with each other. Remove it from the vise, and take it to the anvil. Hang on to one end of it with the vise grip pliers. Make sure the pliers are hanging off the edge of the anvil. Use my big blue blacksmithing hammer to forge the twisted candycane back down into a square bar. Forge one end of the bar, while hanging on to the other wit the vise grips, then flip the bar and repeat. The goal is to hammer the twist marks down until you have something close to a square bar with a twisted pattern shot through it. It doesn't have to be perfect. "Square-ish" is close enough. Once that's done, go anneal it yet again.

The twisted bar in the vixe.

Forging the bar. Note that the visegrips are beyond the edge of the anvil.

STEP EIGHT:

Rolling away. After annealing, we're back into the rolling mill again. Open the rolls far enough to get the bar back through the big groove. Roll it down until the rolls close again. This may take a few passes. Anneal at that stage. Then come back out and open the rolls until the bar will fit through the second-largest groove. #2 from the right. Roll the bar down in groove #2 until the rolls close. Again, this will take several passes, and possibly an annealing or two.

The billet after squaring up. Note that this billet was slightly larger than the billet called for in the instructions, so it will appear oversized.

STEP NINE:

Straighten & drill. When the rolls close on the second groove, the metal should be a sold, square rod, with a twisted pattern swirling through it. There shouldn't be any physical dimples where the twist marks were. It should all be smooth. Once you get to that stage, the bar probably got bent again while you were rolling it. Anneal it, and then press it between two large steel blocks in the hydraulic press. Press it twice, once with each side up, so that it ends up straight. You can do this on the anvil with a hammer if you'd like. It's quicker, but the press is easier. The planishing hammer (the 'bammer') doesn't have

The second pass on the squaring mill. Ending in the second groove this time. Note that the rolls are fully closed.

The billet after the second rolling & straightening.

nearly the power needed to push this thing around, so don't abuse it by trying.

Once it's straight, take a set of dividers and strike a line down the center of the length of the bar. Inspect the bar. Look for cracks or un-even spots. Mark any areas you think are suspect for open joints. There shouldn't be any, but check anyway. Chances are good they'll be near the ends. Make a mark across the centerline mark at a point about 6-8mm inwards from the last bit of nastiness on the cleanest end.

There is a chart of ring blank lengths in the next column. Find the ring size you need. Subtract 3 sizes. Find the slot length listed for that size. Set your dividers for that distance. (in mm) Put one leg of the dividers onto the crossmark you just made. Make another mark "X" mm down from the original mark. Mark the bar 6-8mm further on after the second mark. That's where you'll cut the bar, but later. For now, keep the extra length as a handle.

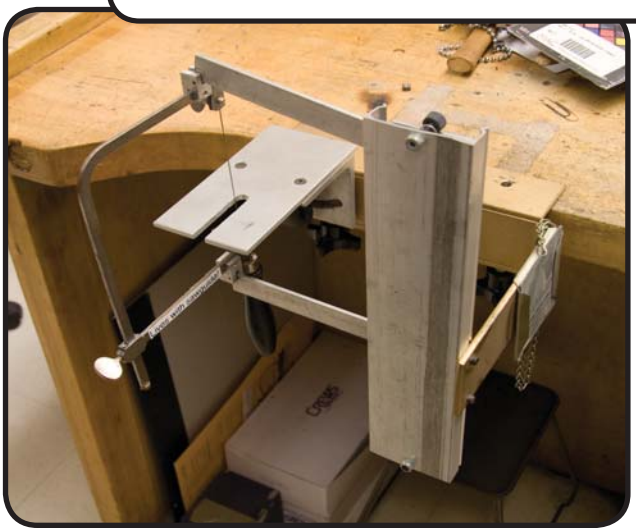
Using the grey precision drill press, drill a pair of holes straight through the bar, at the points you indicated with the crossmarks. It's important that the holes go through straight, and that they be centered in the bar. Remember to center punch the marks so that the drill starts evenly. The size of the drill hole isn't important. A little bit bigger than a #6 sawblade is plenty.

Step Ten:

Slot. The next step is to use the precision sawguide to help you slot the bar. The goal is to make a perfectly straight cut between your two drill holes. If you were cutting freehand with your jeweler's saw, there'd be a serious risk that your hand would tilt one way or the other. If you followed the line straight down the middle on the top of the bar, your tilted hand would have the cut coming out off to one side on the bottom. The sawguide holds the sawframe rigidly straight up-and-down, so that isn't possible. Use a coarse #6 sawblade in the special sawframe that goes with the guide. Thread the blade through the endmost hole as normal. Then make sure the bar is above the cutting table of the guide. There is an aluminum block on the rear upright of the sawframe. There is a slot in the block. There is a pin in the slot of the block on the sawframe. The pin fits into a notch in the end of the lower arm of the saw-

Ring size chart

Size	Slot Length	Length of 20ga Sterling Needed
1	23.6 mm	41.5 mm
1.5	24.2 mm	42.7 mm
2	25 mm	44 mm
2.5	25.5 mm	45.2 mm
3	26.1 mm	46.5 mm
3.5	26.7 mm	47.7 mm
4	27.35 mm	49.0 mm
4.5	28 mm	49.6 mm
5	28.6 mm	51.5 mm
6	30 mm	54.0 mm
6.5	30.5 mm	55.3 mm
7	31.1 mm	56.5 mm
7.5	31.75 mm	57.8 mm
8	32 mm	59.1 mm
8.5	33 mm	60.3 mm
9	33.65 mm	61.6 mm
9.5	34.25 mm	62.8 mm
10	34.9 mm	64.1 mm
10.5	35.5 mm	65.3 mm
11	36.15 mm	66.6 mm
11.5	36.75 mm	67.8 mm
12	37.4 mm	69.1 mm
12.5	38 mm	70.4 mm
13	38.65 mm	71.6 mm
13.5	39.75 mm	73.8 mm
14	40.4mm	75.1mm



guide. There is another block with a pin on the upper upright of the frame as well. That fits into the upper arm of the guide, which is spring loaded to clamp down against it. Once the sawframe is installed in the guide, it should slide up-and-down easily, but not tip side-to-side at all. Using the guide, saw the straightest line you can between the two drilled holes. You will notice that the bar wants to drop into the slot on the table of the sawguide. My solution was to use a scrap of thin sheet metal to bridge the gap. I put it across the gap behind the sawblade, such that the end of the bar rested on the metal, rather than falling through the slot. If you're going to do a pair of rings, or cut the end of the bar in half lengthwise, do that all in one go, before you cut the bar down to the length needed for the one ring. That way you have the whole thing as a handle. Once all of your slotting is done, cut the bar crosswise at the marks you made 6-8mm from the drill holes.

Slotting the billet. Note the ruler across the gap, supporting the metal.

The slotted billet. Note that this billet started larger than the instructions call for, which is why it was possible to get three rings out of it. Yours will be shorter.

STEP ELEVEN:

Drift. Take the slotted and trimmed blank out to the anvil. Find my special blue drift. Put the sharp end into the middle of the sawn slot in your ring blank. Using a mallet (***not*** a steel hammer) start it through the hole. Once it's slightly in, shift positions so that you're driving it over the small round hole in the tail of the anvil. The idea is to have the punch come out through the back side of the ring and slide through the hole, ***NOT*** cut into the top of the anvil.

Once you're started, and sure you're dropping into the hole, just keep driving the drift through. It'll fit through the hole in the anvil, and eventually fall out the other side. Make sure you grab it as it comes out the bottom of the anvil. Bouncing off concrete is no good for it. Watch your ring for signs of splitting, especially at the corners around the two drilled holes. If you see any, ***STOP!*** Come find me and we'll figure out how to deal with it. Anneal once you're done drifting.

Drifting the ring.

Note that the drift goes through the little hole in the back of the anvil. Do NOT strike the drift directly onto the surface of the anvil.

STEP TWELVE:

Admit that you have control. The drift will leave the ring with a pretty peculiar squarish shape. Place it on a ring mandrel, and tap the two 'ends' down towards the mandrel. It helps to have the other 'end' sitting on the anvil as you do this. The sides may arch out away from the mandrel as you pound the ends down. Tap the sides in towards the mandrel as well. This should all be making the ring slide up the

mandrel. Keep tapping it more towards round. Concentrate on the two ends, and watch out for cracking on either side of the drilled holes. It is sometimes helpful to drive the ring up the mandrel by placing the mandrel through the hardie hole on the anvil–the square hole–support the ring by holding the mandrel against one corner of the hole, such that the edges of the hole support the ring. Use a rawhide mallet to drive the mandrel down into the hole. Rotate the mandrel 180° after every blow to even out the stresses. This will drive the ring higher onto the mandrel.

Once you get the ring reasonably rounded, you will notice that the divots left at top and bottom by the two drill holes have not completely vanished. In fact, they have small 'ski-jump' looking ledges. Use a small half-round file to file the ledges away so that there is an even curve between the bottoms of the drill holes and the rest of the curved band of the ring. Once the ledges have been filed away, place the ring back on the mandrel. Support it on the anvil such that one of the stumps of the original bar is down, and one up. Nothing but the bottom stump should be touching the anvil. Strike the upper stump with a flat faced steel hammer to drive the drill marks down a little closer to the mandrel. Even out the shape of the ring as before. Once you've got it about as round as you can, cut the stumps off, leaving about 3mm of the stumps remaining. After the stumps are trimmed, place the ring back on the mandrel, and go back to the anvil. Place one stump on the anvil, and repeat the previous forging and rounding step.

The "ski-jump" steps left behind by the drilled holes

Hammering the stumps down against the mandrel.

The ring on a mandrel. Note that the drill holes have not completely driven down yet.

Step Thirteen:

Even the odd. Once the stumps have been driven down one last time, the insides of the ring should be pretty well round. Make sure you alternate the direction it faces on the mandrel so that it doesn't end up tapered. If everything worked out correctly, your ring should be more-or-less the size you need. Perhaps slightly oversized, but not too far. If your ring ended up too large, now is the time to correct it. Make the ring round by driving it up the mandrel. Measure its size. Find your target size. Mark out a distance of 2.2mm for every size you wish to take it down. For example, if the ring is a size 14, and it needed to be a size 10, you'd remove 4 sizes, or 8.8mm. Examine the pattern to figure out the best place to remove metal. Typically, the best spot will be where one of the two stumps was. The patterns tend to be short and confused there, making it easier to hide a joint. Cut and fit the joint, making sure the fit is tight. Solder the

Filing away at the 'ski-jump' edges of the drilled holes.

joint with hard solder. Then re-round the ring on the mandrel. It should be a the proper size now. File the inside to make it perfectly round if needed.

Step Fourteen:

SilverSleeves. The next step is to prepare and solder the silver sleeve for the inside of the ring. Nickle silver is still mostly copper, so it will tarnish rapidly when placed into contact with skin. The best solution is to line the ring with silver.

To do that, consult the chart for the proper length of silver sheet to make a ring of the required size. Choose a length 1/2 size smaller than your target size.

Cut a strip of 22 ga. sterling sheet to your required length, and about 10mm wide. The exact width depends on your mokume ring. The goal is to be roughly twice as wide as the mokume band. This way there will be plenty of material on either side of the mokume when you finish sleeving it. Thus making life easier.

File both ends of the silver sheet such that the ends are at right angles to the length, and square. Bend the two ends of the strip up at right angles, so that the strip looks like a staple. Then use your fingers to bend the strip around so that the two ends touch. It should end up looking like a "D" shape. A handy trick for getting the ends to line up perfectly is to take one end, and push it over the other one, then pull the "D" open again, and push that end under the other one. Repeat that 'over-under' pattern a couple of times, and you will have built up some work hardness that will want to hold the "D" closed. Hopefully with both ends touching. The goal is to end up with both ends of the strip touching "head-to-head". Straight across, and even in all axes. If they end up tilted relative to each other, use 2 pairs of flat-nosed pliers to grab the ends and rotate them into line with each other.

Step Fifteen:

Solder. Once the "D" is lined up, the next step is to solder it closed. Flux it thoroughly, and place it onto a solder block. Lay the ring on its side, so that it forms an open-topped corral. Cut a snip of hard solder roughly 2-3 mm long. Place that down on the soldering block, and shift the ring so that the solder is pinned directly under the bottom of the joint, crossing the ring. The goal is to use the weight of the

The silver strips required for my two demonstration rings.

The two strips bent up into staple shapes

Closed into "D" shapes.

The "under & over" technique for evening out the stresses, allowing the edges to meet evenly.

The "D" shaped ring after alignment.

ring to pin the solder into place. Holding it right at the bottom of the joint, so that it's exactly where it's needed when the solder starts to flow.

Solder as normal. Aim the torch straight down into the open circle of the silver band. This will use the ring itself to trap the heat of the torch, making the solder proceed more quickly and evenly than if the ring were heated from the outside. It will go more quickly than you expect. Watch out you don't melt it. When the solder gets to the right temperature, you will see it jump up into the joint. When you see solder all the way to the top of the joint, stop. You're done. Quench and pickle.

Step Sixteen:

Stretch to fit. After retrieving the silver sleeve from the pickle, it's time to round it out and join it to the mokume outer band.

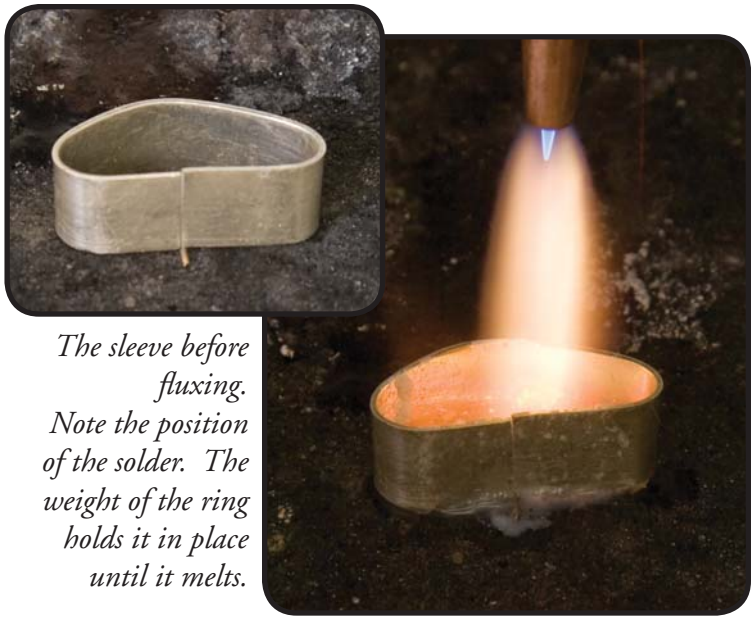
File off any lumps of solder that may be visible, especially on the inside of the ring. Then stretch it on the mandrel until it's round. It should be slightly undersized for your goal. Remember that the size is measured based on the mark that's hidden in the center of the band, not the mark that's on either side.

With any luck, the sleeve should just fit inside the hole in the mokume band. Center the mokume band in the width of the silver sleeve, so that there are equal amounts of silver sticking out on either side.

Place the sleeved ring onto the ring-stretching machine. Stretch the inner ring up so that it fits tightly against the inside of the mokume band. Hold the mokume band centered within the width of the silver sleeve as you do this. Once the inner ring reaches the inside of the mokume, it will hold itself in place. You will also feel a huge increase in the force needed to expand the ring once it starts to stretch into the mokume. If the ring is still undersized, stretch it up with the machine until it is the proper size. You might want to leave it 1/4 size under to allow for polishing.

Step Seventeen:

Solder the sleeve. Once the mokume & silver combo have been stretched to the proper size, it's time to solder them together. Flux thoroughly, and cut 8 snips of medium solder roughly 2mm long. Place the ring on its side on the block, just like the "D" of the sleeve. Place four of the snips of solder at the cardinal



The sleeve before fluxing. Note the position of the solder. The weight of the ring holds it in place until it melts.

Soldering the sleeve. Note that the torch is firing straight down into the ring.

The sleeve inserted into the mokume ring.

Soldering the sleeve into the mokume ring. Note the torch firing straight down into the ring again. This traps the heat within the ring, heating it more quickly.

compass points of the ring. Place them at the upper joint where the silver sticks out of the mokume, right up against the silver tube. Place the other four snips in-between the previous four, so that you end up with eight evenly spaced snips of solder around the circumference of the joint.

Solder in just the same way as the "D" of the silver sleeve: aim the torch straight down into the hollow of the ring, and let the ring itself trap the heat of the torch. The end goal is to have solder visible all the way around the lower side of the joint. That means that it's gone all the way through the joint, and that the sleeve is completely soldered to the mokume.

Quench and pickle as usual.

Step Eighteen:

The trimmings. After the ring is out of the pickle, use an optivisor to inspect the solder joints on both sides of the silver sleeve. They should both be complete rings of silver solder. Any gaps indicate incomplete soldering. Place solder onto any gaps and resolder. Once the joints are good, use a jewelers's saw to trim off the extra silver beyond the edge of the mokume band. File the edges of the ring so that the silver becomes exactly the same width as the mokume band.

At this stage, you'll have something that looks like a mokume tire, with a solid silver sleeve. The next step is to file the ring down to shape. The question then becomes "what shape?". Contemplate what you want from a final design. This technique leads to a fairly thick ring blank. This means you have a lot of room to experiment. Tall rings will show the pattern more clearly, but are less comfortable. A ring with a lower dome shape will be more comfortable to wear. A ring with a groove down the middle will do interesting things with the pattern. Ponder these variables before embarking on the next step.

Step Nineteen:

Final shaping. After you've figured out where you want to end up, it's time to start the final shaping of the ring. Figure out how thick your final ring is. Set your dividers to that thickness. Use the dividers to trace out that thickness around the band of the ring by way of placing one point within the ring's central opening, and sliding around the circumference of the ring. This will leave a round line around the ring, at

The sleeve soldered into the ring.

Marking the outside diameter of the ring.

The ring filed with 45° edge bevels.

whatever thickness you set. Do this on both sides. File away everything that's outside this line. I suggest filing at a 45° angle on one face until you reach the line, then flipping the ring over and doing the same on the other side. This will leave a roof shaped peak down the middle of the ring. Then file straight across that until your file is making a flat surface around the ring, and touching the scribed lines on both sides. Final shaping from here is a matter of personal taste, but I'll leave you with a couple of suggestions. (A) round the edges of the ring. Straight, slabsided rings are uncomfortable. (B) Use a file to round the inside corners of the silver sleeve as well. That will make it more comfortable. (C) grooves can do interesting things with the pattern. You can file a round bottomed groove into the circumference of the ring with the round needle file in your toolkit. (D) nobody said that grooves had to be single 'death-star' style trenches. A bunch of angled grooves across the face might be more interesting. (Sort of like truck-tire grooves, but hopefully not too much like truck tires.)