

Higonokami® Inspired Friction Folders
IronFlower Forge – S.A.Bloom

A student mentioned that the Japanese for ages made friction folders - nice, simple, utilitarian blades – and he wanted to make one. Of course, I knew all about these – er – well, Google did. Historically, 'ages' is a bit of an overstatement. The Japanese friction folder that inspired what follows really only dates to the Mejii Restoration (late 1800's) and the dearth of samurai customers for the Japanese blade-smiths.

The name derives from "Higo no Kami" which in Japanese means "Lord of Higo" and is an allusion to the birth of the knife type and the decline of the samurai . In 1899, the Miki knife guild was founded and in 1907, the term 'higonokami' was trademarked and a corporation was formed to exclusively make and market the knife type. The knife became widely popular until effectively outlawed (along with pocket knives in general) in the 1960's.[1]

The "official" knife (which is still being produced in Japan in several variant forms[2]) consists of a thin metal handle (a thin brass sheet folded in half with sufficient room between the leaves to accommodate the blade), a blade which has a thumb platform or tail, and typically has a straight edge (or "inverted tanto" point). As a general rule, the commercial versions are inexpensive (less than $20).

Of course, friction folders of basically the same design (blade with a thumb platform that swings freely into and out of a handle) have been around a very long time[3]. What is interesting from a maker's viewpoint is that the design can be worked out and then repeated as opposed to using an antler tip as a handle which necessitates a unique blade design for each handle.

So - got to try one. The Mark I was a folded piece of nickel silver & a blade derived from old band-saw material (~0.070" thick). The handle was a little over 4" by 0.85" by ~ 1/8". It is very light, lives well in a pocket, and if you are in to flipping a blade, it works like a dream (or nightmare – depending on your viewpoint).

Kind of cool but not that much canvas for the knife maker to play with. But what if the folded sheet metal handle gave way to an internal frame. The handle would then consist of three parts – two scales and a frame (which can then be gussied up with decorative filing). The basic idea is a friction folder whose handle spans your hand and short enough to slip into a pocket. The design described here is for a ~3.7" f blade and ~4.7" for the handle. I went for the more traditional Western blade profile with a clip. The only real constraint is keeping the point safely in the handle when closed. I will start with the blade but the total design needs to be turned into templates before starting I'll provide the templates I use at the end of the article but if you want to make one of these little beauties, you will probably just want to develop your own.

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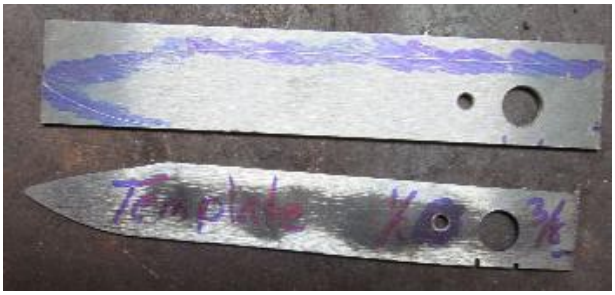
1 http://www.britishblades.com/forums/showthread.php?87498-Higonokami-story

2 "Higonaifu" meaning "knife of Higo" and made outside of the original corporation

3 Cowgill, J. et. al. (2000). Knives & Scabbards – Medieval Finds from Excavations in London. Boydell Press. ISBN 978-1-84383-353-6. pg.106 - No.309 (late 13th century)

The start is a 3/32" x ¾" x ~ 5" piece of O1. Using the template (lower object), drill two holes – a 0.125" hole at the pivot location and a 0.375" hole for the setup of the "flag". The length and width of the blade dictates the size of the scales and the internal frame, so if you design your own - don't go crazy. If too large, it's a monster. If too small, it's a danger to your hand.



Saw off the material not needed. Since I am not simply using a rivet for the pivot, I enlarged the pivot hole with a #27 bit (just why will be made clear later, Grasshopper —but thanks for asking)

The tail is positioned in a vise as shown and the oxy-propane torch is running in one hand and a light hammer resides in the other. Heat the neck to red to no more than light orange and….

Bend the flag up 90 degrees. The neck must be kept at forging temps (NOT yellow) – we are talking tool steel here! If the flag gets out of plane with the rest of the blade – STOP. Remove the blade from the vise, heat it and flatten it back into plane. Try to do this as few times as you can because grain growth is not your friend.

Eventually, flip the blade at right angles to the jaws (as shown). What we want to do is forge the neck (which is now thin due to the stretching) back into something like the original thickness (0.094" in this case)

Use whatever hammer you like – a blunt cross pein or a ball pein but remember to hit it only when at forging heat. Try not to leave divots that can become stress risers – hence a small ball pein is a neat tool for smoothing out the steel.

The next stage is to twist the flag 90 degrees CCW and also 90 degrees such that the flag parallels the top of the vise. Don't worry if the twists take two heats – just don't twist it off and don't overheat it.

Your goal is to create something like this – the bottom rear corner ends up in line with the blade and the plane of the flag now is at 90 degrees to the blade itself. Practice this on scrap! Too little heat or too much will end up in another masterpiece in the stack tub.

You may have to tap and/or use tongs to swing the flag such that the left & right corners are more or less at right angles to the blade and the rearmost corner lines up on the blade axis. Don't get carried away with this – we are a long way from the end – OK – maybe 30 seconds in real time.

The frame of the blade is about 0.125", so slip a scrap of 1/8" material under the flag (You did move the blade back from the edge of the vise jaws and put the spine level to the top of the vise jaws – didn't you?)

So heat the neck again and flatten the flag onto the scrap.

If you are anal, you can reheat the neck and drive the flag a bit towards the tip of the blade (follow the chalk arrows). This makes the neck a bit more at right angles to the spine of the blade but this isn't critical. You can always contour the nose of the frame to whatever angle the neck will eventually make when it touches the frame.

So – you now have a flag offset by about 0.125" from the spine and paralleling the spine. NORMALIZE (heat cycle) the neck & flag. The grain structure is sure to have been pooched – so correct it now and not watch the flag break off somewhere down the line.

The next step to make the flag into a thumb stage – all pretty and nice. You can free draw or use a template, whatever suits your eye. You then jump over to your 2x72 variable speed grinder (you have one, right?) and realize your fantasy.

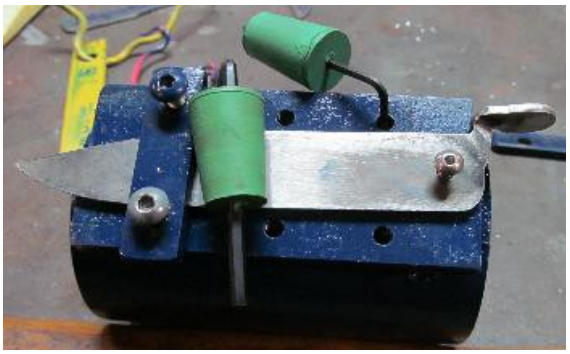
In this case I when for a oblong ellipse. Okay – that's what I got. Remember, a thumb is going to be pressed on this, so don't make it too small!

We have to talk templates. I sketched out a blade shape (long enough to fill my paw), set a pivot location, rotated it and sketched out the cavity into which the blade fitted; I then drew a scale outline around that. All of this was sawed from scrap and painted yellow.

You can see that there is a problem – the blade is too long. If you have ever overheated a tip when grinding, think of this as a safety factor.

. Of course, you can either remove a bit of the frame (not too close to the hole!) or adjust the blade – whatever lights your fire.

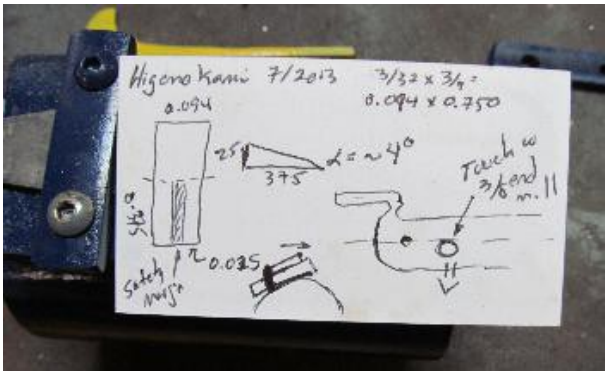
My students and I occasionally joke with the saying "We mill because we CAN". Yup – here's an example. Get a 3" diameter pipe (about 5" long) and weld a flat plate on it. Drill and tap 2 #6x32 holes close to the ends and three sets of #10-32 holes on the edges. Bolt the blade to the plate (the flag dictates the location of the #6 holes). Corks on the Allen wrenches really help when they hit the floor – and they will.



From the side you can see that there is a plate welded in the bore – it's there to stop squeezing the pipe out of round.

The next step is math. Get the thickness of the steel, the bevel start, the safety margin at the edge and my answer was 3.8 degrees to remove 0.025" If you remember trig, the image says it all. If not:

Tan(α) = opposite/adjacent
3.8 = arc tan(25/375)

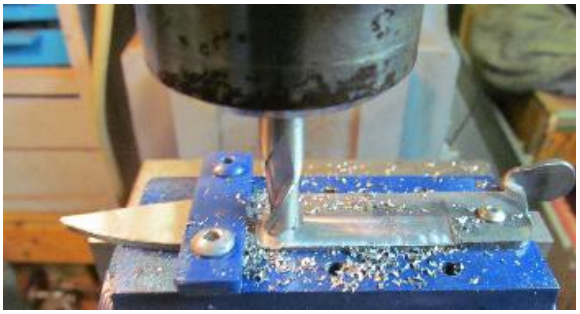


Now – toss that puppy on the mill and plop a digital protractor on the blade (having zeroed it on the vise, of course)

Keep adjusting the rotation of the pipe until the right number appears. I went for 4.00 here. Ain't technology great.

There was a scribed line at 0.375" from the spine of the blade and the mill was adjusted until the end mill just touched that line. Note that the start of the plunge cut is marked by a saw cut on the edge and there is a scribed line perpendicular to the cut (on the rear side of the cut, actually) and on both sides of the blade.

It's then etch-a-sketch time. Carefully approach the perpendicular line and plow through to the edge – and there is your plunge cut. Mill towards the tip until you get close to the clamp. Take as many passes are needed to push the bevel to the designed termination point (0.375" from the spine). Then STOP milling.



Without removing the first clamp, add another closer to the rear. You can then remove the original clamp. This way, there is never a chance of moving the blade on the mill setup. Continue milling to finish this side. Flip the blade over and reposition it to expose the unmilled side up. Re-clamp. Of course, there is a problem. The side down (just milled) is 25/1000 off of square. What to do – what to do?

Slip a 25/1000 copper shim under the edge-to-be and repeat the milling operation described above. When done, run a #22 bit through the hole (up from #27 which is right for the 6-32 screw – see I did tell you why I bumped the 1/8" up with a #27). Now why the #22 – just wait.

The result is a blade 0.094 at the spine, dropping to 0.49 at the edge with the slope starting half way down the blade. Use the carbide shield shown below and do a grind to remove the milling traces.

Heat treat the blade being sure to normalize the entire blade (do the neck again to be sure). Using O1 as a steel, satanite as an anti-scale, a reducing flame of an oxy-propane torch, and the usual toaster oven to temper seems to work just fine. Of course, austempering would be better but for one blade….

You will need to finish grinding the blade. A really clever jig (carbide milling inserts JB-Welded to aluminum angle "iron") makes the grinding without messing up the plunge cuts a lot easier..

In this case (non-pattern-welded steel), I went for the close-to-mirror polish. The blade was run from 60 to 1500 grit, then 3 levels of sisal polish and three levels of rouge. Hey – it's a small blade, so this really didn't eat much time.

Of course a small blade is also hard to hold onto. A set of vise-grips and a Mighty Mag (check Enco) makes holding a blade near a buffer a little less than a terminal experience.

So – we now have a blade. We now need a handle.

A sheet of brass (1/8” thick) was selected as the frame material. The frame template outline needs to be scribed onto the brass. What I like to do is to transfer punch the 0.125” hole into the generally correct location before scribing. Color the general area with Dykem or a magic marker – anything to make the scribe lines more visible.

Drill it, run a pin through and the worries of the template slipping out of position are somewhat lessened. Note the use of a broken 0.125 carbide end mill as a center punch. Nah, we smiths aren't cheap.

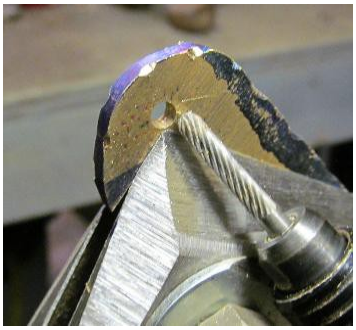
So – finally, scribe the outline of the frame.

A couple of strategically placed holes greatly aid the sawing out of the frame.

So it’s done. OK – this one was done before I thought about the holes. So sue me!

It’s now time to vine-file the outside of the frame. A chuck of waste brass 3/16” wide makes a handy scribe-ruler, so scribe a series of lines 3/16” apart (see above for the Dykem comment) running on the complete outer surface of the frame.

I like to use a 0.125 carbide bit on a pneumatic air die grinder (really cheap at Harbor Freight) to make a shallow depression on every other line on one side, then repeat on the other side on the alternative lines. These depressions help to lock in the chain saw file that will do the real work.



You then use a chain saw file to deepen those depressions until you reach about mid way on the frame (at about 45^0 to the spine). Remember – we're talking brass here and midway is 1/16", so this goes real quick. You will also need a triangular file. Make a cut starting on the scribed line and aiming at midpoint of the unfiled edge and the flanking depression. That defines the 'thorn' (see below). Round off everything but the point of the "thorn" and you've got a nice eye catcher. A tiny flat file (which use to be called a "points" file by us dinosaurs) will do nicely for doing the rounding.

Having a rig like the one shown here makes this stuff easy. There is a well (with the long set screw) into which fits a pipe attached to the base of a small vise. This means you can change the angle relative to the floor by 360^0. The vise allows a 90^0 rotation perpendicular to the floor. The jig to hold the frame is two pieces of plate bolted together with the shorter one with a ¼" piece of square stock at the base, therefore "pinching" the frame.

The real clever bit here is to weld a section of pipe to the plate forming the base of the vise. You can slobber weld to your heart's content and the thing will still rotate smoothly.

This is here to show you the adjustability. Do not underestimate how nice this is!

Oh – and decent lighting and maybe a magnifier can make it that much more special.

So – this is the result. Not bad, heh?

Run a pin and a pivot through the holes on the scale template, add the frame and the blade. Check the fit when open and adjust the length of the 'nose' of the frame so that the blade rotates and stops with the spine of the blade parallel with the spine of the frame and scale. If you remove too much, don't fret. Just arch the thumb stage down a bit to compensate. If this is necessary, be careful. If you didn't normalize the neck, you may be starting over.

Close the blade and adjust the frame and/or blade tip as needed.

It's now time to cut out the scales – in this case, of 1/8" black linen micarta. As mentioned above, I like to drill a pilot hole to stabilize the template for the scribing of the outline (the rear 1/8" hole). The only real requirements are that the pair of holes are in the exact designed location and the scales are equal to or slightly larger than the template.

Drill the other hole. In this case, the front one is 0.154" (#22 bit). Since for me, the holes will eventually need to be the same, I drill the front, put a pin in it, clamp the sandwich again and ream out the rear. Use a #7 bit to make a funnel depression around the outside of the four holes (2 per scale). Make the depression really shallow (0.015" or so).

As shown here, I haven't yet bothered to resize the rear hole. It's only micarta and brass, so there is no biggie on when the resizing gets done, but in the future, I'll follow the instructions above.

The next step is to epoxy the scale to the frame. The frame has a hole, so a pin will restrict movement to rotation only. The tools needed are epoxy (5-minute is good), some spring clamps, a Popsicle stick, epoxy colorant, and a stand-in blade (if the real one isn't out of the tempering oven yet).

Brownell sold a black powder colorant that was just sprinkled on the wet epoxy and stirred in. They stopped selling it. Once mine runs out, I'm thinking laser toner in a syringe This is a GOOD trick.

Epoxy the frame into place. If you have the designated blade or a stand-in, you can check the positioning of the spine of the frame relative to the scale by dropping the blade onto the pivot and making sure the spine of the frame is in the correct position.

Clean off any excess glue and take a breather.

You will need two thin washers – and this tool is a great aid. Harbor Freight carries a cheaper knockoff. Find some thin copper (0.010" here). Using the 3/16" punch, pop a couple of holes in the strip about ½" apart. Note the 3/8" alignment tool (OK - a broken end mill spun on the grinder with a drill – it is still 0.375" in diameter and has a nicely centered point). Note the board that the unit sits on – with holes to match the holes in the plexi tool.

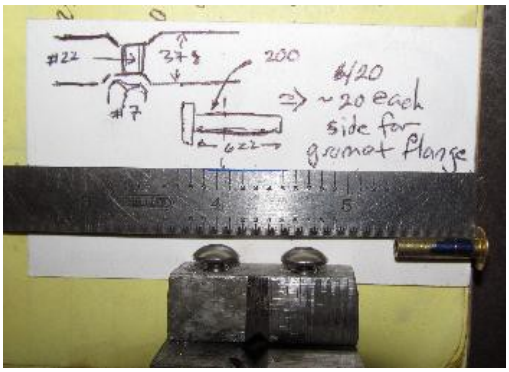
The game is to slide the strip with the 3/16" holes under the 3/8" port and feel for the hole with the pointed tool. When you feel it, the strip will align nicely with the port. Insert the 3/8" punch and whack, you've got a washer.

Here's the result – took way longer to type this that to make the washers.

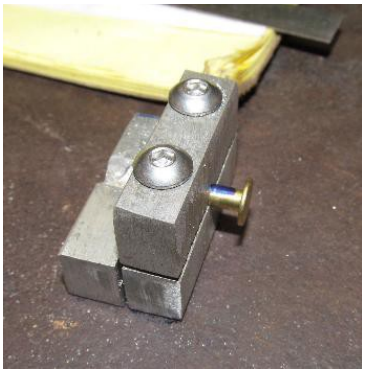
It's now time to assemble. Slip cutler rivets through the bottommost scale (good idea is to wax them a bit), drop a washer over the pivot, then blade and the other washer. Mix epoxy as described above and slip the last scale in place. Tap the rivets as the epoxy sets up but do not remove them.

Clamp as before and make sure that the epoxy completely fills the depressions in the vine filing. Cutler rivets were chosen solely on the basis of being the only small bore brass tubing in my shop on build day. It would be better to just hit an ACE hardware store and buy a foot of appropriate tubing.

The next step is to measure the thickness of the knife at the rivet/grommet points. In this case it was 0.379". I allowed 0.020" for the flange of the grommet, so I needed two 0.420" tubes. In the image, you can see the scribe mark on the female rivet (the tube donor). The 0.420" measure starts at the opening and is about 0.200" from the nearest surface of the rivet head.



A mosaic pin cutting jig is VERY handy at this juncture. Insert the rivet as shown with the scribe line just showing. Head over to the vertical band saw and run the blade just kissing the face of the jig (right side as shown here). Hand twirl a smallish drill bit to deburr the bore. Remove the tube and gently remove any saw trash on the cut surface. The one from the factory is fine.



The result are two tubular rivets. A tiny ball pein is really nice for the next step.

Remove the rear cutler rivet and insert a tube into the hole. I experimented with a tiny ball bearing as an anvil. Don't bother. Just place the ball pein (using the ball) on the tube with a steel surface underneath and tap the rivet with a light hammer. The procedure is place-tap-look-flip over-repeat.

Eventually the grommets will be just below surface and tight. Use a slack belt and normal handle finish procedures to clean up the handle. BE CAREFUL when doing the back under the spine – remove too much or shift the back into a slope and the blade spine won't parallel the handle's spine. The results are shown here – total weight is 2.25 oz (equivalent to $2.75 in U.S. quarters).

As promised – below is an image of the templates –think of these as simply a starting point.

The next step is to use Damascus for the blade.