NON-GUILD COMPETITION, 2020/2021
LINER LOCK FRONT FLIPPER- (THE OYSTER) TUTORIAL

FOLDER DEVELOPMENT NOTES BY JOHN ARNOLD

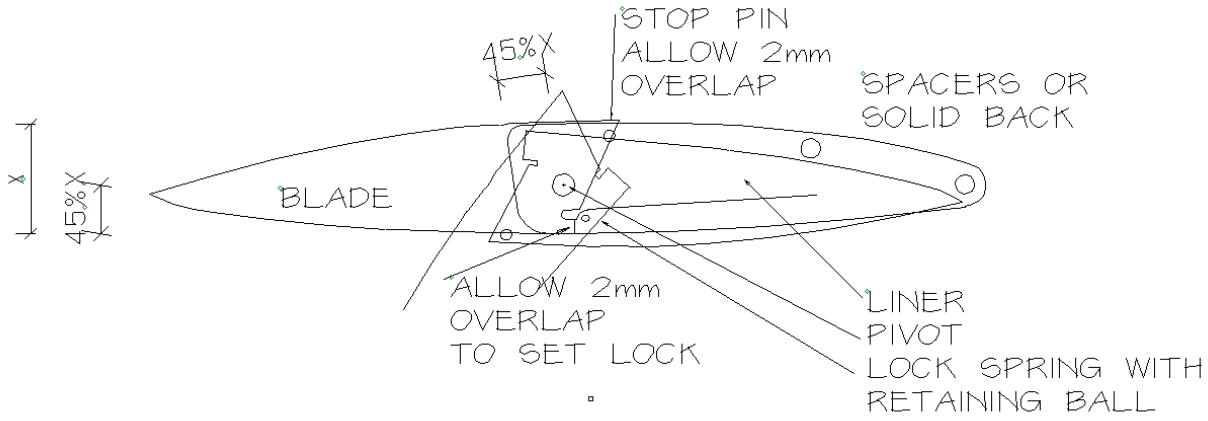
What material do you need?

- Either use the design on the kgsa website. Or purchase a kit of the ARNOLD knife from Kmts.
- Blade of your preferred knife steel 3mm thick will be fine for this size of knife.
- 2 X titanium liners must be grade 5 or 6AL4V thickness 1.2mm or 1.6mm
- Bolster and Handle material to your preference
- 4.5 mm pivot again depending on your design hidden pivot or external pivot.
- 1.6 mm or 080 screws for handles , bolsters and spine
- 2 mm Hardened stoppin

Essential tools:

- Normal knife grinding sanding and drilling equipment
- Drill bits, 1.3mm for 080 screw threads and 1.5 mm for clearance hole. For 1.6 metric screws 1.4mm for screws treads and 1.6 mm for clearance hole
- 2mm drill for stop pin hole
- 4.2 mm drill for pivot hole in blade and liners
- 4.5 parallel reamer for pivot holes in blade and liners

Basic design and ergonomics



LOCK 6mm WIDE 50 TO 60 mm LONG OR 28% X
LOCK TO BE AS CLOSE AS POSSIBLE UNDERNEATH THE PIVOT
ENSURE THE RETAINING BALL STAYS ON THE BLADE

<u>How to design your folder:</u>

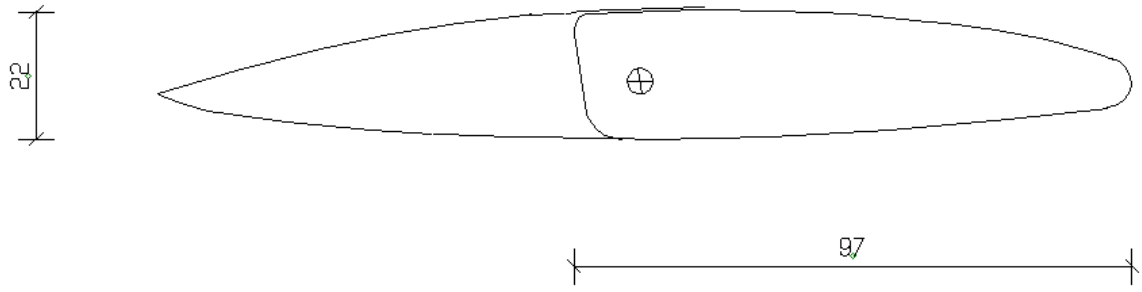
There are many ways to design a folder. The following notes are on the development of a liner lock folder, they are simple, practical, and should get you going:

A folder with a handle length of 100 to 120mm should fit most human hands. More delicate knives can be smaller. The blade is always shorter than the handle in order to fit within the handle.

<u>Step 1:</u>

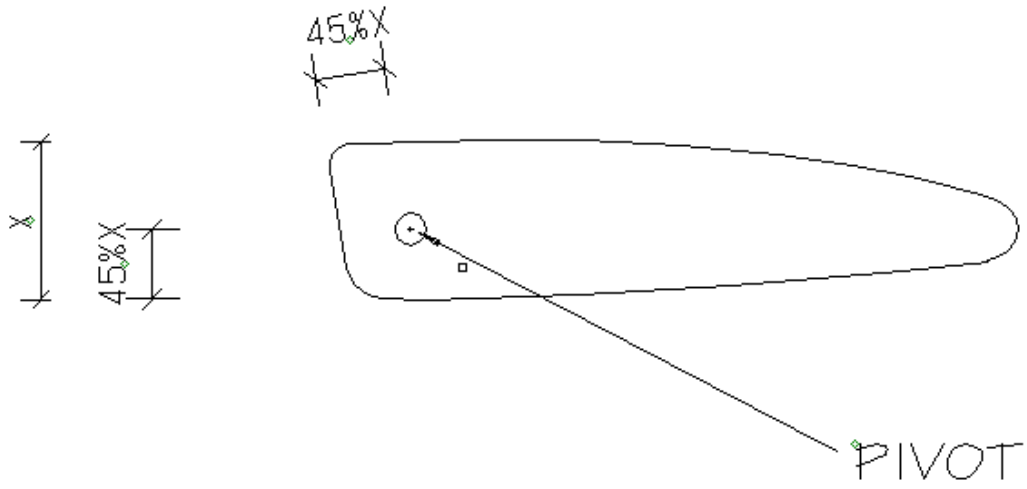
Accurate to scale drawing included (page 11). Modern CAD drawing packages greatly assists with this task, as the blade can be articulated and finer details sorted out.

For our exercise let's use the following knife:



Step 2:

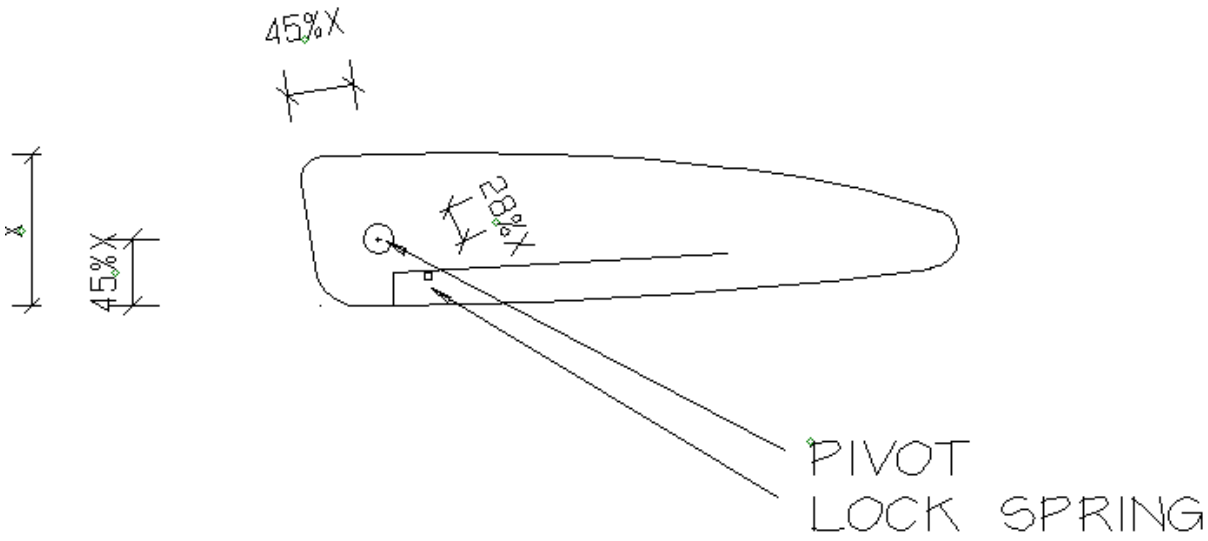
Position the pivot point. This is crucial as the rest of the knife will evolve from this



Pivot ± 45%ofx from the bottom and ± 45%ofx from the front.
As your design progresses and you fine tune the design this positions can alter slightly.

Step 3:

The length and position of the locking bar.

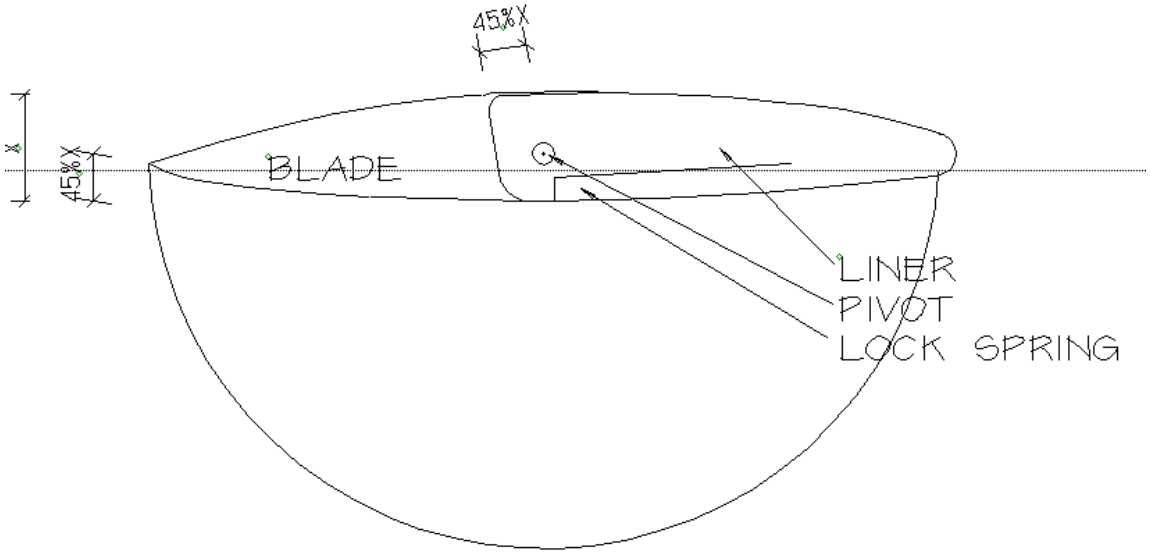


From the Pivot center to the locking bar closest corner = 28%ofx or direct underneath the center of the pivot to 3 mm back from center. Round the corner close to pivot, this gives some room for the shim

The width of the locking bar should be in the order of 6mm wide. The length of the locking bar to be at least 60% of the length of the handle. Sometimes a ratio of 50 x thickness of the liner is used.
The length is not critical, the shorter, the stiffer the lock. The lock should also taper wider to the back of the lock. My locks I keep at 64 mm long. A good practice to keep them at the same length , as the length and the angle of the locking face on the blade goes hand in hand
.

Step 4:

Determine the length of the blade.

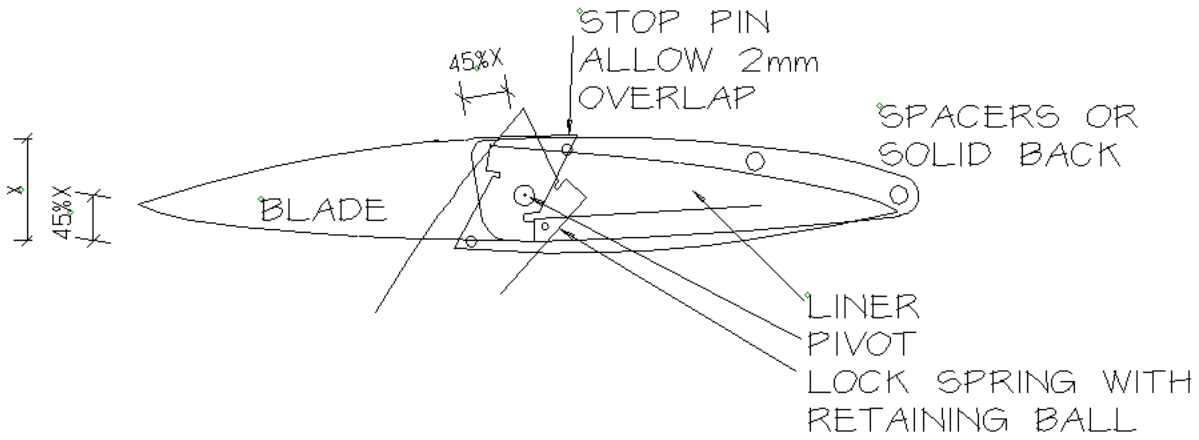


With a divider use the Pivot as centre and the nesting position of the blade tip and draw a half circle.
Complete the shape of your blade.
Transfer the blade onto a transparency and check fit by rotating transparency around a pin stuck in the centre of the pivot..

Step 5:

The Lock:

This is the most important and difficult part of a folding knife. All the elements (stop pin in open and closed position, lock, and lock spring) have an influence on each other and must be understood. The design will dictate if it is a cam , thumb stud or flipper (used on tactical) mechanism. For this design we use a Lateral flipper.



Determine position for the stop pin. Allow excess material to set the blade in the open position, as well as excess material to set the lock.
For the closed position the notch if required must be filed carefully till the blade nest between the liners.
For the open position the back of the blade needs grinding till the blade settles in the desired open position.

Step 6:

Set the Lock:

After finalizing the position of the blade in the open and closed position the lock needs to be set. Be patient and work accurate. One hasty move can destroy all your work up to now.

The lock spring needs to be tapered. This is to allow for the protrusion of the retaining ball in the lock. Taper the 1,2mm liner down to 0,8mm.

The lock angle on the blade is critical and should be between 7° and 9°. I use a 60 mm contact wheel to grind the lock. Set the work table to an

angle 4 to 5 mm above center of the wheel. This gives you about 9 degrees. See sketch (page 25)

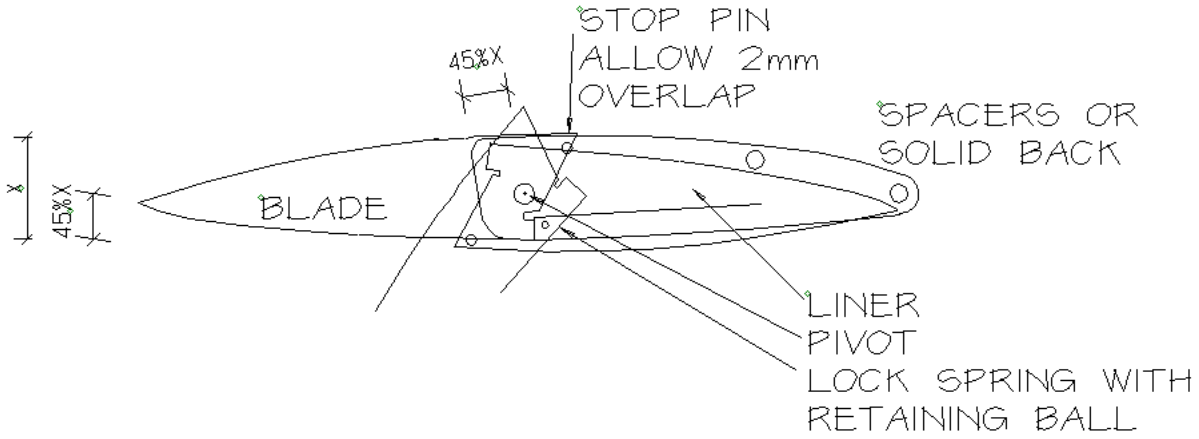
The angle on the lock blade (liner) should be close to the same angle.

The lock also needs to be bend. Bend with a slow curve. Don't over bend the lock as this will result in a unnecessary stiff lock. Bed outwards equal to the thickness of the blade. This will result in pressure of the ball on the ricasso

The final setting of the lock can be done by either grinding the lock or the blade. Care must be taken not to over grind. Assemble and disassemble between grinds till the lock spring just moves in behind the blade.
The lock face of the lock on the blade should not be more than 3 mm. with a slight radius at the top. See sketch (page 26)

Step 7:

The liner lock mechanism has no inherent way of holding the blade in the closed position. For this a hardened ball is positioned in the lock bar that rests into a drilled indent in the blades when closed.



Locate the ball within the area between the tip of the lock and the blade as shown. The ball should not leave the blade
Drill a min 1,3mm hole in the lock.
Assemble the knife complete with shims and Pivot. With the blade closed, nesting onto the stop pin apply slight pressure and clamp with a vice grip drill a 1,3mm indent ,75mm deep into the blade using the hole in the lock as a guide
Dis assemble and drill the hole in the lock to 1,5mm. Insert a 1,56mm hardened ball into lock with a punch and hammer, protruding say .6 mm.
Washers or spacers are also used between the liners and the blade, I use .2 shims

Some notes on materials and fittings:

Blade.
Select a material suitable for the type of knife being made. For medium folders use 3mm and thicker for bigger knives. Edge in the order of 10% of the thickness of the blade.
Liners.
Use 1,2 mm 6AL4V Titanium. Thicker for tactical knives.
Pivot.
4.5 mm pivot. Drill a 4.2 hole, ream with parallel reamer to 4.5mm. The pivot must also be secured to prevent it from coming loose. Position the front hole for the fixing of the bolster carefully to intercept the flange of the pivot, grind a notch in the flange to hold the pivot when the screw is in position. I use the type of pivot with an open ended threaded centre. I then use a 3mm grub screw inserted from the open end and lock it against the screw. This works well and ads freedom in the positioning of screws for fixing bolsters. Locktight 222 also works well.
Screws.
080 unf or 1.6 mm S/S screws. For 080 drill a 1.3mm hole and tap.

The back of the knife.
The back can be solid, partially solid or spacers. Ensure the thickness of the back is equal to the thickness of the blade plus the two shims used.

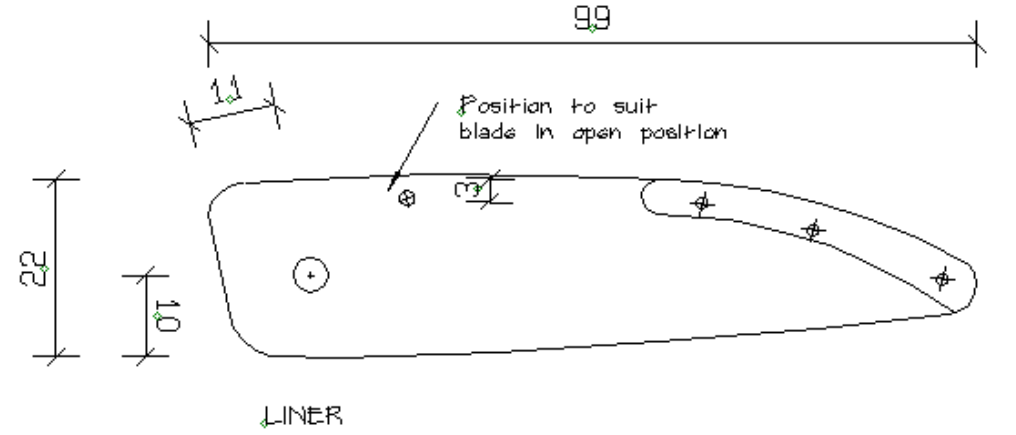
Remember it is all about fit and finish.

"Perfection is no small thing but small things make perfection"

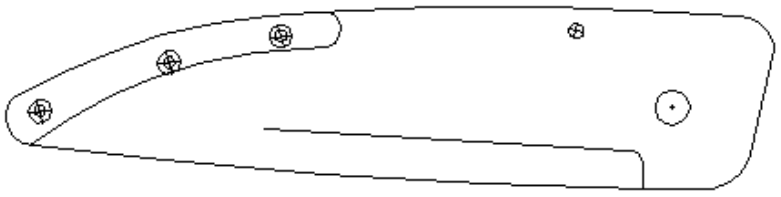
Good Luck.

John Arnold

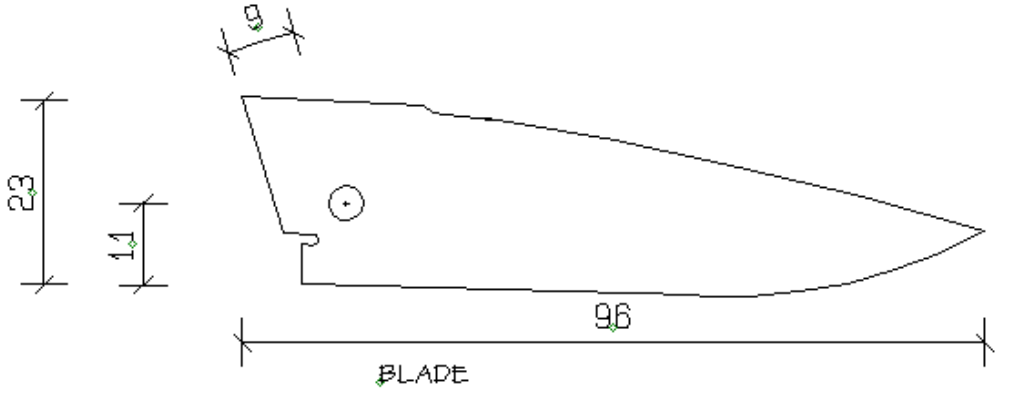
COMPONENTS -TO SCALE



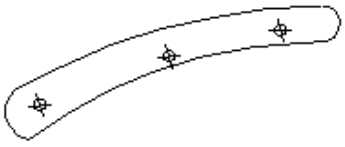
LINER



LINER WITH LOCK



BLADE



SPACER

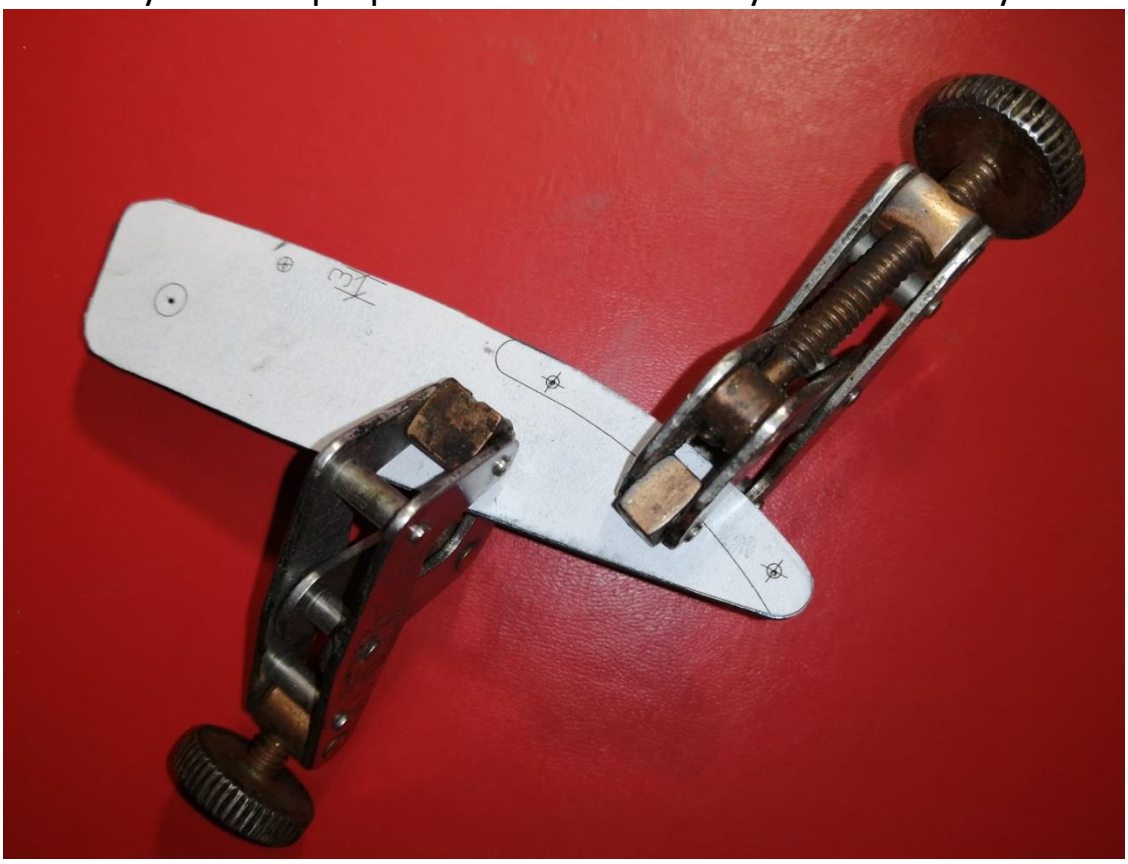
STEP BY STEP PHOTOGRAPHIC RECORD OF HOW I MADE THE KNIFE:

SETTING OUT THE KNIFE

As stated purchase a kit or have your components cut out by water jet or laser. Use the Auto Cad drawing on the webpage. You can also print and cut out the to scale components drawing and glue them to your blanks. Carefully punch the hole positions.

DRILLING THE HOLES

Clamp the two scales securely together. And drill the holes for the screws 1.3 mm (for 080) or 1.4 (for 1.6 mm) screws. 2mm hole for stop pin and pivot. Use pivot hole as a pilot hole and drill to 4.2 mm. ream with a parallel reamer to 4.5.
The one scale you need to ream the holes for the back to 1.5 mm for 080 screws or 1.6 for metric. Chamfer the one side for screw heads. Pay attention to do chamfering to the correct side of the liner
Drill pilot hole in blade and ream to 4.2. Use parallel reamer and ream the hole to 4.5.
Ensure you work perpendicular otherwise your blade may not center



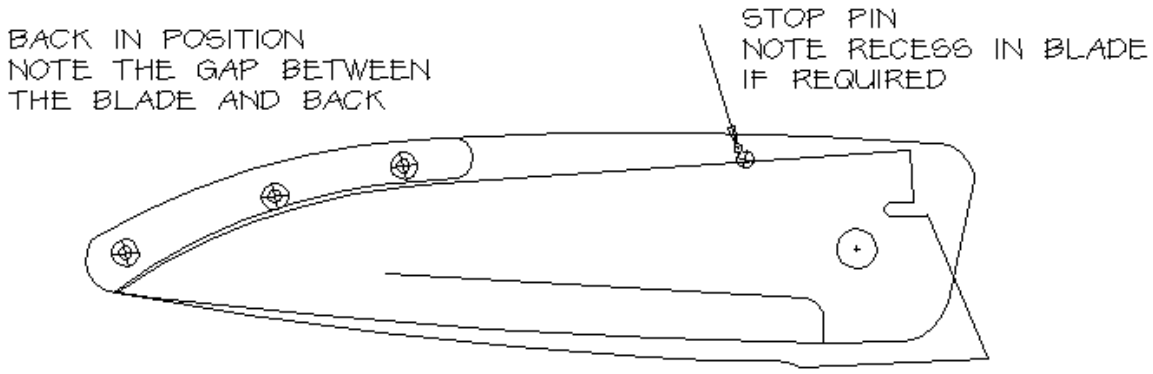
SETTING THE BLADE IN THE OPEN ANDCLOSE POSITION

With the stop pin in position grind the back face of the blade on your disc grinder until the blade nests in the open position. Allow some excess room for final nesting after heat treatment. In the same way grind the bottom side of the blade till the blade nest in the closed position. Also allow for final nesting after heat treatment. Depending on the position of your stop pin you might have to grind a semi-circle at the bottom of the blade.

FITTING THE BACK

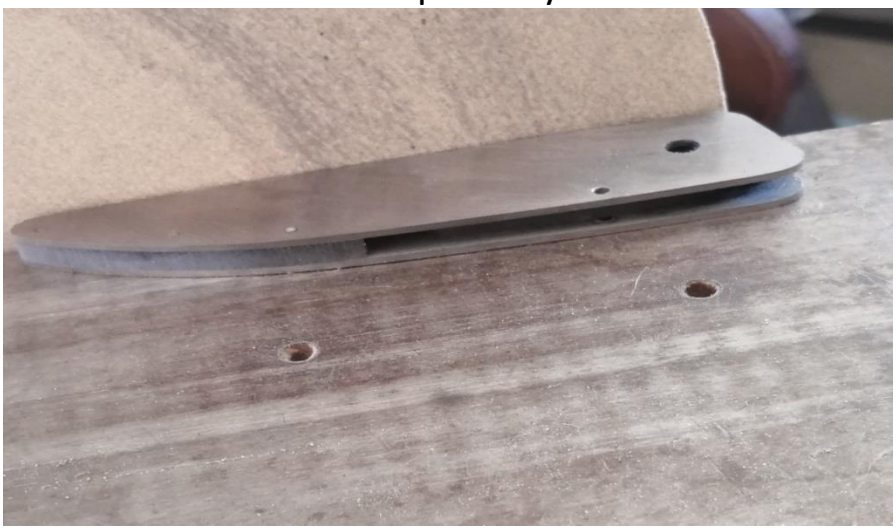
Cut out the back in the material of your choice. Ensure there is a small gap between the blade and your back. Clamp the back in position and using your drilled holes in your liners drill the hole to suit the screws you are using. Tap one liner using a tapping jig.

The back should be quite a bit thicker than your blade. This will be addressed later on.



ROUGH SHAPING THE HANDLE AND BLADE

What is convenient about this design is that you can now roughly shape the handle and blade seperately



THUMB GROVES ON BLADE

With a checkering file do the thumb grooves on the blade.

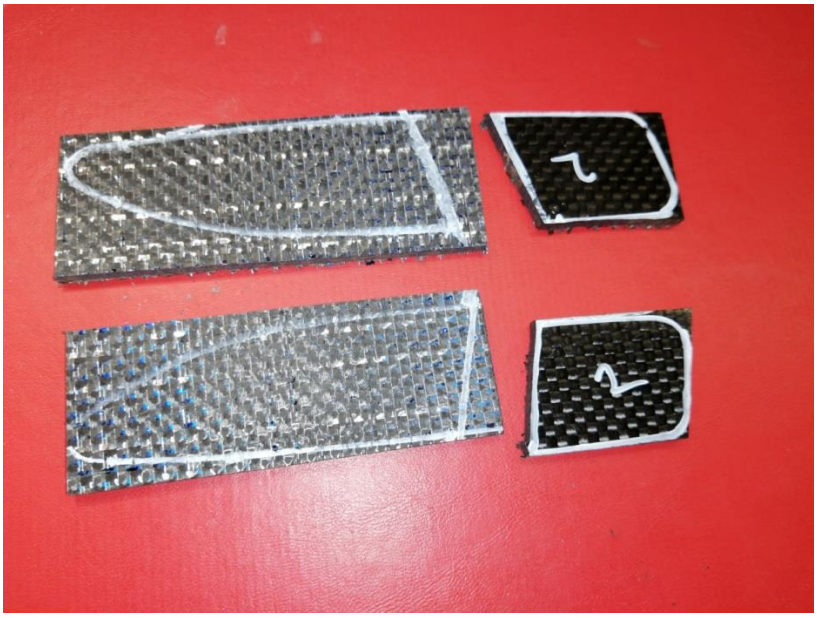
HANDLE

DECISION TIME.

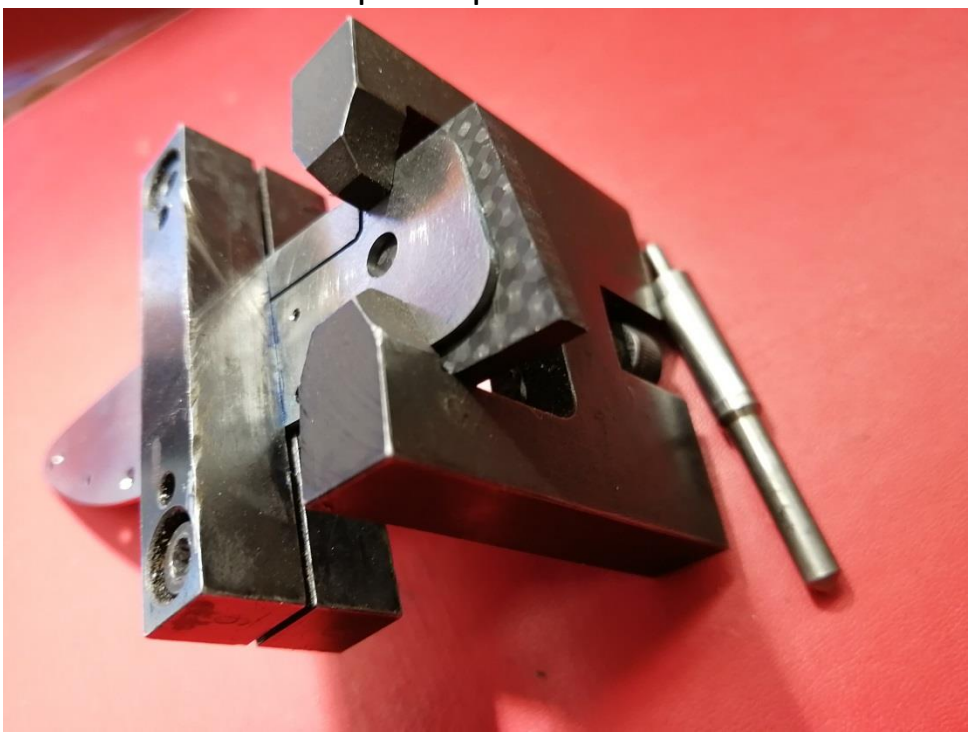
Decide on materials, Bolster shape and size, Hidden or exposed Pivot heads, size and position of screw heads

Use Bolster aligning clamp to position Bolsters

Mark out your components. Cut to shape flatten and grind the faces between the Bolsters and Handle slabs perfect straight and square to ensure a perfect fit.



With the Bolster aligning clamp and the handle drilling clamp drill through the existing holes, 1.3 (or 1,4) for the fixing screws, and 4,2 reamed to 4.5 for exposed pivot head



Mark all the components. This is to ensure you do not end up with two left or right hand handles.

FITTHING AND SHAPING HANDLE

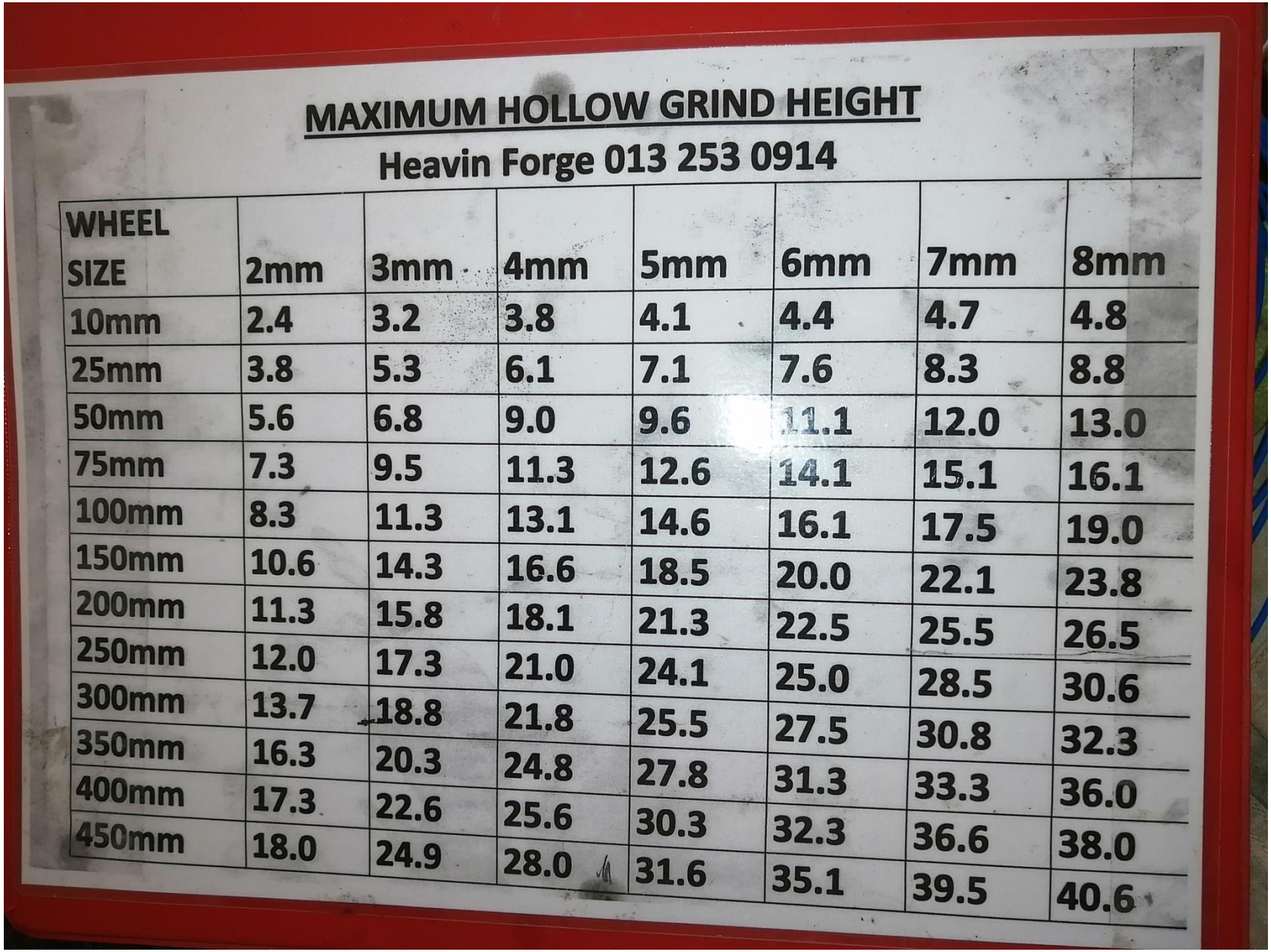
I decided to fix my Bolsters and Handle to a liner. Recess screw heads and exposed pivot head. If you use a hidden pivot you will have to form a recess in the back of the bolster to allow for the pivot head.

Keep your sides parallel as you would use the flat handles to shape and finish the sides on a disc or a horizontal contact wheel. Finish to your preferred grit.

HEAT TREATMENT

Heat-treat the blade to the specification of the steel you used.

Use the following grinding table to establish your grind height



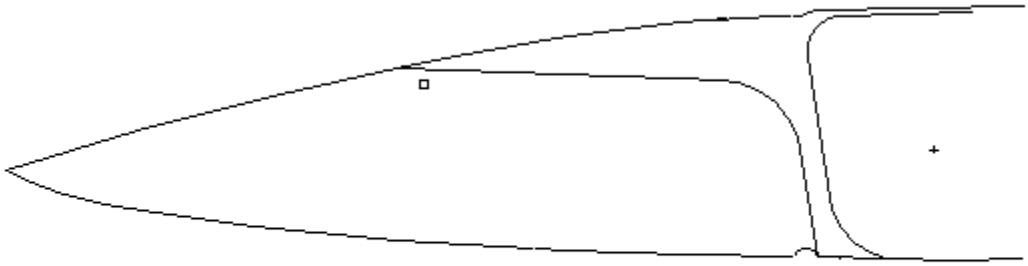
MAXIMUM HOLLOW GRIND HEIGHT

Heavin Forge 013 253 0914

WHEEL SIZE	2mm	3mm	4mm	5mm	6mm	7mm	8mm
10mm	2.4	3.2	3.8	4.1	4.4	4.7	4.8
25mm	3.8	5.3	6.1	7.1	7.6	8.3	8.8
50mm	5.6	6.8	9.0	9.6	11.1	12.0	13.0
75mm	7.3	9.5	11.3	12.6	14.1	15.1	16.1
100mm	8.3	11.3	13.1	14.6	16.1	17.5	19.0
150mm	10.6	14.3	16.6	18.5	20.0	22.1	23.8
200mm	11.3	15.8	18.1	21.3	22.5	25.5	26.5
250mm	12.0	17.3	21.0	24.1	25.0	28.5	30.6
300mm	13.7	18.8	21.8	25.5	27.5	30.8	32.3
350mm	16.3	20.3	24.8	27.8	31.3	33.3	36.0
400mm	17.3	22.6	25.6	30.3	32.3	36.6	38.0
450mm	18.0	24.9	28.0	31.6	35.1	39.5	40.6

MARK OUT OF GRIND LINES

Mark your preferred grind lines on both sides of the blade



Use a homemade marking jig or a height gage to mark the grind lines on the cutting edge.

GRINDING THE BLADE

Take your time and grind the blade. Grinding is not covered in this document.

Finished Blade

SETTING THE LOCK

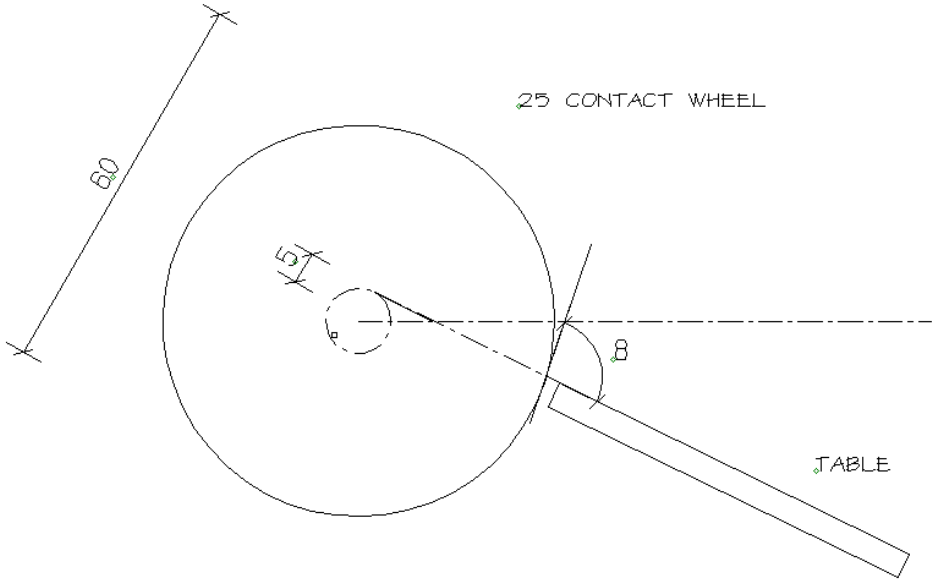
Clean the titanium lock face to ensure there is no carbides on the face after laser cutting. Bend the lock upwards and insert a wedge to gain access and with a square file clean the face.

Now you need to taper the lock. Always taper the outside of the lock blade. You need to reduce the thickness by say around .4 to. 5 of a mm. This is to allow some room for the indent ball. Some form of a jig is needed. An angle iron with an adjustable grub screw to lift the liner and

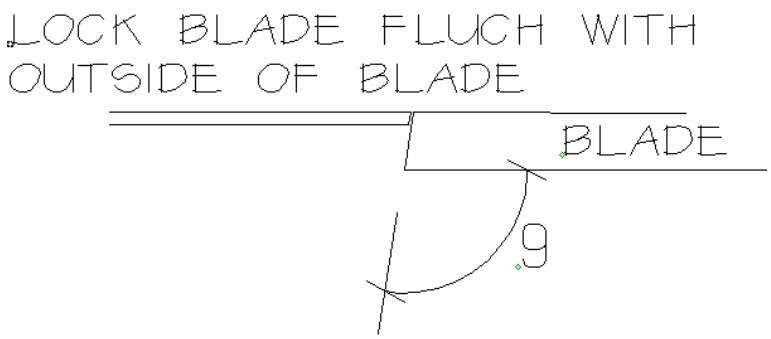
some holes to secure the liner onto the jig. I use a piace of flat bar with a slot and a grub screw on a surface grinder.

GRINDING THE LOCK FACE ON THE BLADE

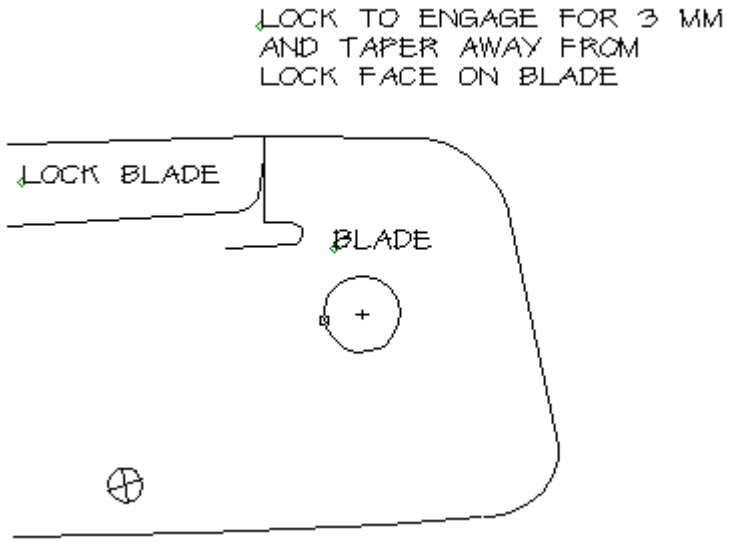
The lock angle on the blade should be between 7 and 9 degrees. I use the following dimensions with 60 diameter contact wheel. When you have finalized the table angle I recommend you weld it in position



Angle of lock face on blade



The lock blade should engage flush with the outside (or slightly in) with the blade and only for say 3 mm at the top edge



THE INDENT BALL

Mark the position of the blade on the lock to ensure the ball stays on the blade. Mark position of the indent ball not to close to the edge and drill 1.3 mm.

First reduce the thickness of the back to the thickness of the blade together with the shims you are using.

Assemble the knife with back , shims, stop pin and pivot
Apply moderate pressure on the blade tip and clamp the lock firmly with a vise-grip. Use the 1.3 mm hole in the lock as a guide and the drill the hole in the blade with a tungsten carbide drill say .8 mm deep.

Take apart and ream the hole in the lock to 1.5.
Carefully tap in the indent ball to protrude say .5 mm
Assemble the knife and the blade should engage nicely in the indent. Check that the lock does not scratch against the blade. Bend the lock if needed.

FINAL SHAPING AND FITTING

Assemble the knife and do the final shaping and finish to the handles. This is to your personal preference. Anodize the liners and form a finger relief on the liner

Fine tune the mechanism. If the lock is sticky you can carbonize the front face of the titanium lock. This is a specialized operation and not covered in this document. I use a diamond impregnated cylindrical rubber on an arbor in a drill press to do the jeweling. The finish of the liners is the maker's choice

THE COMPONENTS

THE FINAL PRODUCT