

SPLITTING HAIRSBy **Vadim Kraichuk**

Knife Grinders

www.knifeGrinders.com.au

Sharper Than a Razor

For Knifemaker Lawrence Cheng

Sharpening is the final step before boxing a custom knife for delivery.

Before that, the knifemaker hafts the blade.

Before that, the blade is polished.

Before that, the blade is heat treated, hardened and tempered.

Before that, the blade is cut out and shaped.

Before that, the knife is designed.

I only skipped about 50 more steps between the moment the knifemaker conceives a new knife, and we sharpen it.



Knifemaker

Lawrence Cheng talks about his path to the knife making passion:

"After serving in the Australian Regular Army for seven years, through a series of converging opportunities, I attended a Damascus steel and knife making class at Tharwa Valley Forge facilitated by Karim and Leila Haddad. At a later date I spent a couple of days with Bruce Barnett at the Windy Hollow Forge in Bridgetown W.A. I am currently based in Perth, Western Australia, as a part time maker whilst completing further qualifications in engineering and work in a metallurgical testing laboratory which allows me to assess the metallurgical quality of the knives I make.

In seeking to bring out the very best from the materials that I use it is important to me that whatever I craft is robust enough to last across generations."

Webpage: <http://www.snakeandrabbitknives.com>

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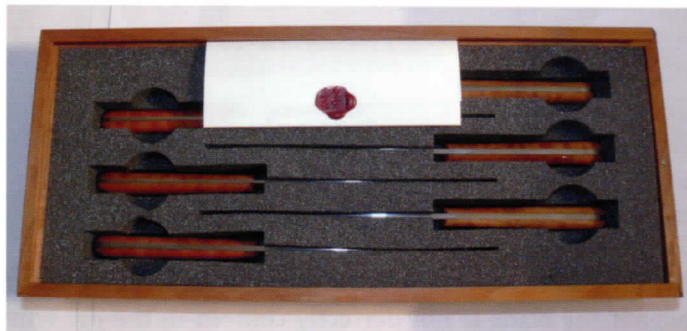
First Encounter

Lawrence asked us to sharpen a set of steak knives he'd made to order, and forward the sharpened knives to the customer on his behalf.

On arrival we saw an elegantly boxed steak knife set...



... accompanied by a sealed enigma message from the knifemaker.



Don't take the lovely beasts out yet - stare at this family of 6 long enough till your imagination delves into their inner world. And when you realize what their life mission is, you will see 6 vampires peacefully dreaming in their individual coffins till the taste of the bloody steak arouse them from their sleep.

Now is time to make the acquaintance of the newborn knife.



The blade has a nice distal taper and gives almost musical ding on flick with your nail. Full tang construction with Tasmanian Tiger Myrtle scales offer moulded grip optimised for backwards slicing motion. The perfect action for delicately slicing red meat. There is no choil - so your knife won't snag as you slice; on the contrary there is a flat at the heel to let you increase pressure and ease

into a more controlled cut. This is a knife designed to consume meat rather than cook it.

Overall, the cleverly thought through design of this steak knife tells me that the knifemaker has cut through enough steaks in his life, and knows this stuff well enough to create a purposely designed functional beauty for the utmost pleasure at the dining table. Hardly a vegan!

As seen in this edge-on view, the blade is intentionally not zero-ground in order not to compromise the cutting edge temper.

The knifemaker leaves about 0.5 mm on the edge side of the blade for me to bevel and sharpen it cool and slowly preserving the heat treatment.

Sharpening Process

First step invariably is to protect the knifemaker's masterpiece from sharpening elements.

Handle is wrapped with a cling film, and the clamping site protected with a cloth tape.

Correct centring in the knife jig is extremely important.

I've noticed that I cannot get anywhere near a razor sharp edge if the blade is not perfectly centred in the jig. This may result in an asymmetric grind.



Angle of the bevels is set with the help of our computer software. This gives us unprecedented precision in the following steps of edge-setting and honing.

Sharpening a newly made knife is entirely different to trivial sharpening.



Tormek knife jig is not self-centering, but we've machined a set of jigs that adjust to blade thickness.

Grinding Angle Setter

About

☒ Tormek-8 Enter the grinding wheel diameter in mm:

☐ Tormek-7 Enter distance between the knife jig adjustable stop and the knife edge in mm:

☐ Tormek-4 Enter the target grinding angle:

(For double-bevel blades, the grinding angle is half of the included edge angle)

Universal Support height in mm:

(Vertical distance from the top of the housing to the top of the Universal Support bar.)

The biggest challenge can be shaping bevels of even and symmetric height on uneven primary grind. This often requires a sharpening strategy so sophisticated that I call it "acrobatic".

Some sharpeners bevel with grit #60-80 abrasives, others with #200-220 grit. We use #400 grit CBN (Cubic Boron Nitride) wheel; although it can take twice as long, this allows to create crisp bevels while minimising the risk of error. All operations are done at low RPM and cooled either with water or a metalworking fluid.

Before I start working on the edge, I need to even out the bevels. During this process, lots of metal gets ground off and also shifted from side to side. I grind each bevel into one plane, getting the edge in a straight line.

This is the longest part of the whole process.



Bevels finally shaped.



When I am happy with the bevels I've created, I set edge on a #1000 grit CBN wheel. Again, using computer software to maintain the same angle we shaped the bevels. This method gives us a razor edge even at this stage. When I say razor, I mean true razor edge, not just shaving! Why CBN and not traditional stones? I have done a number of grinds with aluminium oxide and silicon carbide wheels, followed by Japanese fine wheels yielded an edge near razor sharp, but with the aid of CBN or diamond can I get knife edges sharper than razors. I found explanation to this by studying SEM (Scanning Electron Microscope) images, but omit it for now as it is out of the scope of this article.

The #1000 grit CBN or diamond wheel produces an edge within the range of 0.1 micron. This is actually the same as a Gillette razor edge, though there is significant variation in the apex width along the edge.

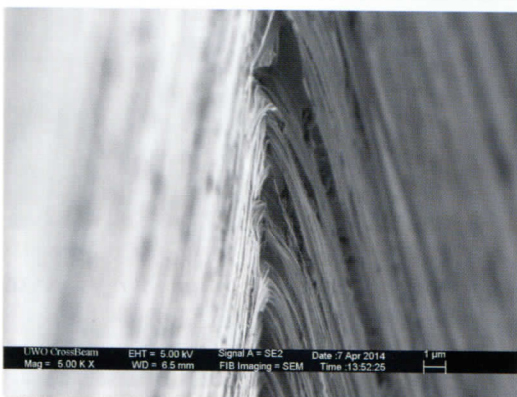
Keep in mind that the edge is already very thin and can be ruined if you are dragging the blade back and forth across



the grinding wheel.

I spend minimum time at this step, just enough to see the coarse scratch pattern from the previous step gone, gently passing the blade across the wheel and alternating sides with each pass. I work with the edge leading in order to minimize the burr forming.

Bear in mind that we are applying macro forces to the



Edge-on view
Scanning Electron Microscope (SEM) image of the edge we get at this phase looks like this:

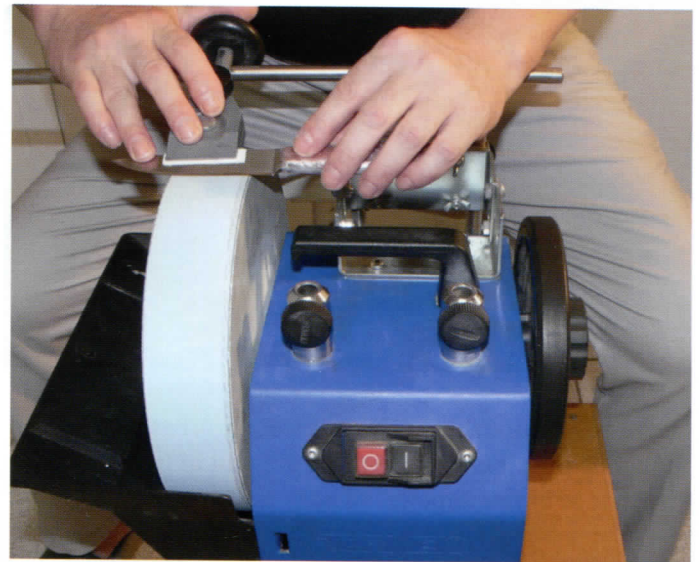
SEM images are provided courtesy of Todd Simpson

micro scale of the fine edge. We want to displace as little metal as possible. For personal use, you could de-burr and start using this razor sharp knife straight away.

There are certain shortfalls with this though:

- Firstly, *unpolished bevels will cause friction within cuts and lower efficiency and quality of cut.*
- Secondly, *we have to hone in order to produce an edge sharper than a razor.*
- Lastly, *for the purpose of this exercise, we are sharpening a knife to presentation standard.*

Next, we move onto polishing the bevels, but NOT the edge apex. This step is to polish the bevels and narrow the edge on the sides sparing the very apex. We do it by honing with fine abrasives at less than the edge angle. E.g. the edge that has been set at 15 degrees per side on the



CBN wheel will be honed at 14.9 degree on a paper wheel or at 14.5 degrees on a stone wheel.

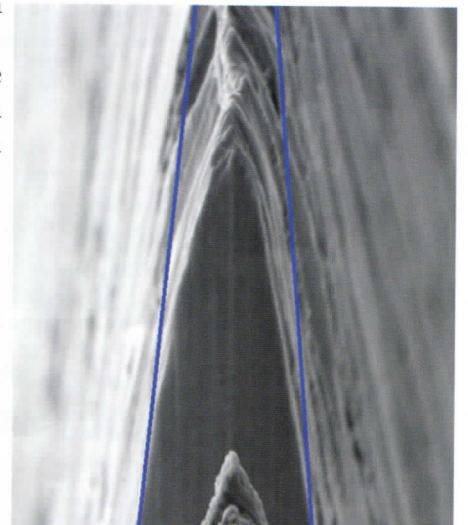
This way we avoid risk of rounding the edge apex that is already razor sharp.

Setting the honing angle with such a high precision can only be achieved with computer software that takes into account diameter of the grinding wheel and distance, to give us an accurate honing angle.

Another goal we achieve by honing at a shallower angle is smoothing out the bevel shoulders, thus allowing the knife perform effortless cuts.

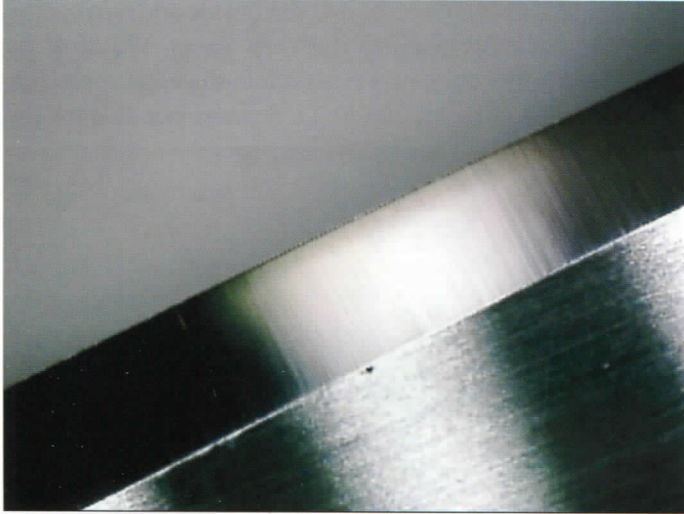
In order to spare the edge apex from any contact with the

The next cross-section SEM image of the same edge shows what we aim to do: hone while not trespassing on the blue lines.

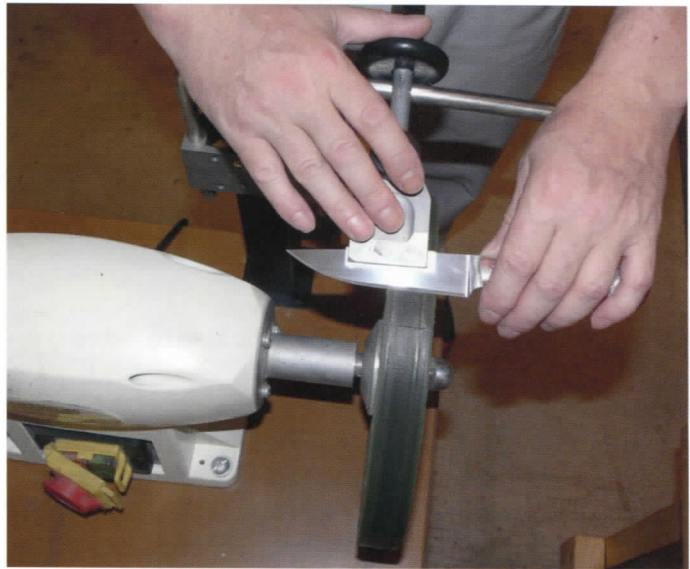
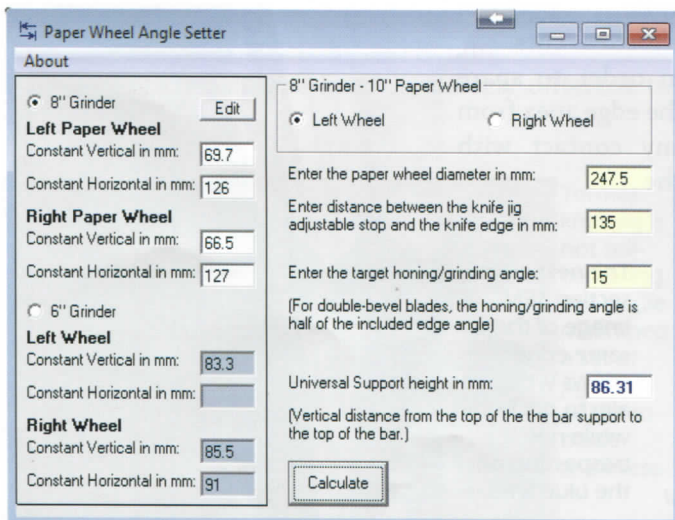


honing abrasive, we always do this operation edge-trailing, even when using fine stone wheels.

The Sandvik 12C27 steel that knives in this set are made of, is better polished on a fine Japanese stone rather than a paper wheel. So for this particular job we use a fine Japanese wheel. We hone using our specially designed frontal vertical base for edge-trailing honing. If you've done this step right, you will get a polished edge with unpolished apex. Even some remnants of micro-burr, because your honing is not supposed to reach the very apex.



I tried to capture this in the following microscope image, though it wasn't easy with the knife still in the jig. That fringe of the unpolished apex that you see at the end of the polished edge is sharp as a razor. An average of 0.1 micron in width, we can now take this edge from razor sharp to sharper than a razor by reducing the apex width. This is done on a paper wheel impregnated with 0.25 micron diamonds at the exact edge angle. This step is as critical, because if you over-hone the edge apex you will ruin all your previous efforts. Do one quick pass across the paper wheel alternating the blade sides, and test on your BESS edge sharpness tester. If the instrument reading is still just in the razor edge range of 50-60 BESS, do one more set of alternating passes on the paper wheel, and test again. As soon as the



instrument shows sharper than a razor's edge, stop. The final result may be anywhere between 15 to 40 BESS because in that micro-world of nanometres, random idiosyncrasies begin to occur.

If you do one more pass at this stage, you may over-hone the apex. Not really blunt it of course, but you may lose that extraordinary sharpness.

This last superfluous pass, may put your edge back in the realm of 60-100 BESS.

QUALITY CONTROL

Sharpness of steak knives in this set has reached 25 BESS, which is indicative of edge apex width near 0.05 micron. Note that the Gillette DE razor has 0.1 micron edge and scores 50 BESS.

This level of sharpness is extraordinary for knives, and can only be achieved by fanatic straight razor sharpeners. This is not just crazy sharp, this is utterly insane sharp! Lawrence Cheng's knives are coming out of our workshop as the sharpest in Australia!

Though a BESS calibrated edge sharpness tester is a great tool to determine the degree of sharpness, by itself it is not sufficient to verify quality of the whole edge as it



samples only one point on the edge, even when you take a couple of measurements at points of the blade. At Knife Grinders we check edge by two devices used

together: a BESS PT50 edge sharpness tester and the Razor-Edge edge tester.

While the BESS sharpness tester is spot sampling, the Razor-Edge edge tester checks along the length of the edge, and used together, they give us comprehensive information of the whole edge condition. This tandem checking is our QA method at the end of each sharpening session.

CONCLUSION

We have developed a method to sharpen knives sharper than a razor using power equipment, within time span that makes it viable for commercial sharpening.

Longevity of that keenness depends on the blade steel, heat treatment and cutting surface. However out of our workshop these knives are sharper than razors.

Edge sharpness is certified by BESS testers, and the cherry on top is an official certificate.

We thank the Australian Knife Magazine for the opportunity to share our experience with the knife community.

Readers who have questions are welcome to contact us via our website knifegrinders.com.au for more information. We also have a subforum at the australianbladeforums.com

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SHARP✓ PT50B

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our members at the
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STATEMENT OF PURPOSES
The purpose and object of the Australian Knifemaker's Guild Incorporated shall be to promote preserve and develop the craftsmanship, design aspects, and techniques of all the various disciplines of knifemaking to the highest standard possible.

The time honoured tradition of crafting "man's oldest tool" is alive and flourishing in the 21st Century with the help of the Australian Knifemakers Guild.

Formed by a group of dedicated custom knifemakers in 1984, our aim is to foster the design, manufacture and sale of custom made knives in Australia. With members of all ages and interests in all types of edged tools, we offer advice and guidance to enthusiasts, while the experienced makers are urged to constantly improve their techniques and learn new skills. That's why our members are recognised and respected around the World.

www.akg.org.au