

Blacksmith Knife Tutorial by Tim Lively

I'm calling this a Celtic Kitchen Knife but it's really just a blacksmith's knife or as the French call it - brut de forge.



I started with some leaf spring from a 57 Dodge half ton pick-up. Leaf spring from US made cars and light trucks from the 1950s and 60s are made of a high carbon steel alloy called 5160. This alloy is an excellent choice for almost any kind of knifemaking.

5160 has 0.56 - 0.64 carbon, 0.75 - 1.00 manganese, 0.15 - 0.35 silicon, 0.70 - 0.90 chromium. It has great edge holding abilities and can withstand prying sideways better than most high carbon steels. I heat the steel in the forge to a non-magnetic state and hot cut a chunk about 7 inches long and about 2 inches wide. Here I just cut off the eye end of the leaf spring.



With the next heat I make a cut down the middle of the steel but I only go about 3/4ths of the way through.



With the next heat I bend the chunk of steel to about a 90 degree angle with the cut side out.



Next heat I pour water down the inside of the fold. Just enough to harden the thin area. Then I lay it on the anvil with the cut side up and give it a swift smack with the hammer. This causes the steel in the thin area to break fairly smoothly giving me two blanks of 5160 steel 7 inches long and almost 1 inch wide. The reason I do this instead of just cutting all the way through is that it leaves a cleaner cut and that makes it alot easier to clean up the edge with a file. For about the last 6 years Ive been making all my knives without the use of electricity so I don't use a grinder. Anything that I can do that makes less filing work for myself the better. The scarfed edge you get from cutting all the way through is alot of file work.



I take one of the blanks I've created and cut an angle on the end like so. I don't know how many degrees the angle is, I just guess. You can see in the photo that I started a cut and then decided it needed a little more. I use a thick copper saddle I made to cover the anvil in all my hot cutting to protect both the anvil's face and the hot cutter's edge. I just cut all the way through on small areas because it doesn't really take that much filing since it's a short cut.



If you find the filing tough you probably need to anneal the blank. Anneal by putting the steel into the forge and bring it up to non magnetic and then go a shade of color past that. So if in your lighting situation you have a middle toned orange you would go up to a light orange. Don't go by color alone, use the magnet to find the lower transformation range and then go a shade lighter and hold what you got for a few minutes. Then drag some ashes over the steel and let it slow cool overnight. This will relieve any stress built up from hot cutting or just from being a leaf spring in it's prior life. Anytime you spend hours forging on a piece you should stop and relieve stress from the steel's microstructure by annealing.



Here's a link to a tutorial of my charcoal burning forge design. I use this forge for at least 95% of my work. I use a ground forge for welding but all my normal forging is done in this little forge. It will handle up to a 15 inch blade with ease and down to small items like guards without wasting alot of fuel. If you find you burn alot of charcoal usually this means you are giving it too much air. Bituminous coal needs alot of air but natural charcoal lump needs very little. I only burn about 2 pounds of charcoal lump per hour while forging out a blade like this one.

[Wash Tub Forge Tutorial](#)



Now forge out the tip. This may take you several heats. You are just shaping up the tips profile here and not putting a bevel on it yet. It helps to keep a large file at hand in case you need to take off any sharp imperfections. At the end of each heat I tap the corners of the profile a little so there isn't any corners. See how it looks kind of rounded slightly? Sharp corners should be avoided because they can fold over and cause cold shuts. These will show up later as little lines on the blade and is a sign of poor forging technique. Cold shuts can also cause stress cracks so dont let any little corners fold over while forging your blade. If it happens, just stop forging and file it out before moving on. Keeping things rounded helps big time.



The reason to keep it thick and not to put any bevel on it yet at this point is because in this next step I counter bend the blade. If you are new to forging you've probably noticed that the easiest type of knife to make is a skinner. When forging, the tip naturally wants to go upwards into a skinner like profile. You can just cut the excess off if this happens but for more control its better to counter bend the blade. I use a couple of thick walled pipe pieces I found at the local scrap yard. Counter bending takes practice to know how much or how little. It usually doesnt take much so don't over do it. A few well placed blows is enough. Before the heat is gone completely from the blade make sure you flatten anything that has flared out. In this photo the side that will be my finished edge is up.



The leaf spring material I started with is about a 1/4 inch thick. I now forge a bevel down to about an 1/8 inch thick. Im also forging along the top of the profile at this point too. It's a balancing act. You forge the bevel until the tip starts rising too high. Then you work along the top of the blade's face to make the tip go back down some. At the same time you are creating a taper towards the tip. Stop and file out any sharp corners if needed. Don't get anything too thin. Work it into the shape you need gradually. Speed will come with practice but right now you need to concentrate on control. If you need to, stop, anneal, and file out anything that bothers you. Don't get in a hurry. This stuff takes time to learn at first. It will get alot easier though after you've made a few blades like this.



Now you can start forging the tang out too to the shape you want. I flip back and forth myself. I forge on the tang a heat or two and then work on the bevel some more as I go. Use the rounded corner of your anvil to make the begining area of your tang next to where the blade starts. I usually get my edge down to a little less than a 1/16th of an inch evernually. Maybe even down to a 1/32nd on an inch. This too is a balancing act. I need to grab the blade end to forge my tang out so I dont want it too delicate but I dont want to leave too thick of an edge because it will be too difficult to

sharpen by hand when Im finished.



Forging out the tang for a knife like this is just basic blacksmithing. It's a matter of taste. You can stretch it out anyway you think looks cool. You can draw it out long and thin and wrap it back to form a handle like this one;



Or get weird and funky and make a snakes head on the end like I did with this one;



Or just keep it simple and make a little curly que on the end. I think this looks sort of Celtic to me but I guess that's always up to you, the knifemaker. So by this point you got everything the way you like it. The back is tapered towards the tip. The edge is thin enough to sharpen after the heat treatment. All the corners are rounded so it feels comfortable in the hand. Looking down the back it's nice and straight. Now you need to anneal it again to take out all the stress.



After it's been annealed you'll want to remove all the scale that's on the blade. I should of told yall earlier to use a wire brush to scrub off scale as you go. Just brush it a couple of swipes before you begin hammering on it each heat to keep the scale to a minimum. You will still have some scale on the blade by this point though so you need to soak the blade in white vinegar. I'm using a tray my wife had under her flower pots for this task. Don't use a metal container. Keep it covered with the white vinegar for a few hours and then scrub off the scale with 100 grit emery cloth and clean water.



It's now time for the heat treatment. When all forging and straightening is completed and the blade has been annealed and cleaned up with white vinegar, I normalize the blade three times. To do this I bring the blade up to a very even nonmagnetic state and go about 200 degF hotter and hold there for at least one minute. The blade is pulled out of the forge and clamped to where the blade is pointing at magnetic north in still air until the blade is cool to the touch. I use spring clamps with their handles clamped in a vise for holding the blade. I like the spring clamp because it doesn't have a lot of mass that will draw the heat out of where it makes contact with the blade. I want the blade to cool evenly so all the structural stress can be relaxed and a fine grain size will develop in the steel throughout the blade's length. If you do this process at night without lights you can see how fast anything touching the steel's surface pulls the heat out where it makes contact with whatever is holding it in position. Make sure your clamp doesn't go across the tang from one side to the other.

This faster cooling along these contact points of the spring clamp can cause a weakened line across the tang. Place the hot steel with the clamp in the middle of the tang running along its length without touching the edges. Practice this in low light and you can quickly see where the clamp needs to be to reduce rapid cooling at the contact points. Let the blade completely cool to the touch. I then rinse the blade in water to cool even slightly further to finalize the step. I repeat this normalizing procedure 2 more times. The blade must not warp during these normalizing steps if they do I straighten them and start the count over. If the blade can go through 3 normalizing steps without warpage then it won't warp during the quench either. I

anneal by bringing the blade up to nonmagnetic and bury it in ashes overnight. After annealing I clean off the scale of the blade by soaking it in white vinegar for a few hours. After this I can do any file work or sanding to the blade. I also give the blade a slight presharpening at this point and then dull it with 400 grit sand paper. This sets up my edge for the shock of the quench. It rounds it over slightly so there isn't any heat risers. The edge will be slightly less than 1/32 of an inch before the quench. Check closely for any unevenness or dings or defects in the edge. It should be smooth feeling to your finger tip.

The blade is now ready for the hardening step. I bring the blade back up to nonmagnetic, hold for a minute and I pick it up close to the end of the tang and quench the entire blade into automatic transmission fluid and hold it there until completely cooled. Don't move the blade side to side because that can cause warpage. I move mine up and down slightly to feather the hardening line in the middle of the tang. The blade should be hardened at this point. I wipe the blade clean in some dirt and give it a light sanding so I can inspect the steel's surface. After every step whether it be normalizing, annealing, hardening or tempering I wash the blade off in water to further lower the temperature and finalize the step before I proceed. Repeat the hardening step two more times.

The blade is then placed edge up in a vise so I can check its hardness with a fine toothed file. The file should skate across the edge without biting into the steel. With practice you can feel if you have a good even hardness this way.

Temper the blade immediately after the following steps are complete. Before tempering I work the blade's surface with stones and sandpaper and clean thoroughly with soap and water. I get a nice bed of charcoal coals going with about a quarter of an inch of ashes on top of them. I lay the blade flat on the ashes with the edge tilted up some so the back of the blade is making contact with the coals but the edge is in air.

Rest the back of the tip on a small chunk of raw charcoal to keep that area from heating up too quickly. I flip it on its other side in a similar position to keep the heat even. I wait until I see a light straw color creeping up the blade from the coals. I move the blade around to keep the color flowing evenly. I usually don't have to crank the blower at all, I'm just using the bed of coals as direct contact. You can also temper by direct contact with a mass of hot metal or tempering tongs.

If I do need to get the coals hotter by cranking the blower I first remove the blade until I have the bed the way I want it. Occasionally I wipe the blade quickly and lightly with a clean, dry, thick cloth so I can see the colors clearly. The blade can be inspected often by pulling it out and holding it edge down so the conduction will slow down. I am only using enough charcoal to have a couple inches of fuel between the forge's tuyere and the blade so there isn't enough heat to travel too quickly into the

blade. It's a slower process but more controlling than a hotter bed of fuel. If the tempering colors are moving to quickly up the blade I pull it out of the forge and stick it edge down in some soft soil to stop the heat from traveling. Some smiths use water or oil to stop the tempering heats from traveling too fast but I feel this is too rapid of a cooling and stressful on the steel. With practice, there isn't a need to stop the heat.

You will be able to calculate how hot to heat it so it will be tempered the way you want it by letting it air cool. Usually this means slight heat ups in certain areas as you go. For this first temper I just go for an even light straw color and then let it cool in still air and rinse in water. I build the fire up a little while I'm waiting for the blade to cool and get the bed of coals even with a layer of ashes on top. When the blade has cooled to the touch I lay it back on the coals as before until I get a dark straw evenly through out the edge area and let cool in still air. I do it again until I get a bronze color all over the cutting area of the blade. I may have some magentas and blues in the back and tang area of the blade but I want a very even bronze color in the edge to at least 1/3 of the ways up the side of the blade towards the spine or back. I let this cool and bury the blade with the bronze colored edge area in fine sand with the rest of the blade exposed. I wet the sand around the blade so it will make good contact with the steel and keep it cool. I then heat up a pair of thick ended tempering tongs in the forge to an orange heat. I quench the tong handles in water so I can hold them with my hands. I use the tongs to grab the back or spine of the blade to transfer the heat into it and to further draw the hardness out of selected areas for greater strength. I go over the entire back and spine area of the blade until I get an even solid blue color there. I temper it even more in the tang and ricasso areas. I give the very tip of the blade a light blue temper. I end up with a blade with a dark blue back or spine into a dusty gray in the tang with a bronze edge. This gives me a stiff flexible back or spine with an extremely tough tang and a hard sharp edge that is still sharpenable in the field.

I hand sharpen my knives on typically available honing stones so the edge can be maintained by the typical experienced user. The blade is tested by putting the tip in a couple inches of a leather padded vise. I grab the tang and flex it with my full weight back and forth and demand that the blade return to true straightness after I release pressure. I wrap the tang with a rag as a temporary handle and chop and whittle on some hardwood for around ten to twenty minutes. I check the edge with an 8x loupe to see if the edge has rolled or chipped any. If the blade fails the flex or chopping tests I start my heat treatment process over again. Thoroughness in each step is the key to better heat treating!

This is not the only way. This is only my way. Be careful and use proper safety equipment!

OK, here's the finished knife. You'll notice that this blade is yellowy on the bevel. That's the color from the tempering process. I sanded off most of the other colors and just left the straw color on the bevel. After use this fades alot but there will always be a slight tinge of color to the blade. If you don't like it you can remove it by soaking it in white vinegar. I like the colors myself. Especially after they have faded into just a tinge of color.

