

## Instructions for the use of Laminated Steels

Thank you for your trust! Here are a few tips and tricks for working with some of my steels.

### General information:

The steel is quickly deformed in the hot rolling stages so it will be fine grained as you receive it. It has typically undergone slow cool in the gas forge so it should be soft enough to drill and grind.

Laminated steel bars in their rough condition will be a few millimetres wider (and possibly longer) than stated in the description. Approximately 2-3 mm have to be ground or cut off the long sides (which will become the cutting edge and spine of the knife) of the billet to get to flawless steel. These edges may contain regions which look like a delamination, this is completely normal on the edge of the bar when laminating steel by traditional means. The core steel will be unaffected.

Billets in their "as rolled" condition have a scaled surface just like forged pieces. If you wish to completely remove the scale from the surface to get to bare metal, you may have to grind off ~0.15 – 0.3 mm off each side. The flat stock in the as rolled condition may also need additional straightening.

### San Mai / 3 Layer steel (as an example: ApexUltra core / 80CrV2 jacket)

These steels generally have a harder core layer along with two tougher and easier to finish jacket layers. The heat treatment always focuses on the steel in the cutting edge / core as it will be the most critical in terms of performance – I will select the clad layer steel grade so that the heat treatment temperatures will also result in good properties of the outer layers. These steels can be forged and treated similar to objects made from one steel (Mono steel). Care must only be taken to make sure the core layer is centred so the edge will be made up only of the hard core steel. I do a quick etch in ferric chloride after rough grinding to make sure the cutting edge will be where the core steel is and adjust the bevels if necessary. Let me know if you encounter any problems and need help.

Steels with soft cladding (e.g.: wrought iron, S235jr) can be carefully straightened by light hammering even after the heat treatment. Steels with stainless cladding (e.g.: V2A, V4A) have a strong tendency to warp during heat treatment if they aren't perfectly symmetrical. These also may be carefully straightened by light hammering.

### 5 Layer steels with an intermediate layer of Nickel (eg.: ApexUltra core / Ni / 80CrV2 jacket)

The same principles as with San Mai steel applies. The additional Ni layer will prevent carbon diffusion from the center of the billet to the jacket steel. The Ni layer will etch as a bright silver line adding to the overall appeal of the blade. (Etching with (diluted) Ferric chloride and / or concentrated instant coffee will work).

### 5 Layer Steels with an intermediate layer of Copper (eg.: 1.2562 core / Cu / 1.2842) and Copper Damascus steel

The copper layer will not only offer a very interesting visual contrast, it also inhibits carbon diffusion from the core to the jacket steel. In stock removal these steels can be treated just like any other combination. Forging is tricky though and care must be taken: Keep the hot forming temperature between 980 and 800 °C and only forge perpendicular to the layers (hitting the large flats of the steel) – DO NOT FORGE THE STEEL UPRIGHT.

It is recommended to do any forging or texturing with the weld seam around the edges still in place. The interface between copper and steel can otherwise initiate a crack at forging temperatures and it may start to delaminate.

### Etching:

The best etching solution will always depend on the combination of steel as well as temperature and finish used. Generally I etch most of my steels in a 1 part Fe(III)Cl / 10 part water solution for depth. For a nice contrast some combinations will profit most in an even more diluted ~1/50 ratio for a clean etch, others seem to get the best contrast in mixture of 2l water + 1 l of instant coffee powder. Times will vary depending on temperature – I usually check every 5-10 minutes on the depth etching and every 30-60 minutes for the contrast etching. To get a dark and even etch it might be necessary to repeat the etching steps a few times and gently rub it with fine steel wool in between.

After the etching it is important to quickly rinse off the acid/coffee with fresh water, then neutralise the acid with some detergent or baking soda (all done without touching the blade) and then air dry the blade. The neutralizing and drying procedure is a very common source for unclean etches. Once you are happy with the result oil the blade and it will result in a nice contrast and a dark etch.

Let me know what you made from your steel and tag @messerschmiede\_hangler on Instagram. If you encounter any problems, please just let me know and I am sure we will find a way to fix it.