

Jan. 9-29, 2012

### **Florida Symposium, Tool making class.**

Dear adventurous student:

In thinking through how we will make all 5 tool in the 3 ½ hrs, I think that it may be a bit of a full schedule, but Hey – it is worth a try. I just hope you all are up to a busy time. Yes we will make at least 3, and I have the material for all 5 for each of you. Good news – the cost of material was not very much, so the total package will be \$15 each.

I plan to give you a quick overview the first ½ hr to get you thinking outside your normal box, and then get to work. I think assembly line method will work the best. I will show you the first one, and then turn it over to each student. Once we get going on one item, we may be able to start the next.

There will be 3 basic skills needed.

- 1) Heating steel, bending and treating using a torch or oven, pliers, vice, etc.
- 2) Cutting the steel, Drilling and taping screw holes.
- 3) Grinding the shape on a grinder.

If you have a propane torch, gloves, vice grip pliers, Hack saw, bring them. I will have extra tool for you to use, but some people like to use their own. Be sure to bring your glasses and face shield (needed for grinding.)

As some of the tools need to “soak” in the oven for 1 hr. we will do them first.

I plan to make the tools in the following order:

- 1) Hook tool cutting tip, (grinding, heating & bending & Heat treating)
- 2) 3/8 drill rod tool (several cutting-tip options to be ground on end, and heat treated.)
- 3) Tool tip holder (drilling and taping)
- 4) Goose Neck tool (heating, bending, sawing, drilling and taping)
- 5) Double ended scraper – Brazing and grinding.

As time permit, we will drill any handles to mount the tools – if you bring them (undrilled.) That should take only a few minutes.

Pray for great weather – as I plan to do the torch work outside. Anyway – plan to be outside some, and wear cloths to work in. No open toed shoes (red hot metal does not go very well on bare toes!!)

Here is the process for each tool:

#### **Hook tool**

The hook tool will be made from a cut nail (hardened concrete nail). Steps are:

1. Grind the shape of the cutting edge
2. Heat red hot and bend the hook.
3. Sharpen or modify shape as needed. (Allow to cool, steel is soft for filing, etc.)
4. Heat to red again, and dunk in cold water (harden)
5. Put in oven to temper (400 deg. For ~1 hr.)
6. Cool slowly.

#### **3/8” Drill rod spear point tool. (or other shapes)**

This tool will be made with tool steel – 3/8” drill rod. Steps are:

1. Grind the shape on the end.
2. Heat to red hot, and dunk in cold water to harden (oil for oil steel)

3. Put in oven to temper (400 deg. For ~1 hr.)
4. Cool slowly.
5. Optional – polish steel shaft, then mount in handle.

### **Tool tip holder (for hook or other cutters.)**

This is the ½” holder for the cutter tips. Steps are:

1. Drill 3/16” hole about 1” deep in end of ½ “ steel shaft. Use spray lub to keep drill bit cool.
2. Drill #21 hole in side of steel shaft about ½” back from end for set screw. Use spray lub to keep drill bit cool.
3. Tap hole with 10-32 thread tap. Put tool in vice and keep tap aligned with hole – don’t force the tap – it will break.
4. Put in set screw.
5. Optional – polish steel shaft, then mount in handle.

### **Tool tip holder (for other cutters.)**

You can make other type of ends to allow use of other type of cutters (flat shelf same as goose neck tool, etc.)

### **Goose Neck hollowing tool.**

This tool will be made from ½” cold rolled steel. Steps are:

1. Cut off ½ of end – about 5/8” back from end to form tool shelf.
2. Drill # 29 hole in center of shelf for cap screw. Use spray lub to keep drill bit cool.
3. Tap hole with 8-32 tap. Put tool in vice and keep tap aligned with hole – don’t force the tap – it will break.
4. Heat end 4-5” and bend to goose neck shape – let cool normally. (Bend in vice, may require two people. Check alignment of shelf and end – cutting tool should align with handle center line.)
5. Sharpen cutter
6. Install cap screw and washer and cutter.
7. Optional – polish steel shaft, then mount in handle.

### **Wooden Nickel tool.**

This is a very handy double ended scraper (square and round points.) Steps are:

1. Silver solder / braze tool steel cutters on ends
2. Grind to shape
3. Optional – polish steel shaft.

### **Heat Treating Basics;**

High-carbon tool steel (HCTS) is hardened by bringing it up to ~1500 deg (cherry red – non-magnetic) to the transformation temperature to change the steel crystalline structure and then very rapidly cooling the steel to “lock” in that structure. The cooling rate should be very fast, done in cold water, brine, or oil. Each steel type has its “best” cooling medium. In our case, the steel is very quickly removed from the flame, and plunged in the water/oil and stirred rapidly. At this point the steel is very hard and brittle (don’t drop it on concrete – it may shatter.) The next step is to “temper” the steel, to reduce the hardness, and make it less brittle and tougher. For the steel we are using the means heating to ~400 deg. Then cooling slowly. The old method is to polish the steel and slowly heat to “straw” color, then cool. It is much

easier and gets better results by putting the item in an oven (toaster oven) and heating for about 1 hr, then removing and letting it cool normally.

The only problem with HCTS is that if you accidentally heat the item to over the 400 deg tempering temperature, you will soften the item, and destroy the hardness that made the tool work so good. That is why when sharpening HCTS it is so important to not let it get hot (turn blue.)

When heating the tool initially, do not heat it over the red or yellow color to the white color, as that will drive out the carbon which is needed for achieving the hardness. This is not much of an issue in the way we are heating the steel, but if using a forge or acetylene torch it is very easy (just leave in the fire to long.)

High Speed Steel (HSS) is much more complex using special other metals in alloy to achieve the hardness, and is not as sensitive to overheating, so we will not get into that subject.

Steel Types and Heat Treating:

| <u>Quench Speed</u> | <u>Quench Medium</u> | <u>Steel type:</u>   |
|---------------------|----------------------|--|
| <u>Fast</u>         | Water, Brine         | 1045-1060<br>1080<br>1095, W-1<br>4140-4145<br>Shock Absorber shaft, RR Spike, etc |
| <u>Medium</u>       | Oil                  | 4340-4350<br>5160<br>5200 (bearings)<br>6150<br>O-1, S-1<br>Hy-Tuf                 |
| <u>Slow</u>         | Air                  | S-7<br>A-2<br>H-13   |