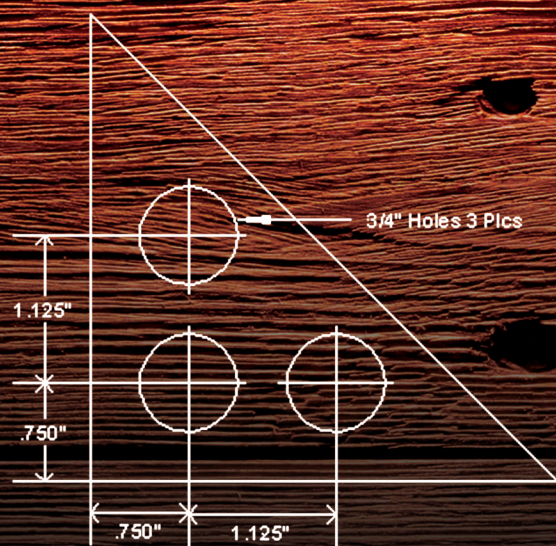
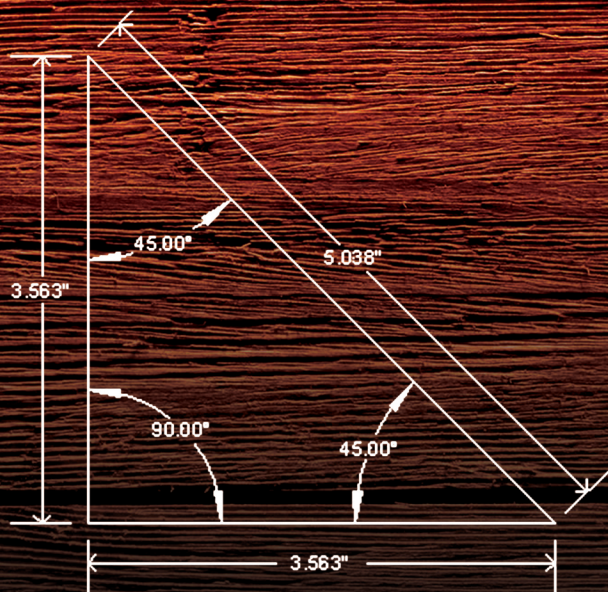


ANGLE PLATES



By Doug Ross



Online Community for Builders of Homemade Tools

HOMEMADETOOLS.NET

a BuildThreads site

30°-60°-90° and 45°-45°-90° Angle Plates

Basic Instructions

Commercial angle plates are readily available, but are not very thick. These plates were fabricated from O-1 tool steel, but can be made from any oil-hardening steel. They're designed to be 3/4" thick (for optimized standing ability), then hardened and ground very accurately, and ground together as a matched set.

Machine the plates to .020" over their required dimensions as shown. The holes are just drilled; it's OK if you go over or under a little, as it's really not that critical, so long as you finish grind them together.

Harden the steel. I have included a hardening sheet and a color chart for this purpose - refer to those sheets for this step. Once that's done, you're ready to start grinding.

It is up to the individual to set up and perform the machining and grinding operations. There are numerous videos about grinding on YouTube and a great deal of literature on the net, as well.

Heat Treating And Tempering

You will need at least 4 gallons of oil in a 5-gallon container. This can be old motor oil or transmission fluid. I use a simple, 5-gallon bucket with about 4.5 gallons of old motor oil.

Safety is of great concern, so be very careful. Do this in a well-vented area of your shop with a fan going to help rid the smoke being generated during this process.

Heat-treating is absolutely crucial to achieving maximum hardness; I use an oxy-acetylene torch for this with a 1" diameter heating tip.

The first step is to prepare the components required for the heat treating process. Everything needs to be at your finger tips. Start by cutting a piece of 5/32" - 3/16" diameter wire about 3 feet long. Next, bend about a 3" 90° in one end, insert the 3" bend into one of the holes in the base or slot and bend the wire again, so the piece wants to slip off. Have your oil and torch all within turning distance from you.

Next, fire up the torch using a neutral flame (60psi Oxygen - 12psi acetylene). Holding the part being heat treated by the long end of the wire, begin applying heat to the part. Hold the flame about 6" away from the part, moving the torch up and down, around the top and bottom. Continue doing this until your part is a uniform color. This will take a few minutes; the color you're looking for is between red and bright red (1400°F - 1500°F). I have included a temperature color chart in the next section. When the desired color has been achieved, immediately quench the part in the oil about 1/2 way down in the bucket using a swirling and up and down action at the same time, keeping the part moving in cool oil. This is crucial: **do not hold the part in one place**. Keep doing this in the oil for at least 2 minutes - when you pull the part from the oil it should stay wet. If it doesn't, submerge it again until it stays wet when pulled from the oil.

After it cools down to where you can handle it, check your hardness with a file. The file should not scratch it. Check several places with the file, as some places might be harder than others. If that's the case, then repeat the process all over again. I do this 2-3 times on thicker, heavier pieces, as this will insure maximum hardness. Next, temper the steel by cleaning off all the scale created by the heat-treating process (right down to the bare metal). I de-scale with 50-50 muriatic acid and water; it's a very simple process requiring only the use of a plastic container for this in the great outdoors.

Once you have the base and sliding jaw clean, fire your torch back up and heat the parts to a light straw-looking color, quench in oil again using the same actions as described above, and let the part finish cooling by laying it down on something flat. You have now taken the brittleness out of the steel, so you're done!

Temperature Color Chart

Fahrenheit	The Color of the Steel
2000°	Bright Yellow
1900°	Dark Yellow
1800°	Orange Yellow
1700°	Orange
1600°	Orange Red
1500°	Bright Red
1400°	Red
1300°	Medium Red
1200°	Dull Red
1100°	Slight Red
1000°	Very Slightly Red, Mostly Grey
800°	Dark Grey
575°	Blue
540°	Dark Purple
520°	Purple
500°	Brown/Purple
480°	Brown
465°	Dark Straw
445°	Light Straw
390°	Faint Straw

Grinding

This is, by far, the *most crucial* of all steps outlined in this guide

Once a piece of metal has been hardened, its surface then becomes too hard to be machined; the only way to machine it now is by grinding.

It is up to the individual to assure that all surfaces are ground flat, square, and parallel. There are numerous ways to accomplish this on the surface grinder. One should have an absolute flat surface to check for flat, square, and parallel such as a surface plate, an absolute right angle plate or cylinder square, and a tenth indicator. Without these 3 things, one will never achieve a suitably high degree of precision.

All measurements described in the drawings are ground to a tolerance of plus or minus .0001" to the required dimensions, while the holes, slots, and undercuts are machined only.

If you're a little rusty on the surface grinder or need a little help, then I suggest that you watch some of these videos from Don Bailey, CEO of Suburban Tool: <https://www.youtube.com/user/SuburbanToolInc/playlists>

I would have to write a book in order to teach you how to use a surface grinder and all the little tricks of the trade; Suburban Tool has some very good educational videos on grinding.

Good Luck!