An Improved Tool Support for a Harbor Freight® Tool Grinder, version 2.2

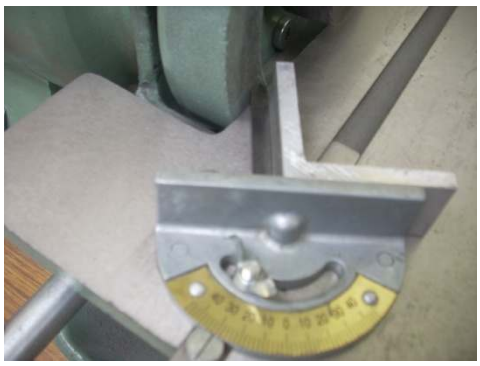
By R. G. Sparber

Advisory

This article was written with a hobby machinist a bit above novice in mind. Someone new to our hobby may have trouble following along. If you do, please don't hesitate to contact me with your questions.

The tool support that came with my 1/2 HP 6" Tool Grinder enables me to grind any included angle from 90° to 180°[2]. That means that shaping a thread cutter with an included angle of 60° is a problem. I need to put this type of cutter perpendicular to the compound. Then I can grind any included angle from 0° to 90°.

One fix for this problem is to add a right angle support. This does work but now I have to keep the right angle pressed against both the tool support and the cutter at the same time. There must be a better way.

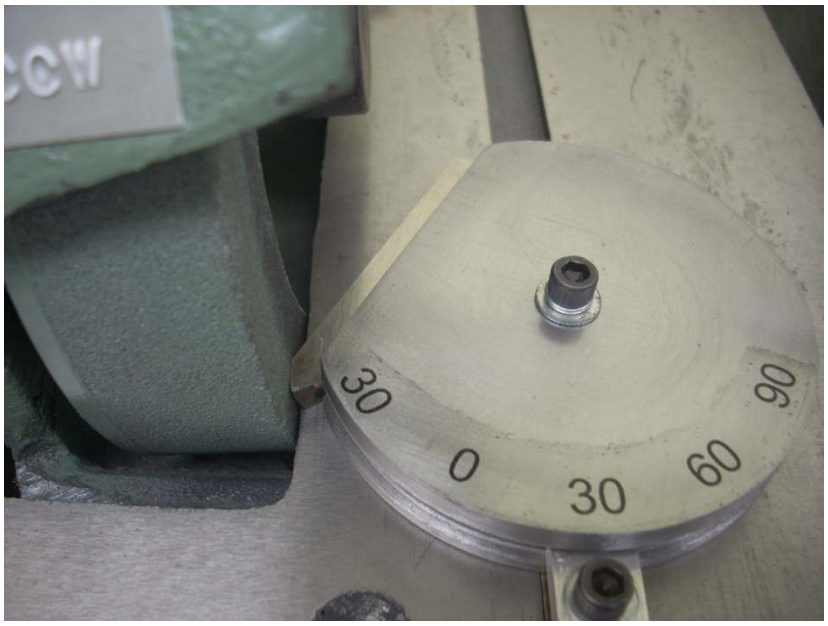


[1] You are free to copy and distribute this document but not change it.
[2] See the appendix for details.

My new tool support solves this problem.

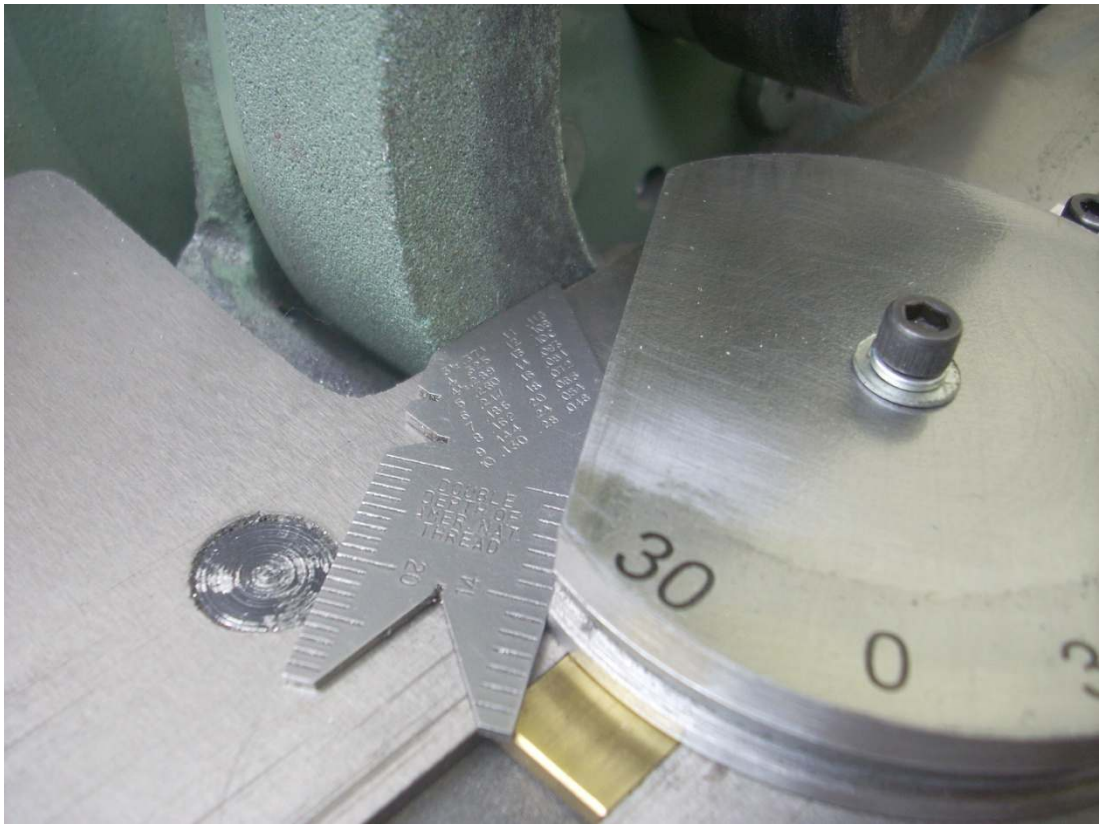
My tool support can be set from -30° to +90°.

To form a 60º included angle, grind the left face with the compound as shown.



I grind the other face of the cutter with the compound set to +30° and flip the base around so the clamp is in front.

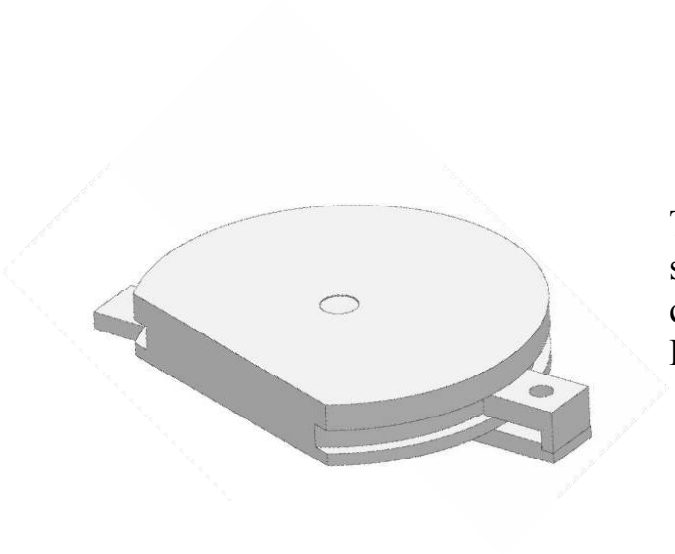
I have chosen to just put a few numbers on the compound for rough alignment.



The exact angle should be set with a gage pressed up against the grinding wheel and the flank of the compound.

The surface of the wheel must be dressed flat.

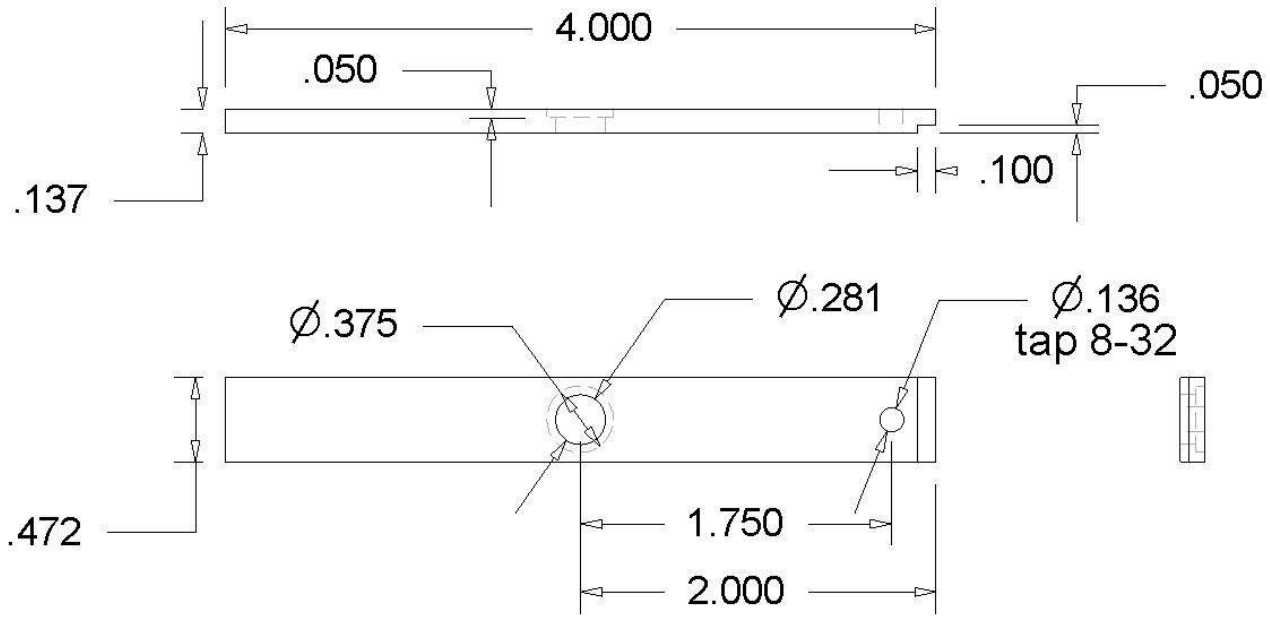
Another problem with the original tool support is typical of such a low cost machine - poor fit of the slider in the table. Fortunately, I found the slot to be of uniform width so only the tool support needed to be replaced.



The tool support is made from four parts: the slider, the pivot, the clamp, and the compound. Not shown are two 8-32 Socket Head Cap Screws.

The Slider

Before making the slider, measure the width of the table slot. You need a nice, sliding fit. Also measure the depth of the slot. The slider should not touch the bottom of the slot. Adjust the design as necessary.



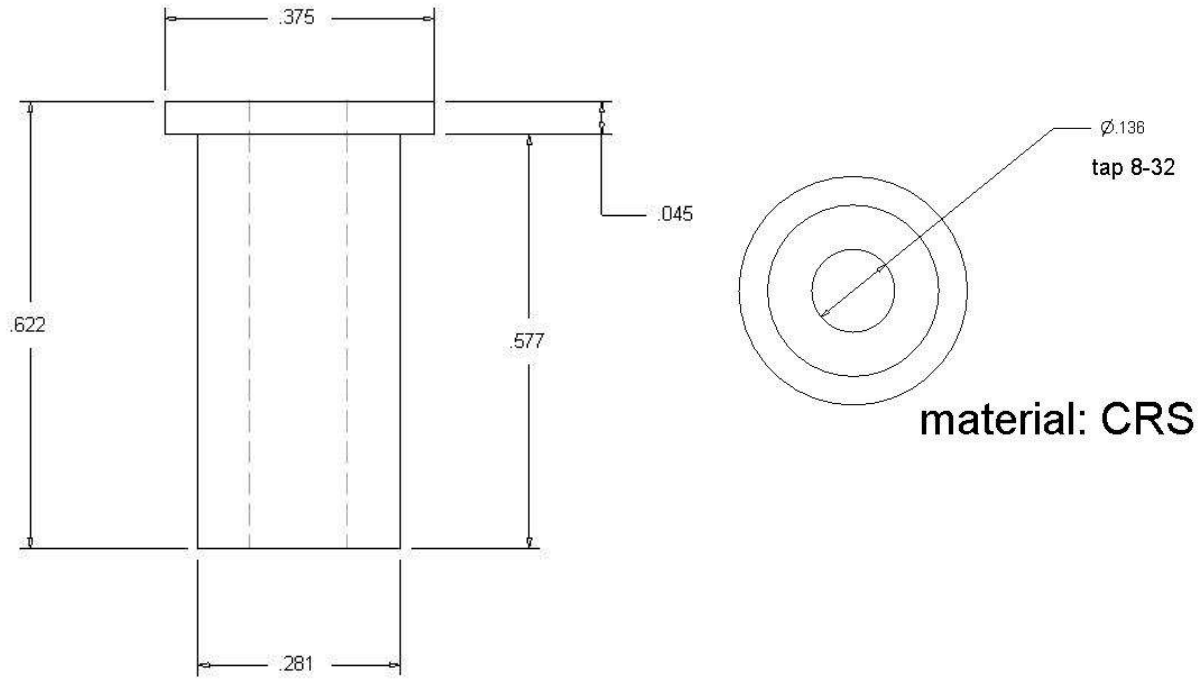
material: hard brass

Shop Procedure

1. cut bar to 4.1"
2. mill 0.05" from one end
3. mill step 0.05" deep by 0.1" wide
4. mill overall length to 4.00"
5. drill and ream 0.281" hole
6. drill with #29 and tap 8-32 hole
7. flip bar over and use reamer to align hole with the spindle
8. use 3/8" end mill to counterbore 0.375" hole to depth of 0.05"
9. measure width of bar
10. put bar on edge and mill off half the difference between bar width and slot width
11. flip bar over and mill second edge to slot width
12. trial fit to slot and file for sliding fit
13. deburr part

The Pivot

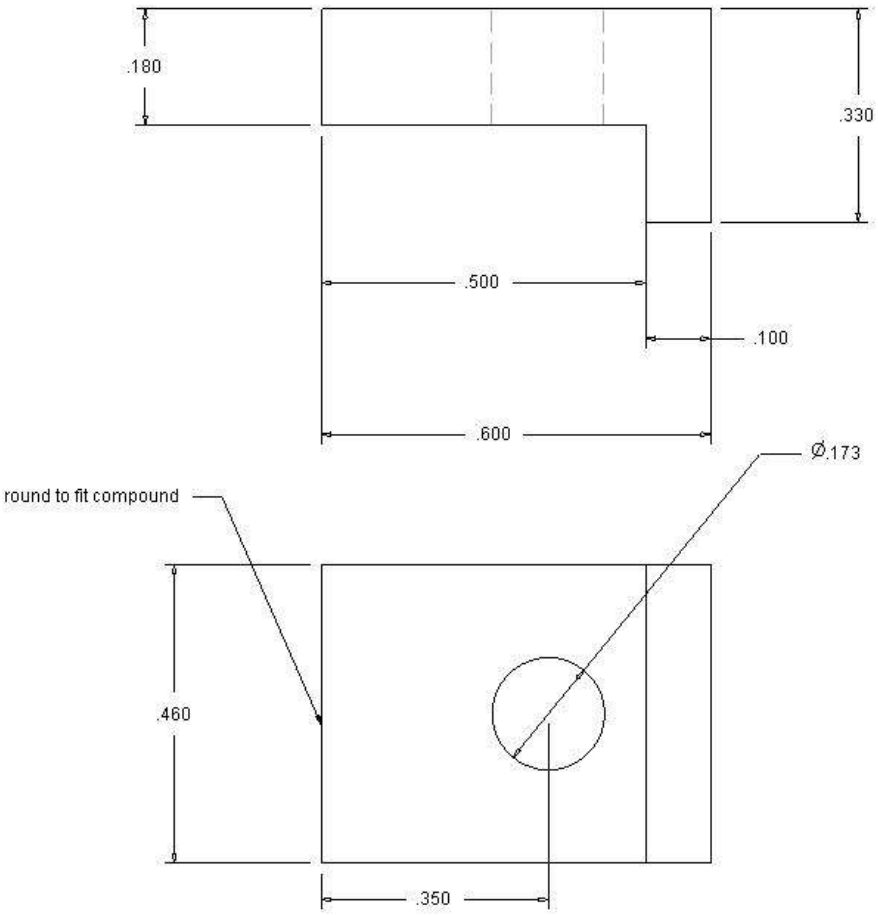
Cold Rolled Steel was used for the pin because it was at hand. Hard brass or aluminum should work as well. The lip should be a press fit into the slider's counterbored hole. If it is a little undersized, use Loctite® to prevent the pivot from turning in the slider.



Shop Procedure

1. extend 3/8" round stock about 1" out from chuck
2. face end square
3. turn 0.281" diameter for 0.577"
4. drill #29 to depth of 3/4"
5. remove stock and saw off at 0.7"
6. put back in chuck and reduce flange to 0.045"
7. run 8-32 tap through part (tapping at this point in the procedure avoids tapping into a blind hole)
8. deburr

The Clamp



material: aluminum

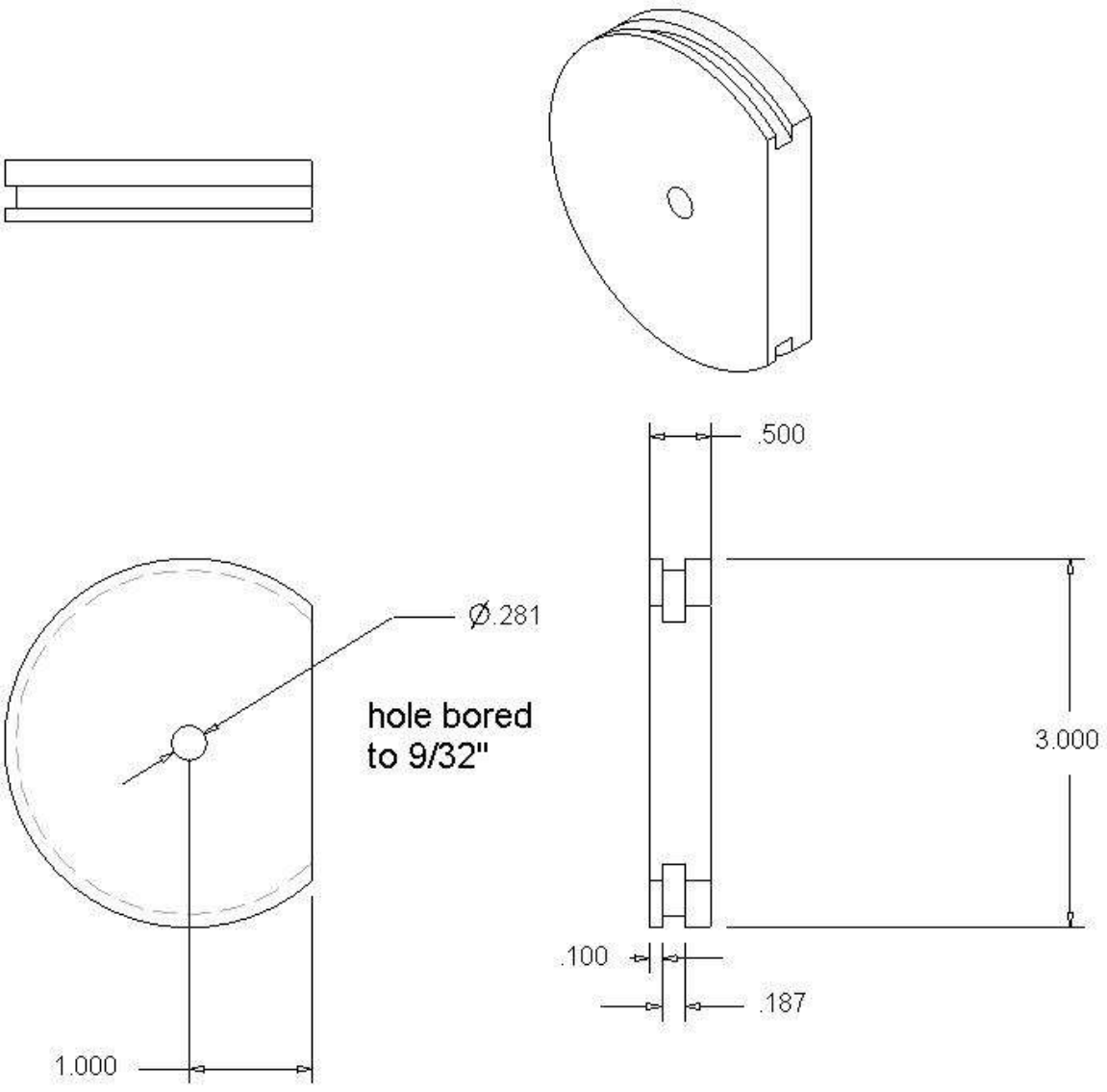
This part is tiny and so can be difficult to clamp during machining. One solution is to machine the end of a bar and don't cut the part free along the 0.330" dimension until all other surfaces have been finished. I used a bar of ½" x ½" x 8" 6061 aluminum and cut the part up-side-down.

Shop Procedure

1. layout clamp up-side-down on end of ½" x ½" bar that is at least a few inches long
2. Side mill end square
3. set end mill 0.340" from bottom of bar and rough cut 0.7" wide
4. set end mill 0.330" from bottom of bar and do finish cut
5. set end mill 0.190" from bottom of bar and rough cut leg 0.11" wide and cut the underside of the horizontal at least 0.5" wide
6. set end mill 0.180" from bottom of bar and finish cut leg 0.100" wide
7. drill #17 clearance hole 0.350" from end
8. remove bar and rotate 90º so the side face is exposed
9. remove half of the difference between the bar's width and 0.460"
10. flip bar over and reduce the width of the clamp to 0.460"
11. remove bar and cut the clamp off leaving about 0.05"
12. mill the clamp to 0.600 long
13. file a slight curvature into the end of the clamp to fit a 2.8" diameter circle
14. deburr

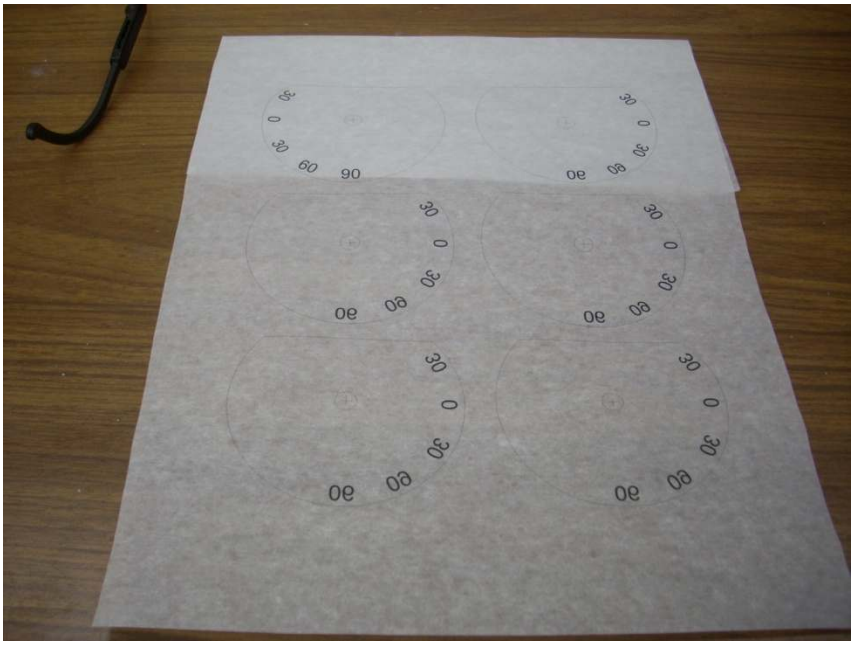
The Compound

I started with 3.125" diameter 12L14 steel. The width of the slot was set by my cut off tool. If you change this dimension, change the clamp too. Similarly, the center hole was set by the reamer I had at hand. You could use a 1/4" to 5/16" reamer. Be sure to change the pivot pin to match.



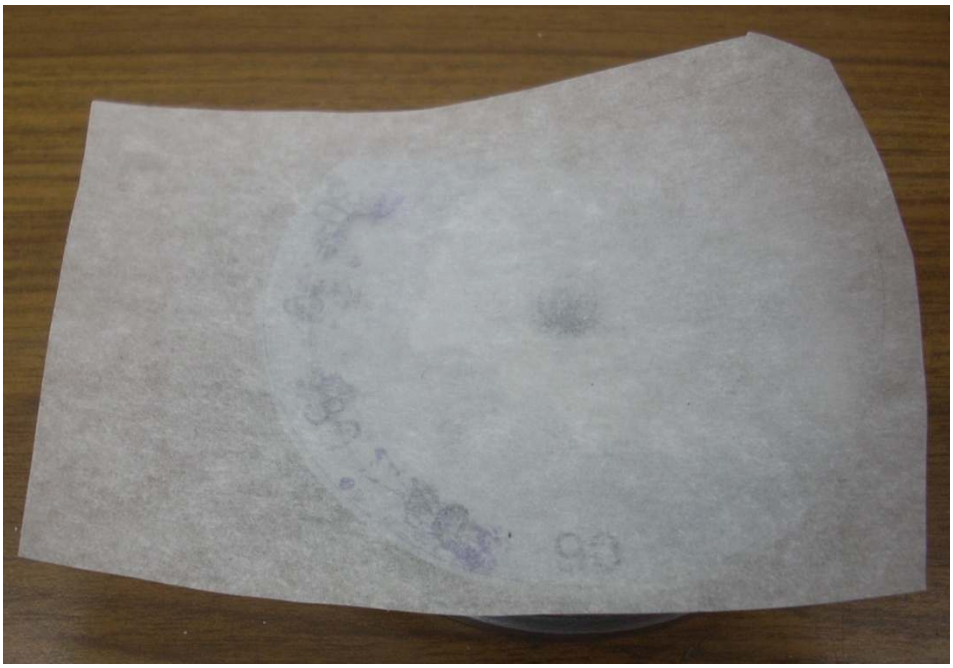
Shop Procedure

1. chuck 3 1/8" round stock in lathe with about 1" of overhang
2. face end
3. turn diameter down to 3.00"
4. use 0.187" wide parting tool to cut slot 0.1" deep and 0.1” from face
5. drill and ream hole to 9/32" to a depth of 3/4"
6. saw off disk 0.55" wide
7. mount disk back in chuck with finished face towards headstock and have the rough face exposed enough to reduce the disk's thickness to 0.50"
8. sand and polish top face smooth in preparation for numbers
9. remove disk and deburr
10. saw secant line off about 1.05" from center
11. mill secant line to 1.00" from center
12. deburr



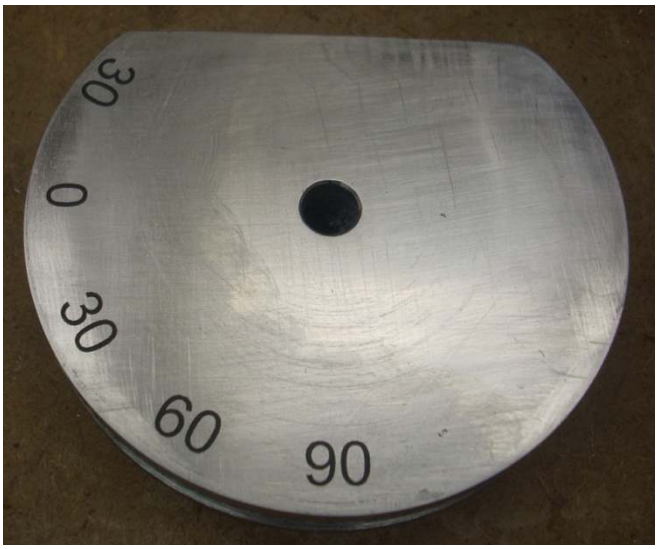
The numbers on the compound use my Parchment Paper and glue technique[3]. I start by printing the artwork on Parchment Paper using my HP® laser printer.

I print one right reading copy to see how it looks plus five mirror image copies in case I screw up the toner transfer.



After coating the surface of the compound with Loctite® Glass Glue, I put down the mirror image artwork. It then set for about fifteen seconds before the paper lifts off. The Parchment Paper lightly holds the toner and the glue holds it firmly.

[3] See http://rick.sparber.org/ttm.pdf.



With the glue fully cured, I spray down a few coats of Rust-Oleum Crystal Clear Enamel Spray®. The solvent slightly melts the toner and darkens it. The enamel protects the toner.

You can see where the glue was put down. Next time I plan to coat the entire surface so there is no contrast with the uncoated area.

It is hard to tell in this picture, but the perimeter of the compound is about 1/4" from the wheel.

I could have cut my secant line closer to the pivot point but then I would not be able to turn to -30º.

The step cut in the slider was intended to keep the clamp from rotating. It did not work as well as hoped. So I coated the bottom of the leg of the clamp in violin rosin. The added friction did the trick.

Thanks to Tim Hofstetter for reminding me that the wheel must be dressed flat before using the fish to set the angle of the guide. Thanks to Jerry Halcomb for pointing out that a am referring to a secant *line* here and not a secant (as in function).

I welcome your comments and questions.

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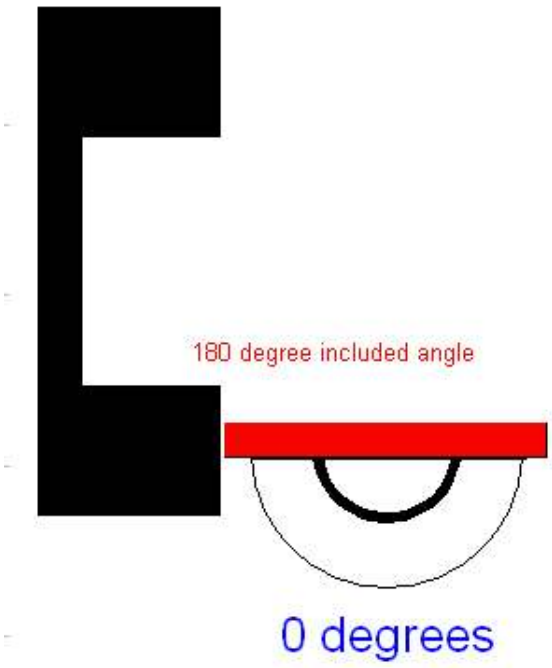
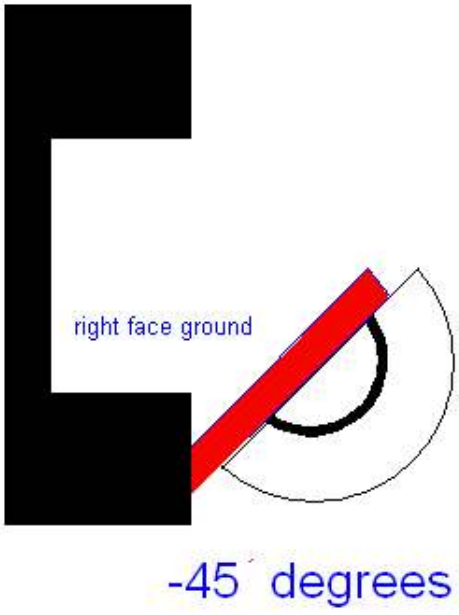
Appendix

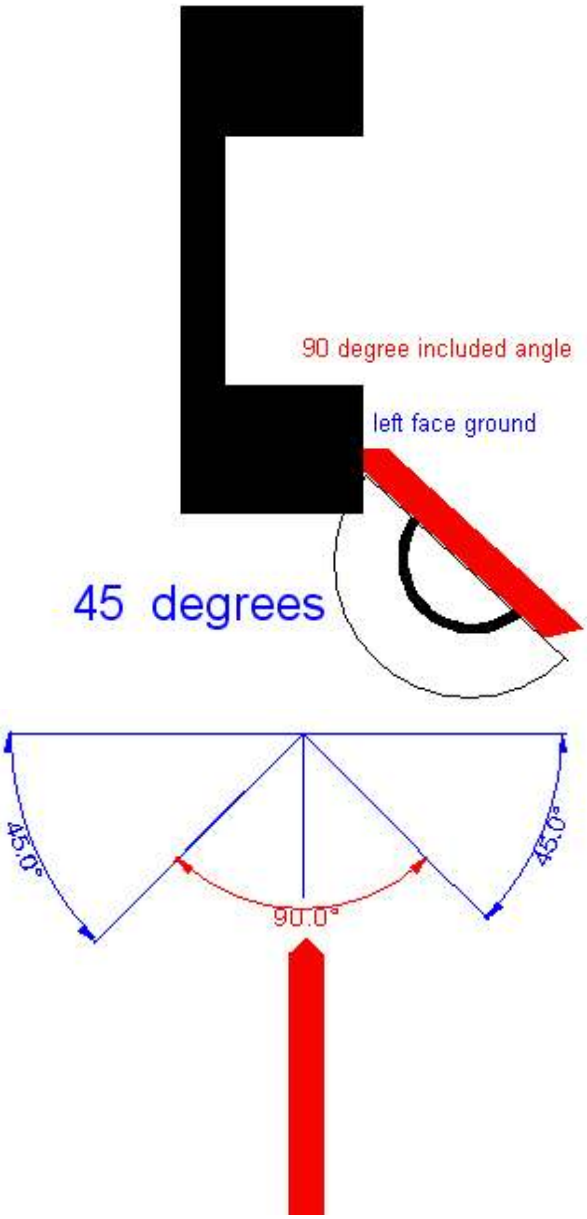
It may not be obvious why the compound that comes with the grinder is limited to an included angle of 90° to 180°. Here is my attempt to explain it.



With the compound set to 0°, the cutter blank has the end ground square. This is an included angle of 180° as will hopefully become apparent soon.

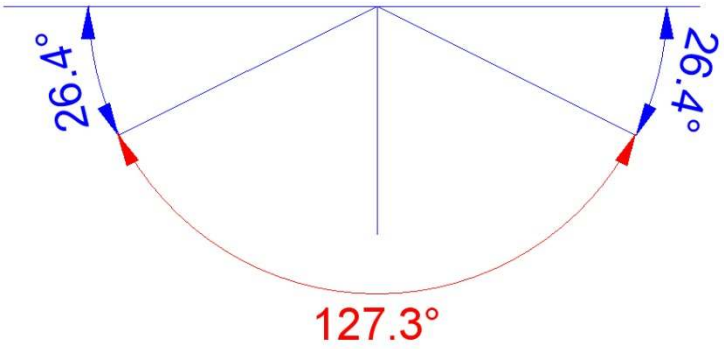


I can swing the compound over to -45° and cut on the right side of the cutter. It cannot be turned more than this.



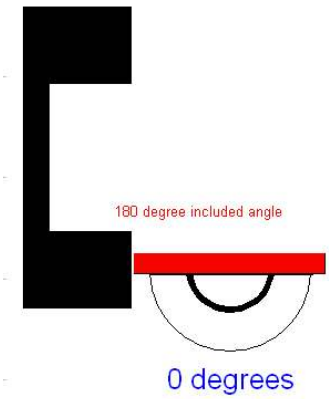
I can then rotate the compound to +45° and grind the left face of the cutter. I cannot rotate more than this angle.

The resulting cutter has an included angle of 90°. Note that the compound's angle is measured from a line perpendicular to the center line of the cutter blank. Yet we usually talk about the angles on a cutter with respect to this center line.



If I turned the compound to 26.4° and ground both sides of the cutter, I would get an included angle of

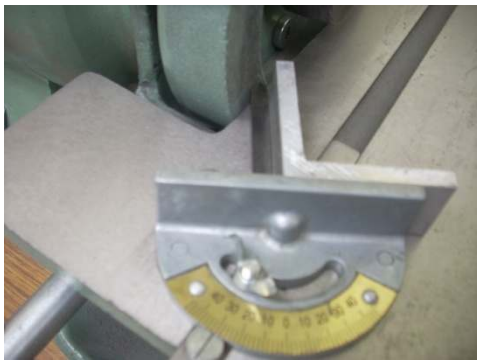
180° - 26.4° -26.4° = 127.3°.



The trend here is that the smaller the compound angle, the larger the included angle. This is why a compound angle of 0° causes an included angle of

180° - 0° - 0° = 180°.

Given that a threading tool needs an included angle of 60°, the compound that comes with the grinder would have to turn to +/- 60° yet can't get past +/- 45°.



Now, if I put the cutter on end and support it with a right angle, I can get to +/- 60° by setting the compound at +/- 30°.