A Universal Bolt Beveling Fixture, version 1.1

By R. G. Sparber

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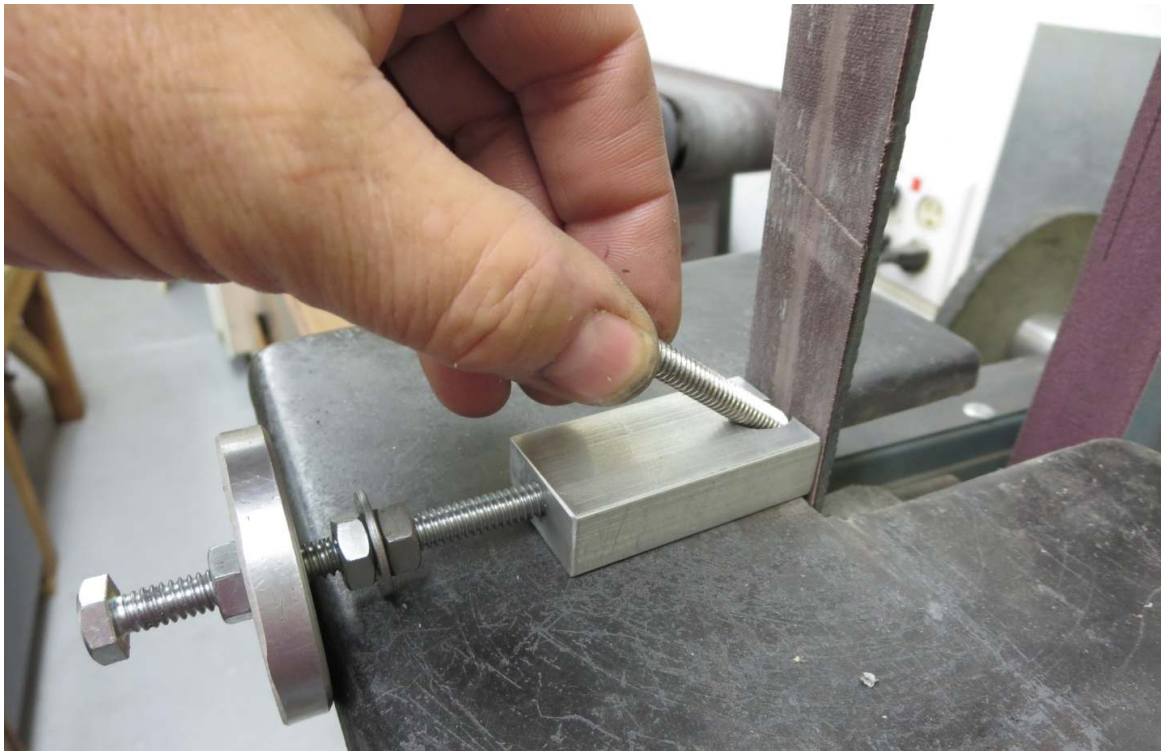
A YouTube video exists showing how to use this fixture:
http://youtu.be/9uMnIKKZj4M



If you have built the Universal Bolt Cutting Fixture, there is a small pile of cut bolts waiting to have their ends beveled. The fixture presented here solves that problem. It can bevel any bolt from 3/8" on down to at least #6.

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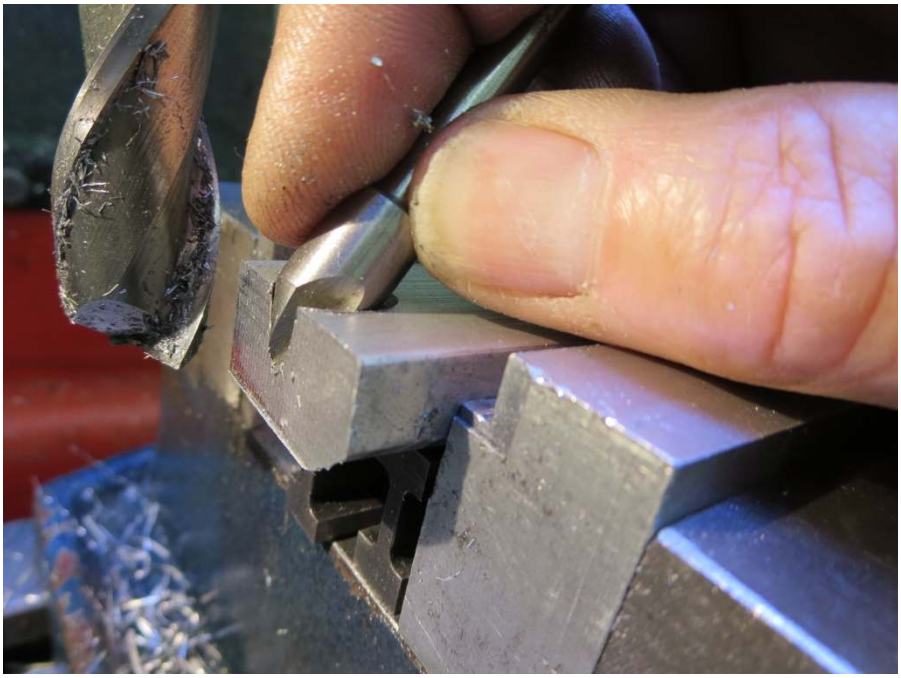
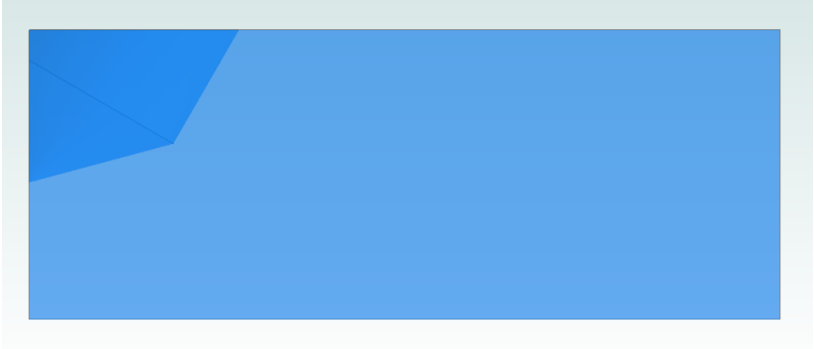
Here you see a ¼-20 bolt in the hole. Note that the thread at the end of the bolt is exposed. When the end of the block is close to my sanding belt, a bevel is cut in the threads. The user must keep the bolt roughly centered in the hole and give it a full turn.

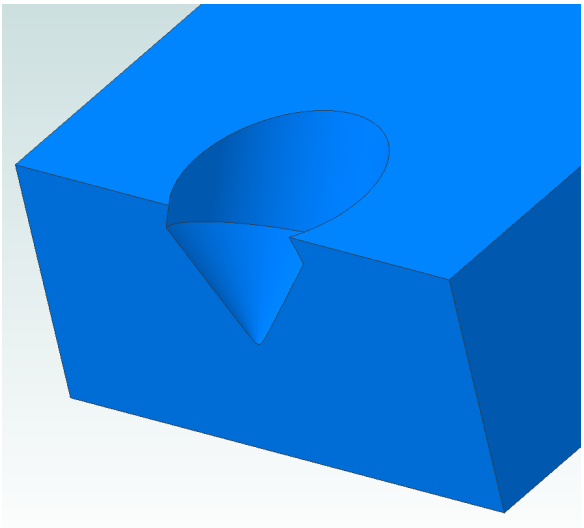


The fixture consists of drilling an angled hole in a piece of aluminum using a countersink. Then the end of the workpiece is milled off until the center of the hole is a little over the edge. The ideal location will be explained in the next section.



This diagram came from my 3D drawing program. You are looking at a side view.

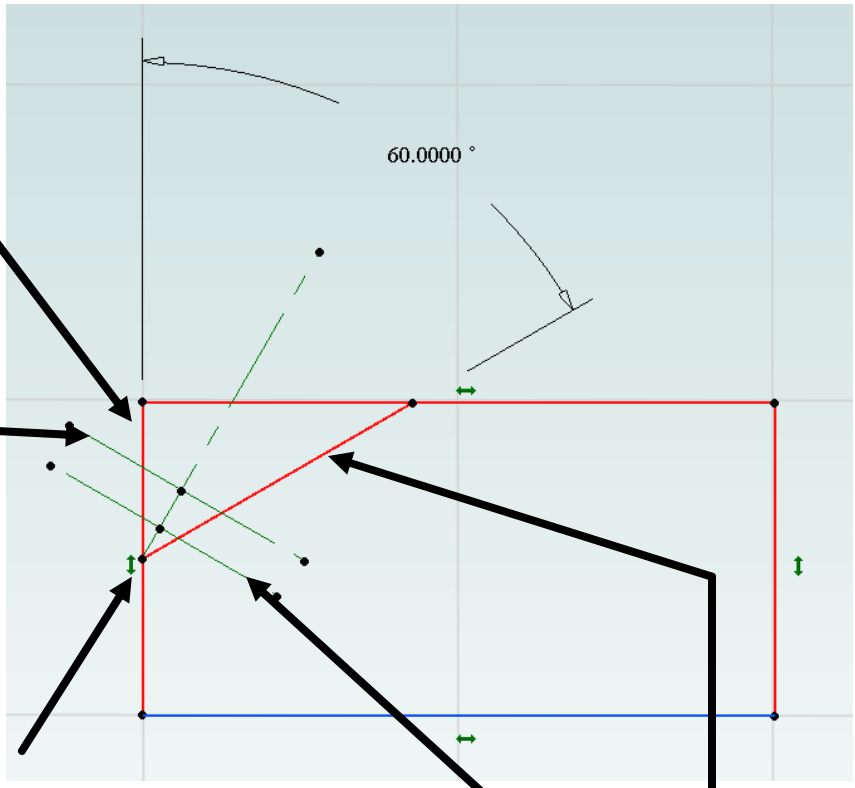
The light blue is the aluminum block made translucent. The dark blue is the hole. I used a 60° included angle 3/8" diameter countersink to drill the hole. The hole has been angled at 30° so the left flank of the hole is vertical. Here is a close up of the hole with the aluminum block made solid. By milling the end of the block so it is at the center of the hole, we open up a slot to expose the bolt threads to the belt sander.



Take a Moment for the Theory

This diagram represents a side view of the fixture.

The left face of the countersink was aligned with the left vertical face of the block of aluminum.



Since the included angle of the countersink was 60°, the centerline of the hole is at 30°.

Say that this lower line, perpendicular to the centerline, is the end of a small diameter bolt. The right bottom corner of the bolt touches the right flank of the tapered hole. The left flank must be at the vertical face of the block.

The upper line is the end of a larger diameter bolt. The right bottom corner of the bolt touches the right flank of the tapered hole, just not as deep into the hole. The left flank must be at the vertical face of the block.

So if the end of the block was exactly lined up with the center of the hole, bolts of different diameters would all have their left flank lined up at the surface of the block.

Before we can proceed, more information about thread heights is in order. I will spare you the math and just say that the height of the thread equals about $\frac{0.541}{TPI}$ where TPI means threads per inch. Note that the thread height does not involve the diameter of the bolt.

Here are some sample sizes:

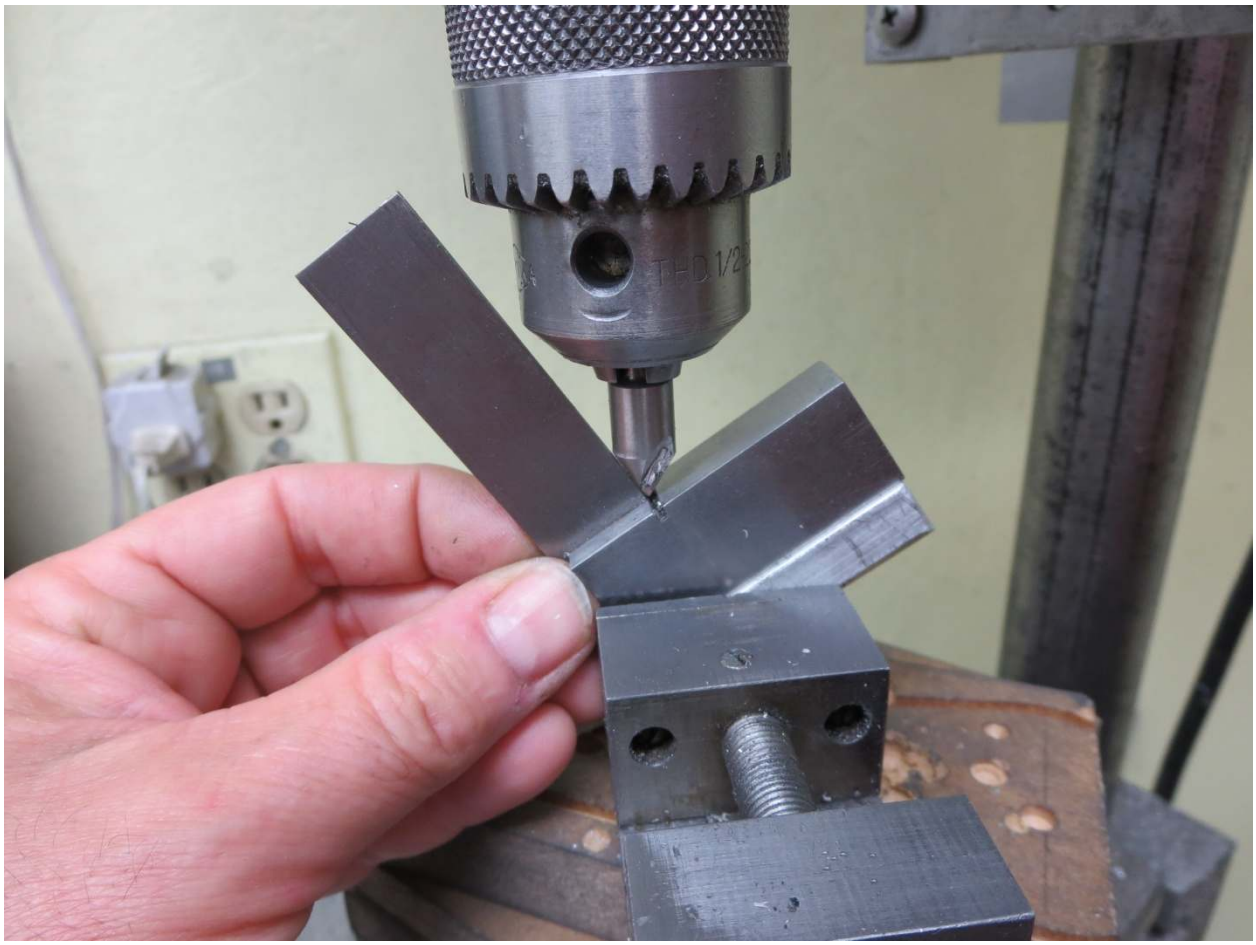
Threads Per Inch	Thread Height (inches)
32	.017
24	.023
20	.027
16	.034

If we cut the end of the aluminum block so the 16 TPI bolt has all of its thread exposed, then the 32 TPI bolt will have .017" more metal removed than necessary. Not a big deal in most cases. If it is a problem, then simply back the block away from the belt by this amount.

The bottom line is that the amount of metal removed from the end of the aluminum block is set by test placing the coarsest TPI bolt you plan to bevel into the hole and machining until all of its thread is exposed.

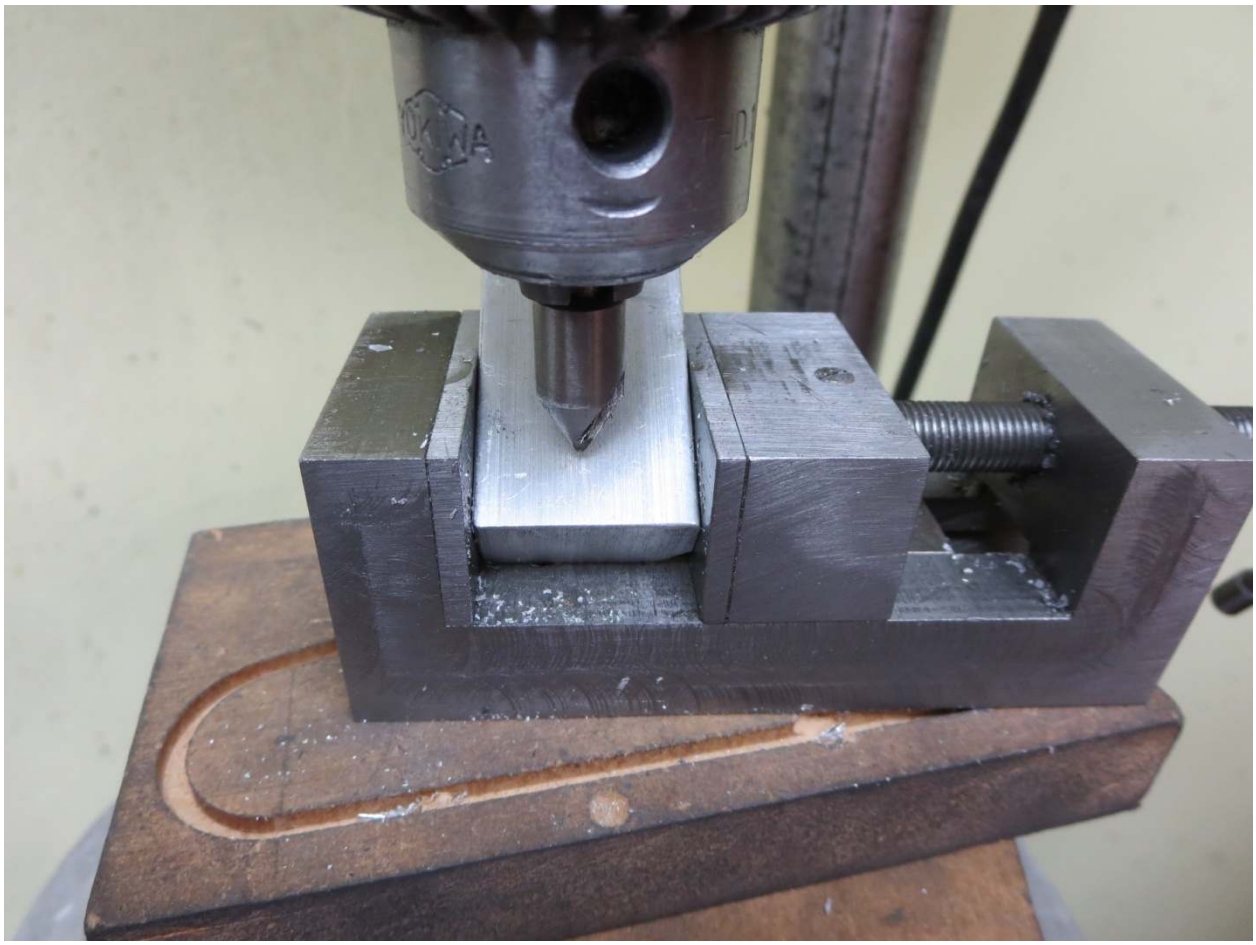
Shop Work

I started with a piece of ½" x 1" x 1.5" aluminum scrap.

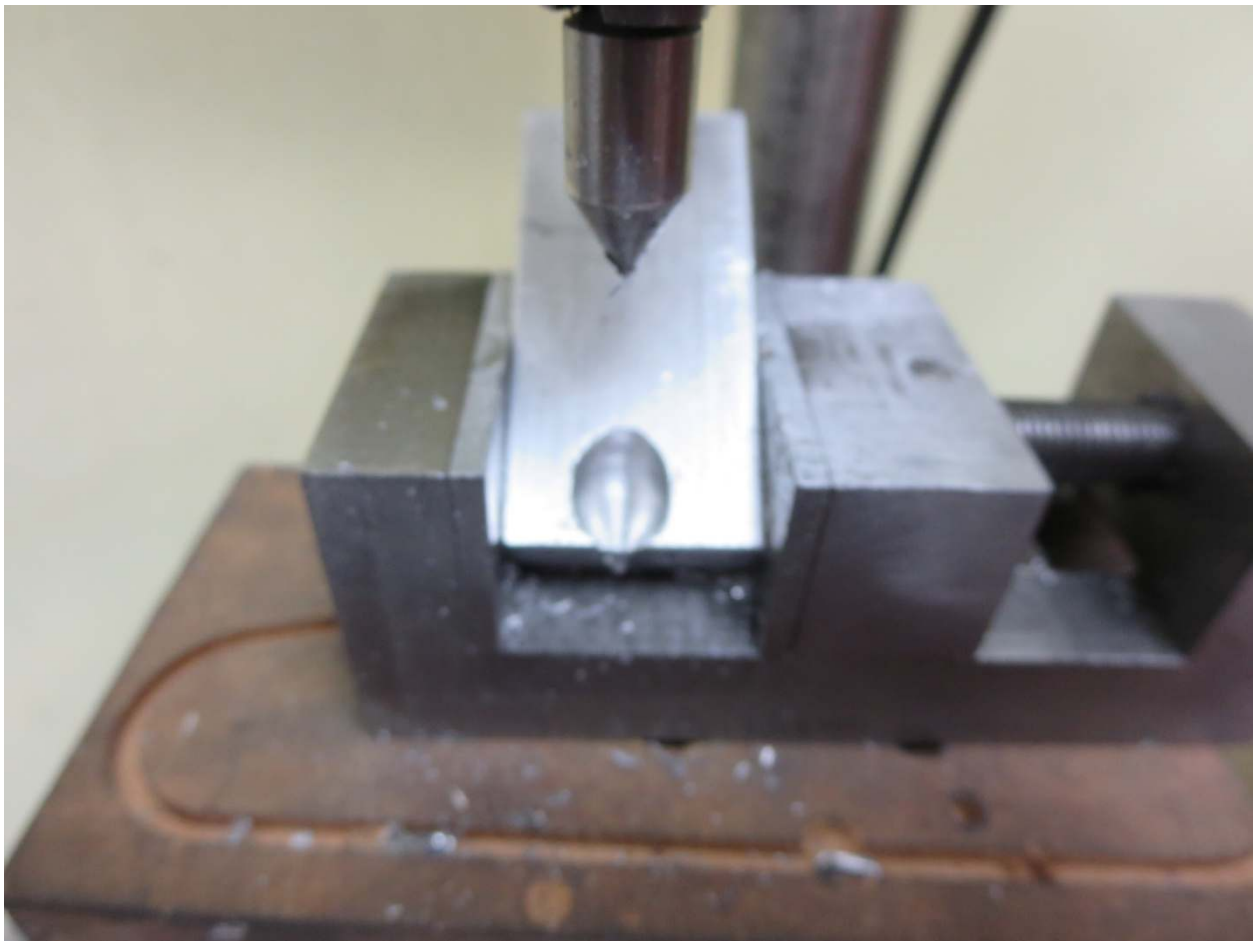


A 3/8" diameter 60° included angle countersink was mounted in my Gingery drill press. The workpiece was then clamped in my homemade vise. I used a 2" square to set the workpiece so the left flank of the countersink was perpendicular to the face.

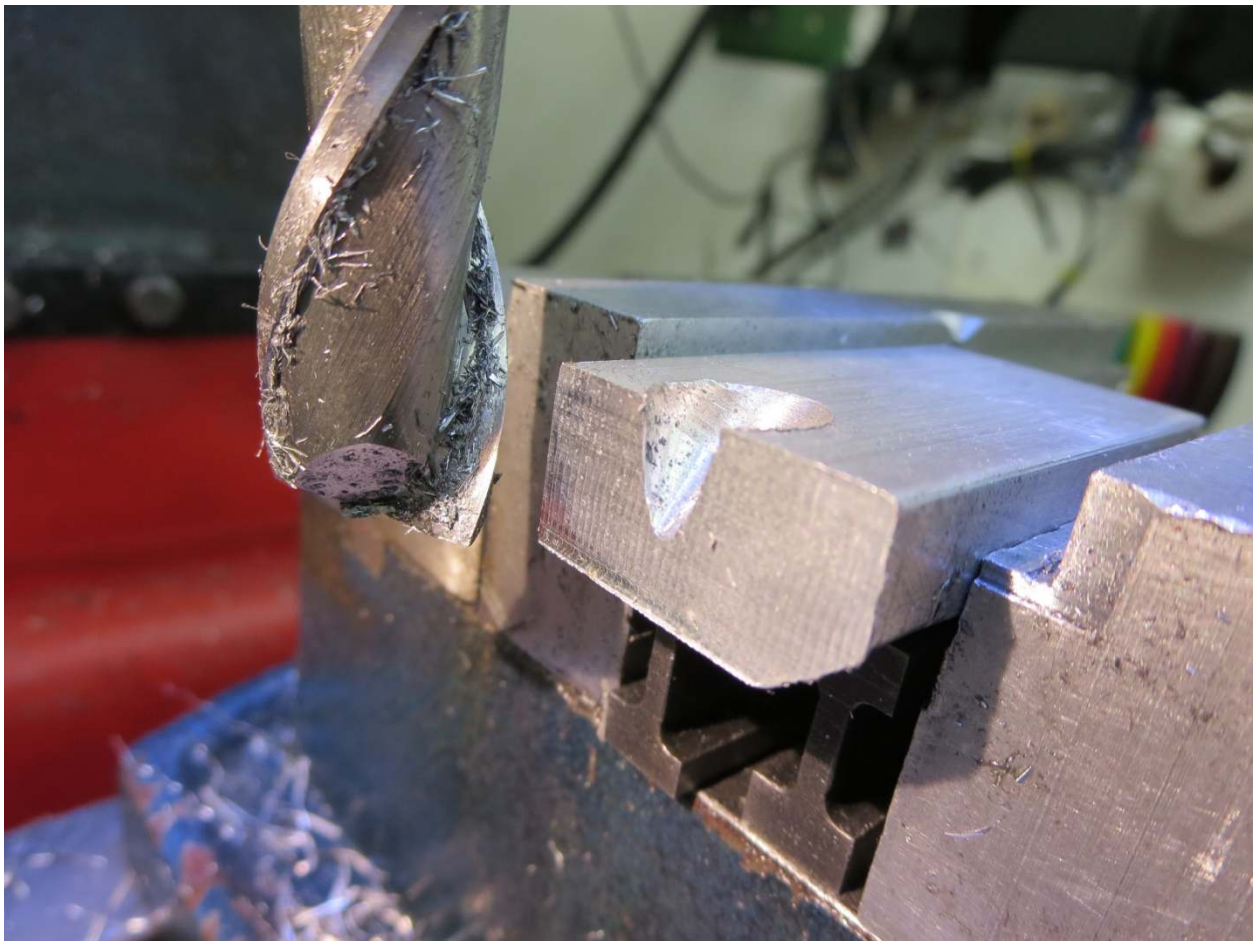
There is nothing special about using a 60° countersink. The key is that the left flank be perpendicular to the workpiece's surface.



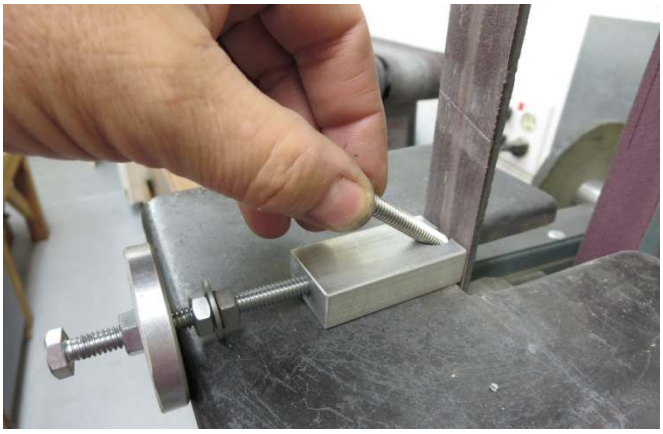
The hole was started far enough back from the edge of the workpiece so it did not break through the end.



You can see that the bottom of the hole barely broke through the end of the workpiece. This was a bit too close for comfort. However, I still had milling to do in order to have the end of the block pass just beyond the center of the hole.



I ran the mill across the end of the work piece until just the center bottom of the hole was exposed. Then I used a 16 TPI bolt as a gage for the final cut as explained in the theory section.



The last step was to drill and tap a hole in the end of the block to accept a long bolt. An arrangement of washers and scrap parts made up the stop.

The stop was adjusted to give me a small clearance between the belt and the end of the block. Test bevel a bolt for final adjustment.

I welcome your comments and questions.

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