The Start of an Idea for a Shaper Vise, version 4

By R. G. Sparber

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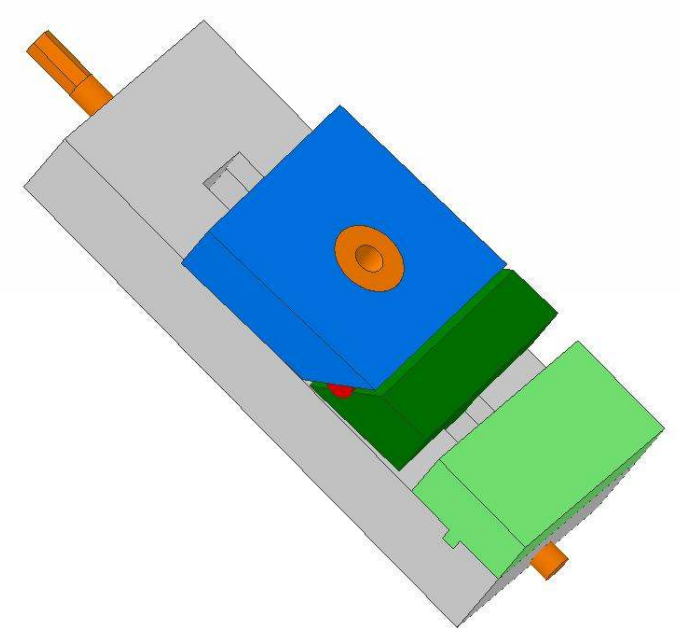
Initial Design



I guess this saves time, but can't be sure. Rather than making a prototype in my shop, I'm attempting to do it with my CAD program, Alibre. All I know is that each time I look up at the clock; the hour hand has jumped by 2.

My goal is to design a low profile vise that has the same clamping action as a Kurt®. This means that my movable jaw is pushed both into the fixed jaw and down onto the vise ways as the lead screw is advanced. While the Kurt uses a hemisphere to perform both motions, I have chosen to do it in two places using round stock.

My design must be free of complex machining operations as found in the real Kurt vise. Some rigidity has been sacrificed. The parts can be machined from bars of steel and from round stock. However, the base could be built up from plate in order to avoid milling out the slot.

Not designed yet is the means of clamping this vise to the table. I am tempted to go with socket head cap screws passing right through the ways and recessed so the movable jaw can freely move. I have also not designed a means of holding the

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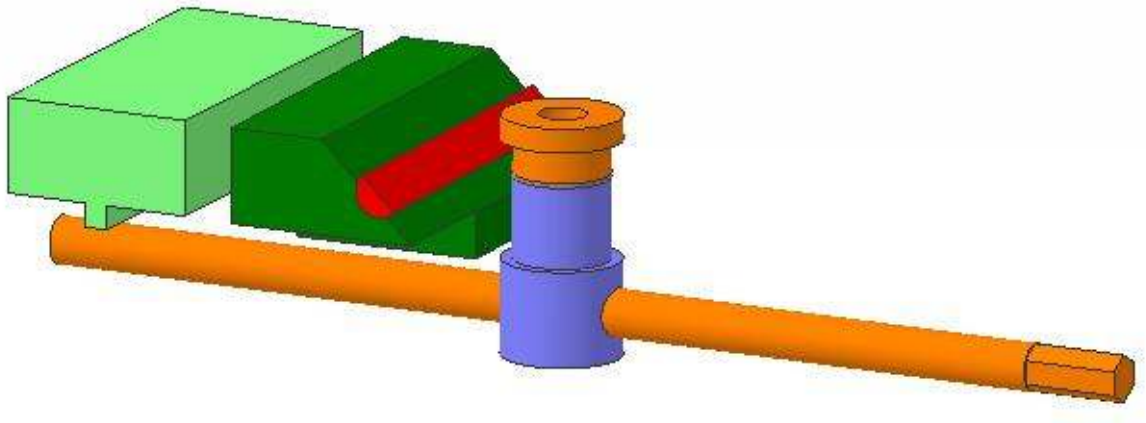
movable jaw to the pusher block. One option is to put a few dots of silicone caulk in the gap. I also need a means to keeping the half rod from falling out. I don't see any show stoppers here.



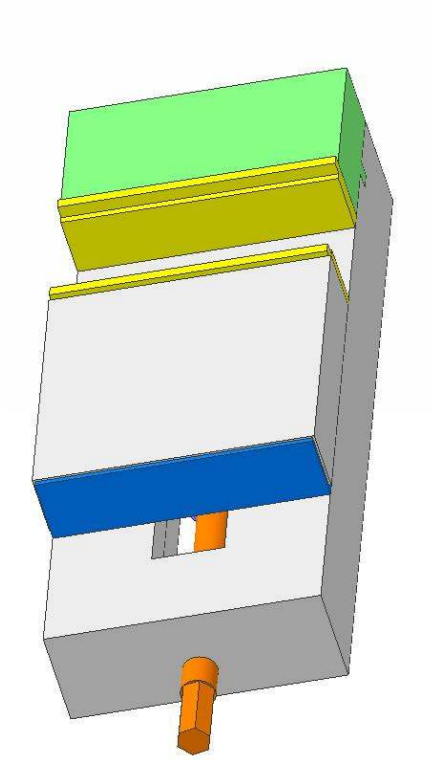
Here is a picture of the vise with the base and pusher block removed. In purple I have a turned "nut" that has been cross drilled and tapped for the orange lead screw. The nut is a little smaller in diameter than the width of the lower slot in the base. It necks down by 1/4" to provide a bearing surface. Upward force on this nut will cause this bearing surface to ride on the lip inside the base. The smaller diameter then enters the pusher block and almost touches the top washer, shown in orange. Both the nut and top washer are drilled and tapped so I can hold the pusher block down on the vise ways yet permit some play.

The pusher block presses on a rod, shown in red, which has been milled in half lengthwise. This rod is free to rotate in the movable jaw plus slide over the angled face of the pusher block. In this way the pusher block can lift up yet the movable jaw stays down on the vise ways.

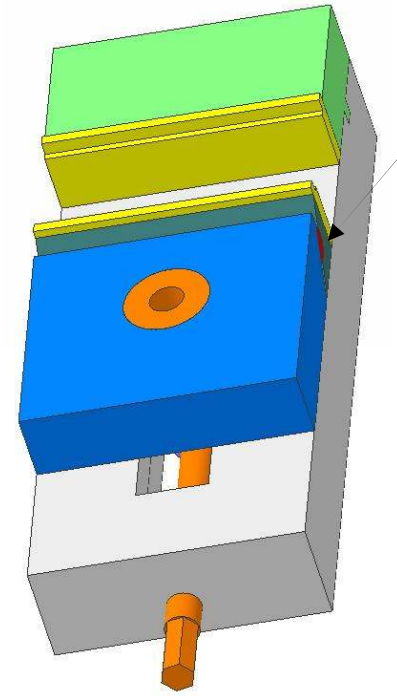
The movable jaw has a key under it that is a loose fit to the slot in the base. This permits the jaw to move side to side a little to accommodate parts that are not square.

Second Iteration

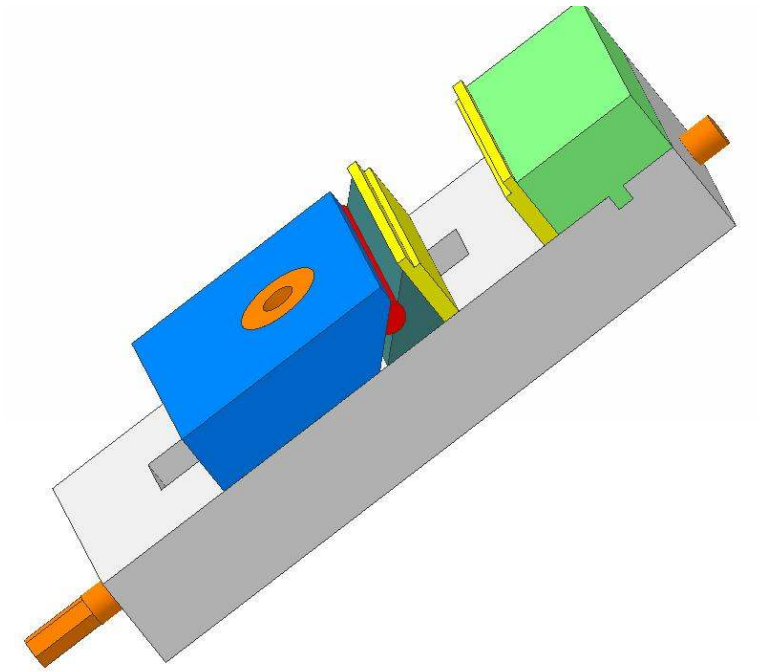
I received a lot of great design advice from the various BBS and will list the contributors in a later version due to a time constraint.



Here is the entire vise. The only thing I have not changed is to put the hex drive of the leadscrew on the fixed jaw end. Apparently, shaper vises work by pulling the movable jaw into the fixed jaw rather than pushing it as is common with mill vises.

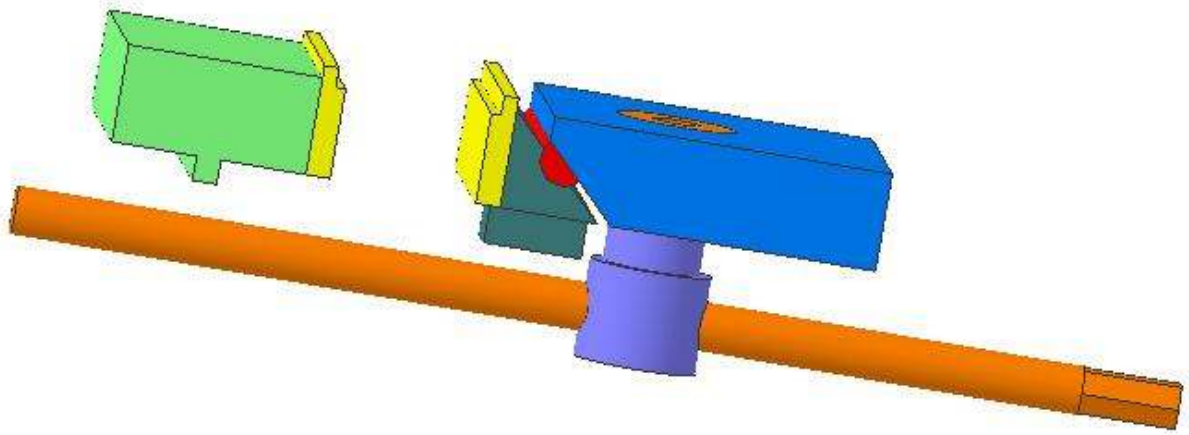


I have removed the sheet metal cover over the pusher block and movable jaw. The cover keeps the (red) half rod in place plus keeps swarf out of the gap between the two blocks.



The half rod is easier to see in this side view. I have a 0.1” gap between pusher block and movable jaw. I could cut the half round deeper in the movable jaw and cut the half rod so more than half of it is left. That might make machining it a little easier.

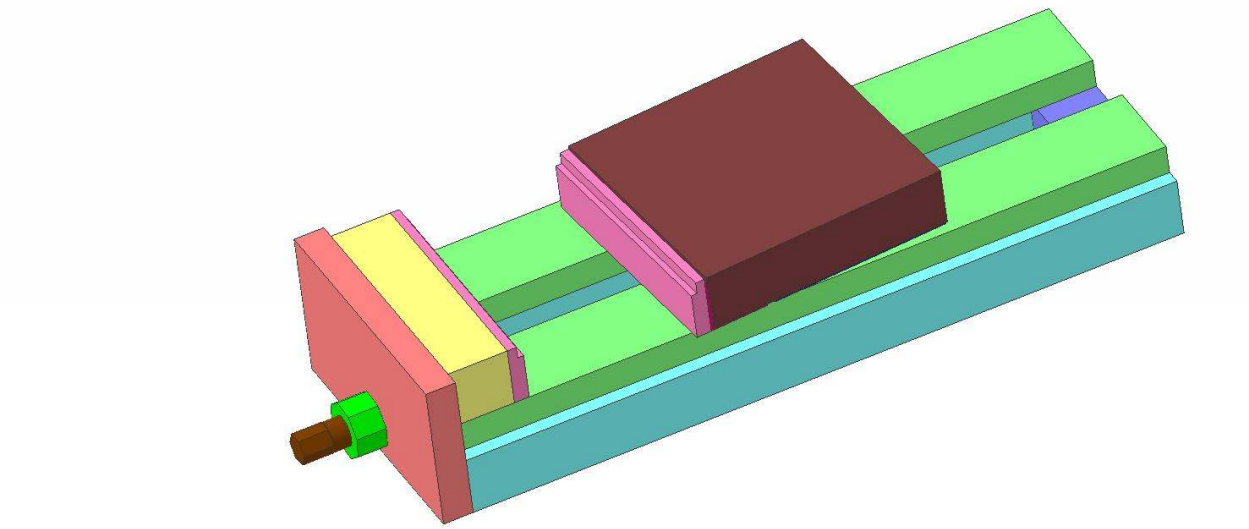
As the leadscrew is tightened, the pusher block presses on the flat face of the half rod. The angled face of the pusher block is free to slide over this face. The force exerted on the half rod is applied to the half round cut in the movable jaw with half of the force going down to the base and the other half going towards the fixed jaw. If the part being clamped is not exactly square, the pusher block with movable jaw can rotate slightly to accommodate it.



With the base removed, you can see how the leadscrew nut relates to the pusher block. The step in the nut presses on a ledge inside the base to prevent the pusher block from rising up too much. The nut almost touches the top threaded washer. In this way I can adjust the amount the pusher block can rise yet not bind on the base.

The stepped jaws (yellow) are softjaws and will screw on from the inside of the clamping area. I could move the fixed soft jaw to the far side of the fixed jaw for more capacity but can’t do that with the movable jaw.

Third Iteration



There are three major changes with this design.

The fixed jaw is supported by an end plate which avoids the complexity of having a keyway.

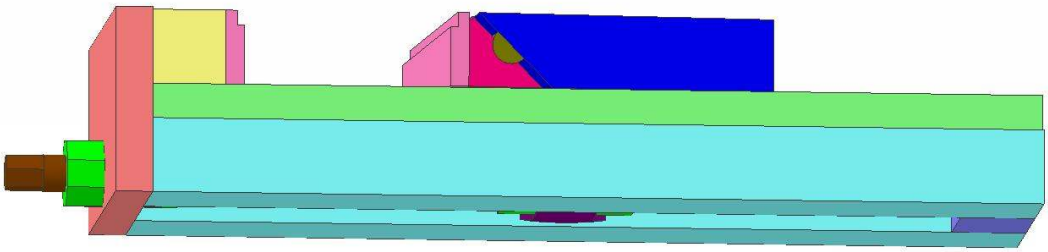
The second change is that the vise is now mostly “bolt on” with minimal milling. And the third change relates to the leadscrew and bottom nut. I am using an Acme thread here and the bottom nut is assembled from low cost Acme nuts. No threads have to be cut.

The body of the vise is formed from a pair of 1”x1.5” bars spaced 1.5” apart. On top of these bars are a pair of ½” x 1.5” bars that form the ways. They are spaced 1” apart. This offset gives me an internal ledge for holding down the pusher block plus an external ledge for clamping the vise down. All four of these bars bolt into the ½” x 2 ½” x 4.5” plate. This plate also backs up the fixed jaw, is a thrust surface for the leadscrew, and provides support if the vise is used on its flank with the ways vertical. A spacer block in the end of the vise provides extra support when in this position.

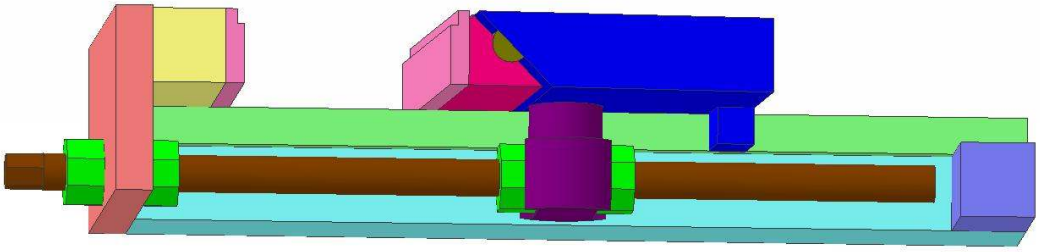
The sheet metal cover for the pusher block and movable jaw has a small lip that engages a slot in the front/top of the movable jaw. In this way the movable jaw is captured yet free to move slightly relative to the pusher block.

Not shown in this drawing are the various fasteners plus the thrust bearing. I have bought a needle bearing plus bearing race that will fit between the outboard nut and the end plate. All fasteners will be recessed.

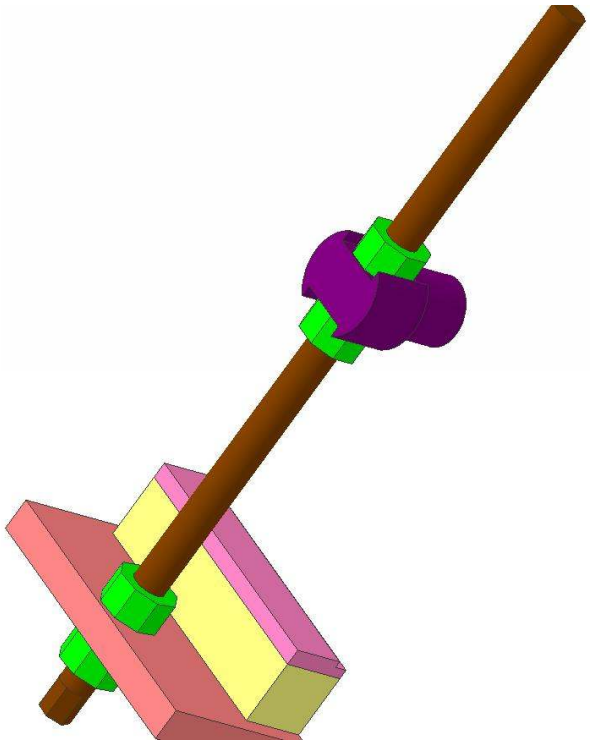
For now, I have chosen to have the overall length be 12.5” but only because the bar stock is 12” long and I have plenty of leadscrew. This would be easy to change.



With the cover removed, you can see how the bars will lay up. You may also be able to see the groove in the top of the movable jaw.



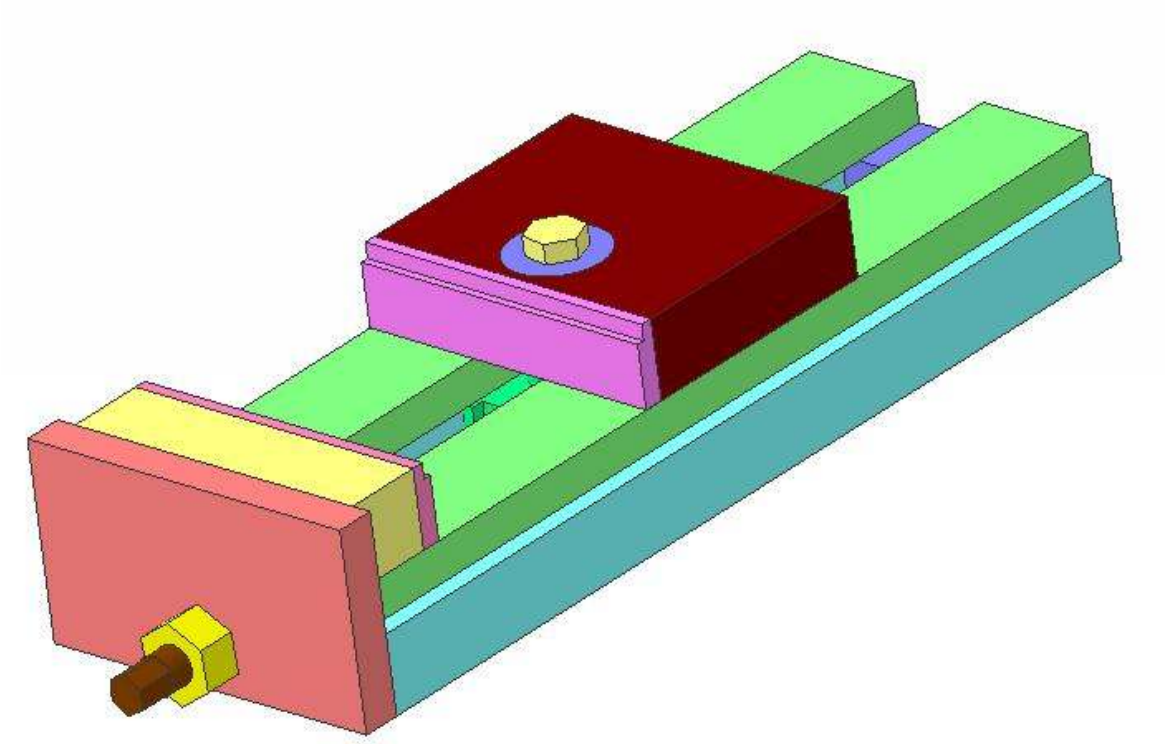
I have removed one side of the base and you can see the bottom nut and the anti-rotation stop attached to the pusher block. The spacer block can be seen on the back.



This view gives a better idea of how the bottom nut works. The two Acme nuts are separated by 0.8”. The thread is a ½-10. This means that I should have 8 threads inside the bottom nut and the Acme nuts should be snug on the pockets of the bottom nut.

The pulling force from the leadscrew will press on the backing plate. This plate is bolted to both the ways and the fixed jaw. The fixed jaw will also be bolted to the ways.

Forth Iteration



This time around the movable jaw and lower nut have been redesigned.

Brian Lamb of valleymetal pointed out that the old movable jaw would not work correctly. After a bit of rethinking, I decided to take a more direct approach to insuring that the movable jaw would clamp both into the part being held and down to the ways.

I simply modified the top nut so it could be easily tighten. The idea is to have a thou or two of clearance between the bottom of the movable jaw and the ways. Turn the leadscrew until the movable jaw clamps the part. The movable jaw will lift up at the jaw end.

At this point the back edge of the movable jaw will be touching the vise ways. The front end, which has the soft jaws attached, will be raised up by the amount of clearance set by the top nut.

When the top nut is tightened, the movable jaw will pivot and its softjaw will move both towards the fixed jaw and down to the vise ways. Total motion will be equal to the clearance.

I trust that people will speak up if the above idea has a problem.

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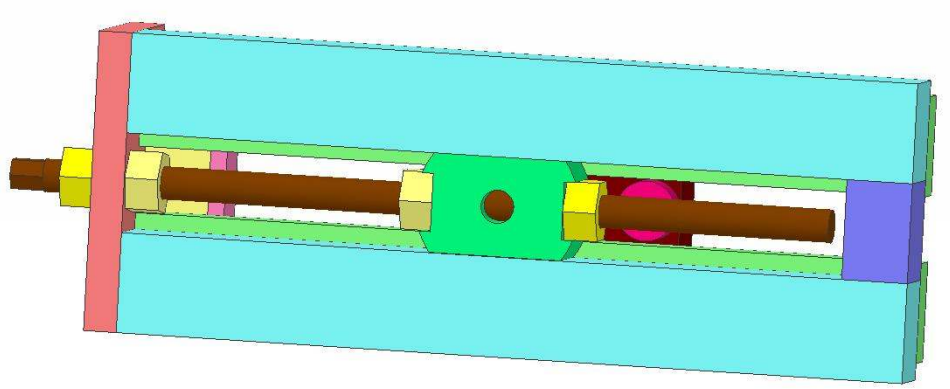
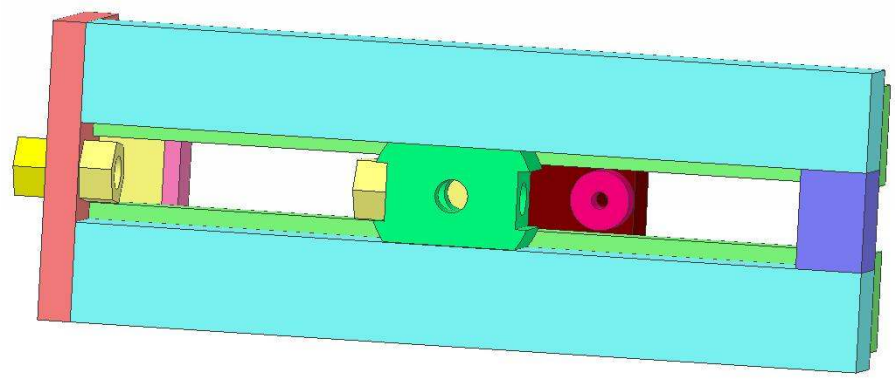


This bottom view shows the new bottom nut, suggest by JRW of valleymetal. It has a much larger contact area with the underside of the ways. This should spread the top nut clamping force over a wider area.



Here you can see the limited rotation stop (in red) fixed to the movable jaw. I have changed from a square block which would need two screws to prevent rotation to a round block which only needs one screw.

Not shown above is the thrust ball bearing that fits between the external Acme nut and the end plate. This bearing has a steel jacket that will keep swarf out.

The only design issue still unresolved is what size hex to have on the end of the lead screw. Using an Acme nut would be simple but it is 7/8” flat to flat so is not the same as my other vise which is 7/16” flat to flat.

Acknowledgements

Thanks to Jim S. for inspiring me to look at redesigning the Kurt vise for use on my shaper plus many critical design suggestions. Ron Thompson for information about Acme threads. “CT2” of gingery_machines for a means of providing a pivot for the base. David G. LeVine for suggesting I buy the Acme thread and nuts at Enco (which is what I did), an alternate methods of clamping non-square parts, plus suggesting how to mill the half rod. “Doc” of Metal_Shapers for suggesting how to clamp down the vise and pointing out that the thrust bearing and drive could be at either end of the vise. Alan of Metal_Shapers for suggesting an alternate pivot arrangement. JR Williams for supplying details of how a Kurt® vise works plus finding weak points in the design. Rob B of mill_drill supplied a short list of pitfalls to avoid. “Snag” of mill_drill for suggested changes to the movable jaw. Brian Lamb from valleymetal for explaining how the Kurt vise works and pointing out a design problem with the clamping mechanism.

I welcome your comments and questions. My hope is that this design can be refined on “paper” and through discussion so my first prototype simply works as expected.

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