

# Match Drilling and Tapping Holes, Version 1.1

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This article is a bit different than the others I have written. I'm focusing on "the journey," not the "destination." How to drill and tap holes, not why I want to do it.



The part I am fabricating is unimportant. I want to focus on the steps I used to drill and tap the holes that secure the bar to the plate using close-fitting screws.

I also ran two setscrews horizontally at the ends of the bar (blue arrows).

If I was running a bolt through just one hole, I could drill through the bar and plate separately. The bar would slide around on the plate until the holes lined up.

But what if I needed two bolts? Either pair of holes can line up and pass a bolt. But the other would likely be misaligned.

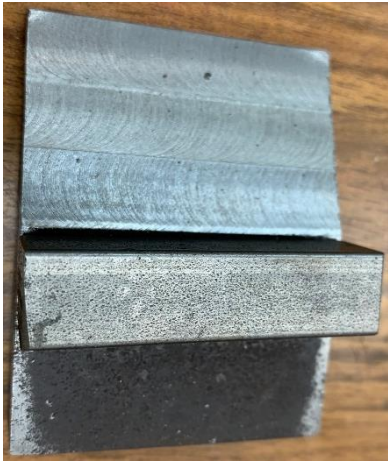
Sure, you can make the clearance holes larger. The bolt can then slide in place, but the two parts will be free to shift under sideload. What if you could drill these holes with close-fitting holes and nothing binds? The trick is to *not* measure!

There is a down-side. This procedure is excellent for a "one-off" but will cause trouble if parts must be interchangeable. In other words, when absolute distances must be achieved.

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## Cut To Fit



I cut the 1/2-inch by 1/2-inch bar on my bandsaw using the plate as my length gage. You will see that a recurring theme is that I try to avoid measuring.



I coated the top ends of my bar with layout fluid



and gently scribed the centerline on one end.



Then I scribed a line 1/2-inch from each end.



I used my spring-loaded punch to mark the crossed lines on one end.



Moving to my drill press, I installed my fence<sup>2</sup>.



Then I put down my vise along with my floating vise jaw<sup>3</sup> and sacrificial piece of MDF.



After clamping in my bar, I installed a spud<sup>4</sup> and located its point into the punch mark. Then the fence was set against the vise and locked in place.

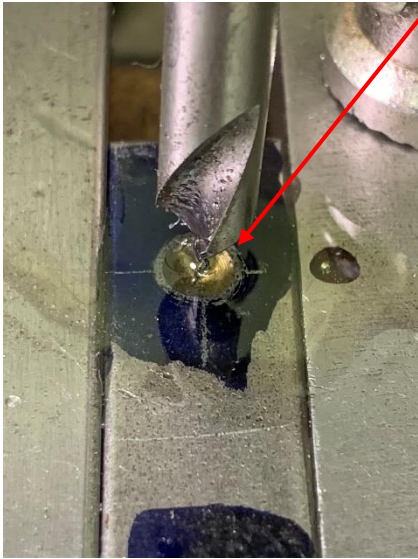
The vise can now freely move along the fence, and all holes I drill will be on the centerline.

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<sup>2</sup> <https://www.youtube.com/watch?v=T-iMkEfz9M0&t=20s>

<sup>3</sup> <https://www.youtube.com/watch?v=c-22bzq5ZXI&t=12s>

<sup>4</sup> <https://www.youtube.com/watch?v=zArRvm9sxks>



After replacing the spud with my spotting drill, I cut a cone.



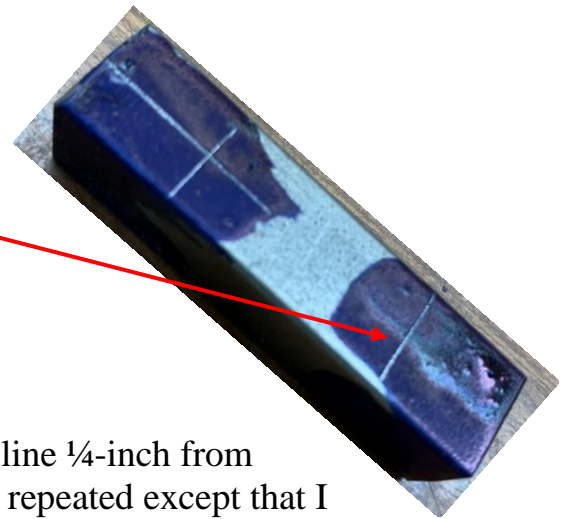
I followed up with my #4 drill. When I later tap this hole 1/4-20, I will get a 55% thread engagement. A #7 drill yields 75% thread engagement, which is not significantly stronger, but it is harder to tap.

Notice that I am using my quick engagement clamp<sup>5</sup> on the vise while drilling.



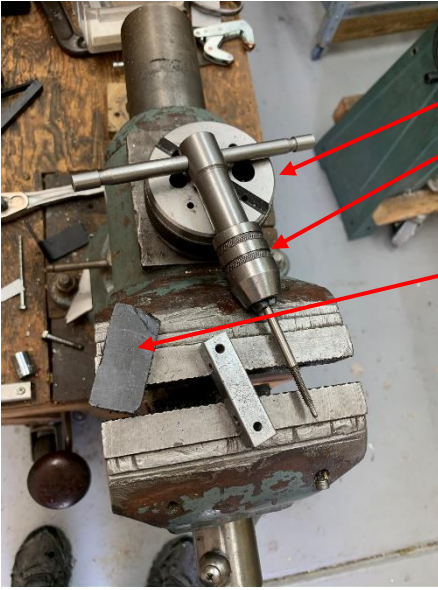
I then slide the vise along the fence with the spud installed and stopped at my scribed line.

After clamping the vise, I used my spotting drill and then my #4.



After deburring the holes on my belt sander, I marked a line 1/4-inch from each end on the adjacent flank. The drilling process was repeated except that I used a #21 drill this time in preparation for tapping 10-32. I again deburred the holes on my belt sander.

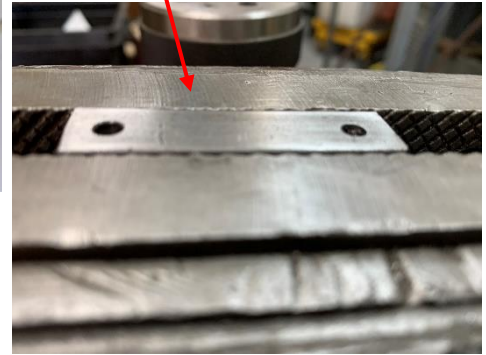
<sup>5</sup> <https://rick.sparber.org/ModifiedDrillPressClamp.pdf>



Moving to my bench vise, I took along my bench block, 10-32 tap with tap handle, and a magnet.



I stuck the magnet to the bar and placed it between the vise jaws. This ensures that the top of the bar is flush with the top of the vise jaw. After tightening, I removed the magnet.



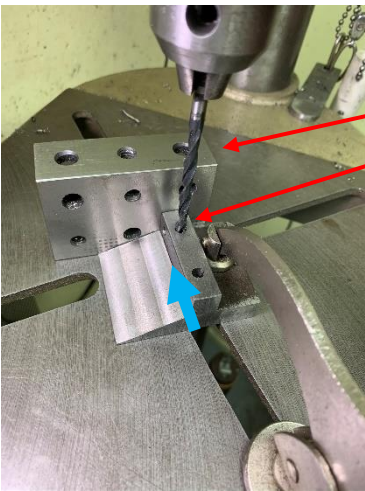
After coating the tap with cutting oil, I passed it through the bench block and into the bar. This keeps the tap vertical as I cut the threads.

Notice that the bottom of the bench block is resting on the top of the vise jaws. Because of the magnet trick, I know my bar is also aligned to this surface. Therefore, my threads will be perpendicular to the surface of the bar.



After tapping the hole, I used my brace-and-bit fitted with a countersink to deburr.

The process was repeated on the second hole.



Going back to my drill press, I used a 1-2-3 block to align the end of the bar with the flank of the plate while having the #4 drill down the hole. I eyeballed the edge of the bar, so it is aligned with the transition from sloped to flat (blue arrow).

then



After clamping the plate down, I removed the bar, used my spotting drill, and my #4 to go through the plate.

I used my belt sander to deburr the hole.



My 1/4-20 tap was fitted into this tap handle with built-in base. After aligning the top of the plate with the top of the vise jaws using my magnet trick, I tapped this first hole. Then I deburred it with my brace-and-bit.



Then I used my #F drill to open out the #4 hole in the bar. I am only enlarging the hole that I used to locate the hole in the plate.

As before, I am using my quick-acting table clamp to secure the bar.



I'm running a 1/4-20 button head screw down the tapped hole until it is tight.



The screw sticks out the back.



After sawing the excess screw off on my bandsaw, I sanded it flat on my belt sander.



With my 1-2-3 block against the edge of the plate, I lock my caliper to the distance between the face of the 1-2-3 block and the bar.



Then I move to the other end of the bar with my caliper and nudge the bar, so it is the same distance. This puts the bar parallel to the edge of the plate. I then tightened the screw.

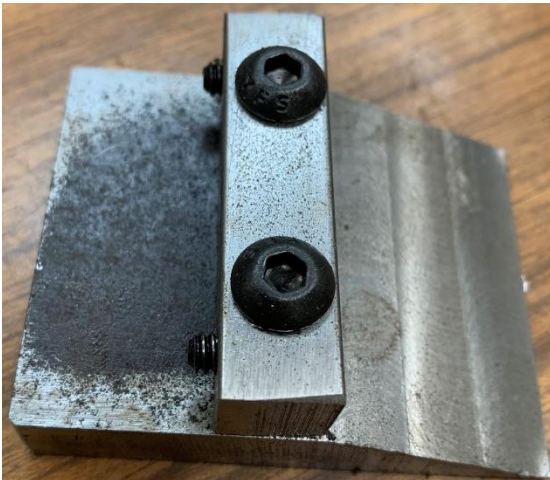


Moving back to my drill press, I lowered the #4 drill through this second hole. Then I clamped the plate down.



Next, I loosened the screw, swung the bar away, and tightened the screw. I do not want that bar swinging into the drill bit as I cut my second hole in the plate.

Notice that I did no measuring to locate this second hole, yet it will be precisely aligned with the second hole in the bar.



I tapped the second hole and deburred it. Then I ran the second button head screw, sawed off the end, and sanded it flat. And finally, I ran two set screws in those horizontal holes.

Of course, both button head screws easily fit through their holes with no binding. In fact, the closer the fit between the first screw and its clearance holes, the better the alignment of the second screw.

As a matter of general good practice, it is still wise to loosely fit both screws before tightening either one of them.



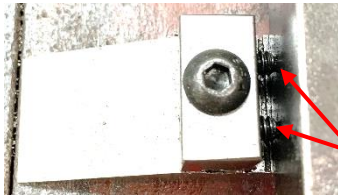


I installed another bar to a plate that was half as wide. The button head screws are again  $\frac{1}{2}$ -inch from the ends, and the 10-32 set screws are  $\frac{1}{4}$ -inch from the ends.

If I had more screws to install, I would drill all tap holes in one part. Then I would screw in the two screws and make them tight. Then I would run the tap drill through all of those holes.

After removing the screws, I would drill out the top holes with my clearance drill and run the tap through the bottom holes.

Although not related to match drilling, I thought I would toss in one more trick:



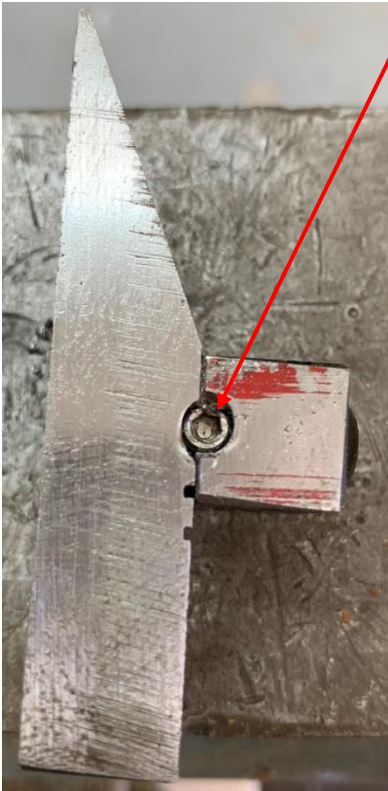
The last plate was too narrow to have two screws, so I was forced to only use one. If this was all I did, the bar would rotate as I fed in the setscrews.

Not acceptable.

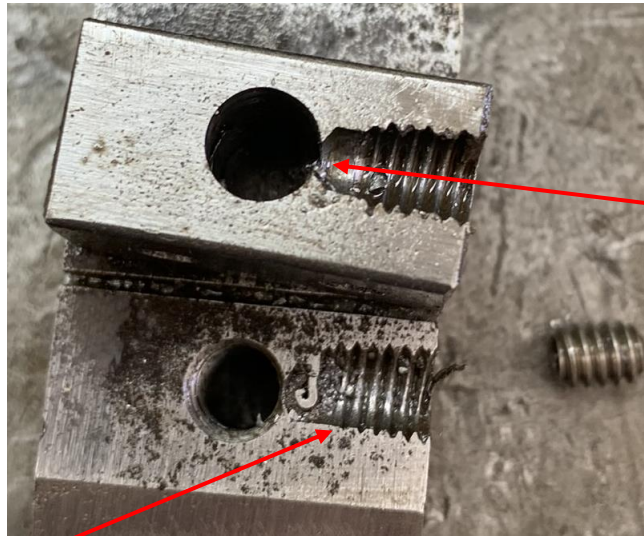


I fitted the block on the plate and placed it in my drill press vise on its side. Then I used my spotting drill to cut a cone at the joint between the block and the plate.

Next, I drilled down about  $\frac{1}{4}$ -inch using my #21 drill. And finally, I tapped the hole with a plug tap. This last operation takes care. You must feel the difference between resistance due to the cutting of the threads and the bottoming out of the tap.



I screwed in a 10-32 setscrew that was 1/4-inch long. This acts as a key to prevent the block from rotating relative to the plate.



I removed the button head screw to inspect the blind tapped hole. You can see that I was able to drill down to the 1/4-20 screw but did not damage it.

The deepest threads are partially cut. This will let me jam the set screw to prevent it from working itself out.

After deburring, I reassembled the block onto the plate.

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