

Adventures in Friction Forming of Bosses, version 1

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Is it possible to friction form a boss in steel tubing in order to increase the number of threads cut? Yup, with certain limitations.

This is steel tubing with a wall thickness of 0.117". The hole has been tapped $\frac{1}{4}$ -20. At 20 threads per inch, you would get about 2 threads in this tubing if a hole was simply drilled and tapped. But here I got more like 5 threads.

Since this article documents my "adventure", I will start at the beginning which was kind of rocky.

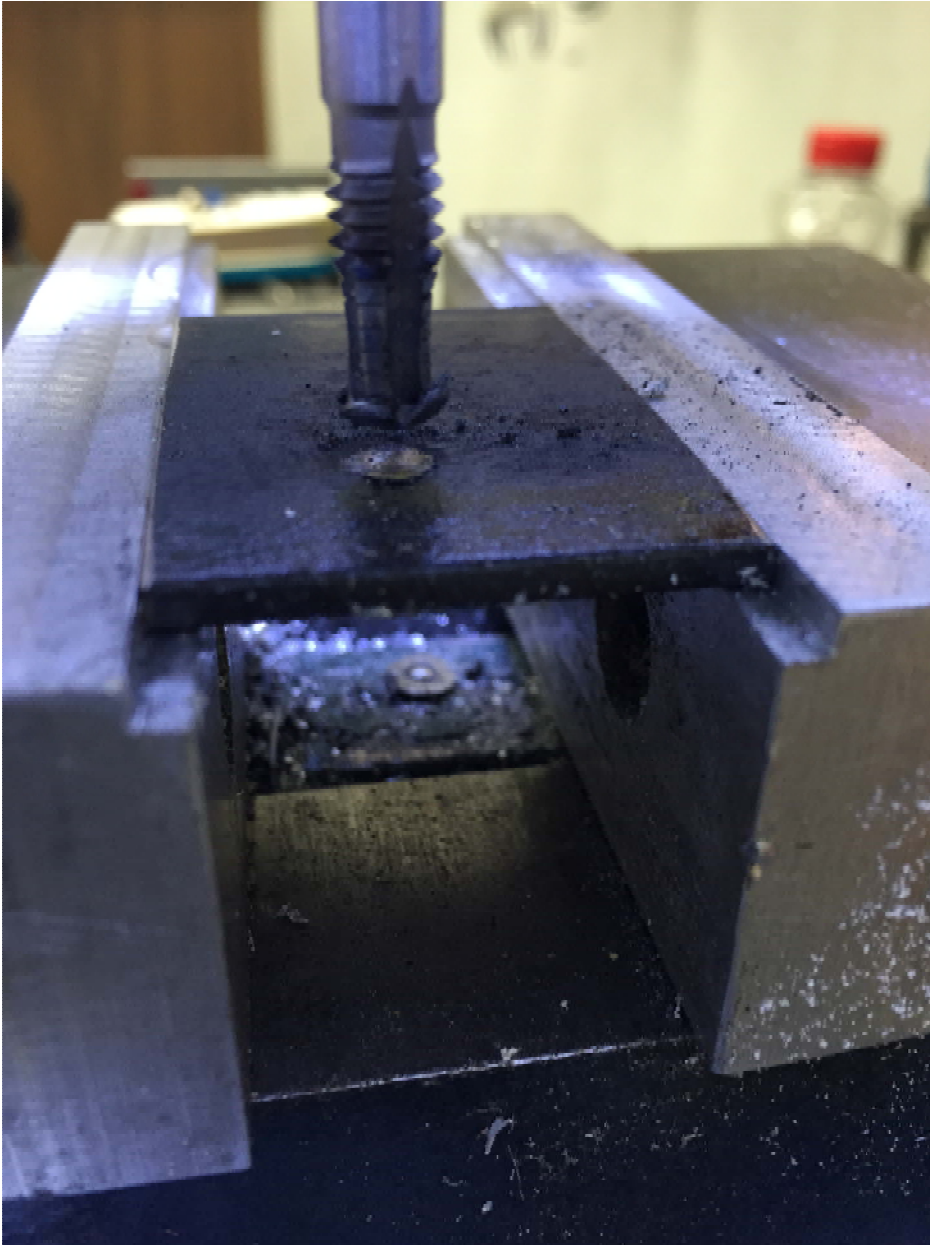
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I started with a worn out 1/4-20 tap made of High Speed Steel.



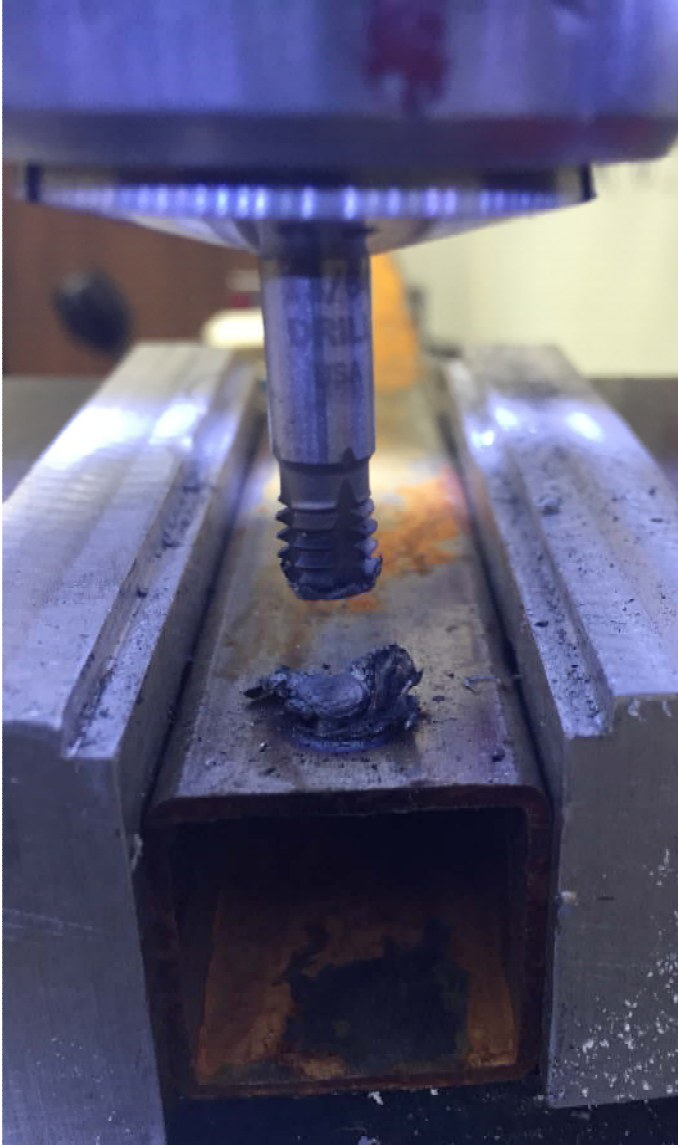
The goal is to form a hole that can be tapped. That is easy - freehand grind off the threads until only the root is exposed. I also ground the end to a point. Previous experiments showed that if the end is flat, a disk of metal is left in the bottom of the hole. That is wasted metal that can't be used in the walls of the hole.



My first attempt at thermal forming was with a piece of 10 gage steel. I ran my RF-30 mill/drill at 1700 RPM.

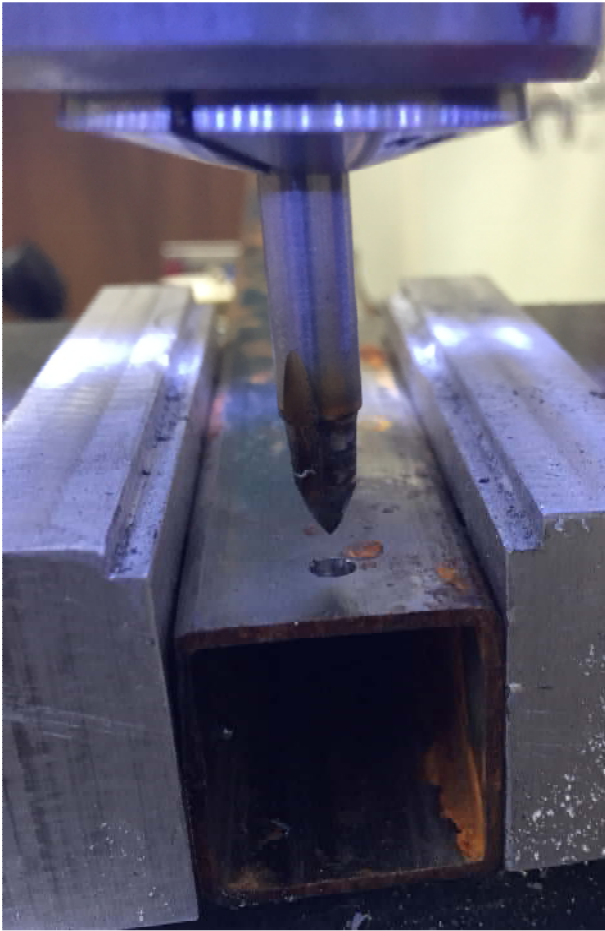
It did a mediocre job of thermal forming *my tool* and did transfer some metal to the plate. Not exactly what I was looking for.





After making a second tool, I tried my luck on some 16 gage tubing. Got more metal to transfer but nothing close to forming a hole.

One thing learned from these two events was that I was spending a lot of time applying pressure. The more time running, the more likely the tool would heat up and fail.



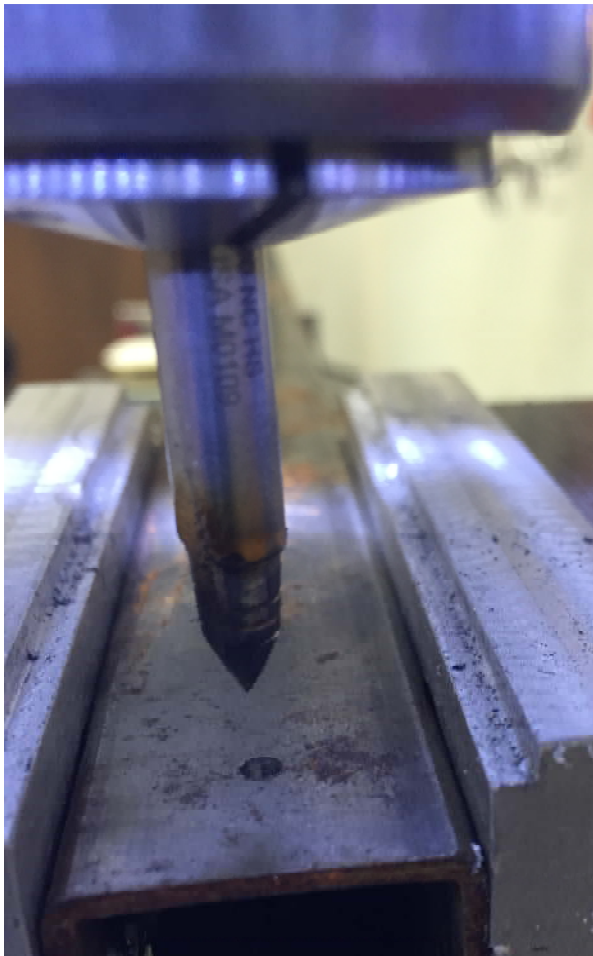
Staying with the 16 gage tubing and grinding my third tool, I first drilled an 1/8" pilot hole. I knew this would remove metal that would be needed to form the walls of the hole but it would also give me a start getting through the steel.



Limited success this time. I did get through the steel but there wasn't much metal left for the walls. The best news was that the tool survived.



I attempted to tap the hole and, as expected, got a mess.



This time I drilled a 3/32" hole in my 16 gage tubing.



The resulting boss looked good so I tapped it. Not bad from this side.



The underside tells a different story. The wall thickness is paper thin.

So how good are these threads anyway?



I took some threaded rod and screwed it into the hole. A thick washer and nut was installed on top. Then I used my torque wrench to see when it would tear out.

As a reference, I drilled the 16 gage tubing with a #7 drill and tapped it $\frac{1}{4}$ -20. It pulled out at around 50 inch-pounds.

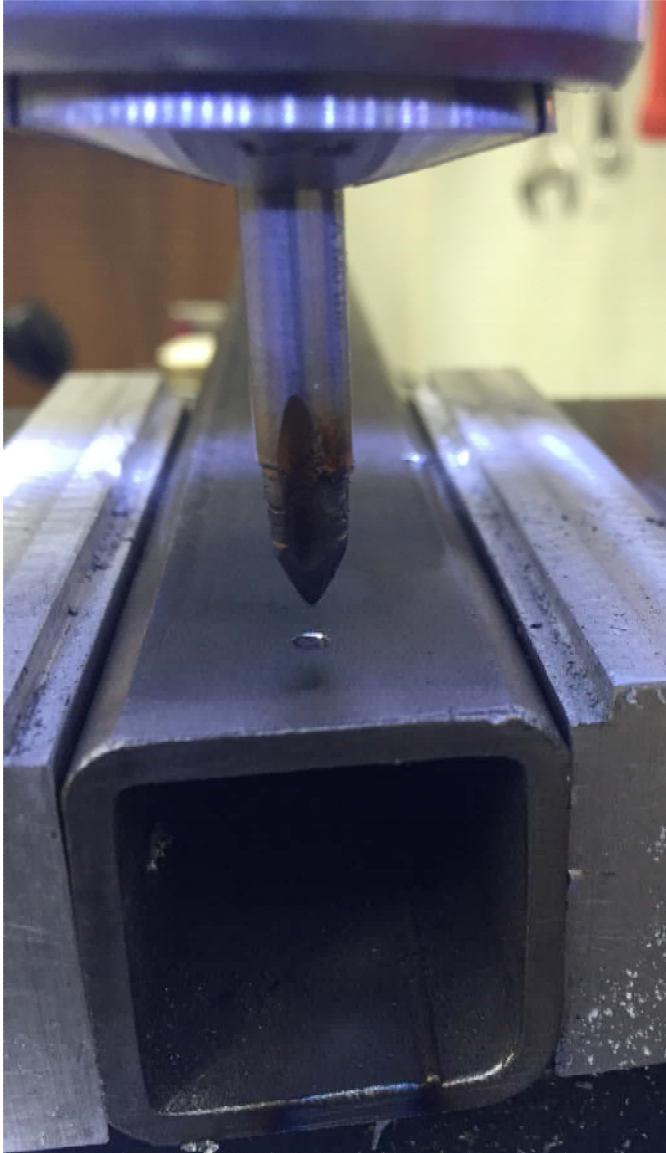
Using the $\frac{1}{8}$ " pilot hole, I had pull out at around 75 inch-pounds.

Using the $\frac{3}{32}$ " pilot hole, I had pull out at around 85 inch-pounds.

As a second reference, I screwed the rod into a $\frac{1}{4}$ " threaded plate. It sheared the rod at 150 inch-pounds. Not the best rod.

This all told me that I needed more metal in the walls to get close to approximating $\frac{1}{4}$ " plate. I could try a smaller pilot hole but doubted this would double my pull out torque.

But wait, the pilot hole helped with the 16 gage tubing. Why not try it on the 0.117" wall thickness tubing?



I drilled a 7/64" pilot hole this time.



The resulting boss was a bit rough but the wall thickness was much better.



The tapped hole looks reasonable.

Time for another torque test. Using the stud, I hit 140 inch-pounds but then realized it was the rod that failed. I re-tapped the hole and used a grade 5 bolt. This time I measured failure at 250 inch-pounds. As a reference, I drilled a hole with a #7 drill and tapped it $\frac{1}{4}$ -20. It failed at 130 inch-pounds.

Conclusions

1. The threaded friction formed boss does improve the pull strength.
2. Wall thickness heavily depends on the thickness of the tubing.
3. Drilling a pilot hole first made it possible to use High Speed Steel for the tool. If the tool was made from carbide, the pilot hole might not be needed.

I welcome your comments and questions.

If you wish to be contacted each time I publish an article, email me with just "Article Alias" in the subject line.

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