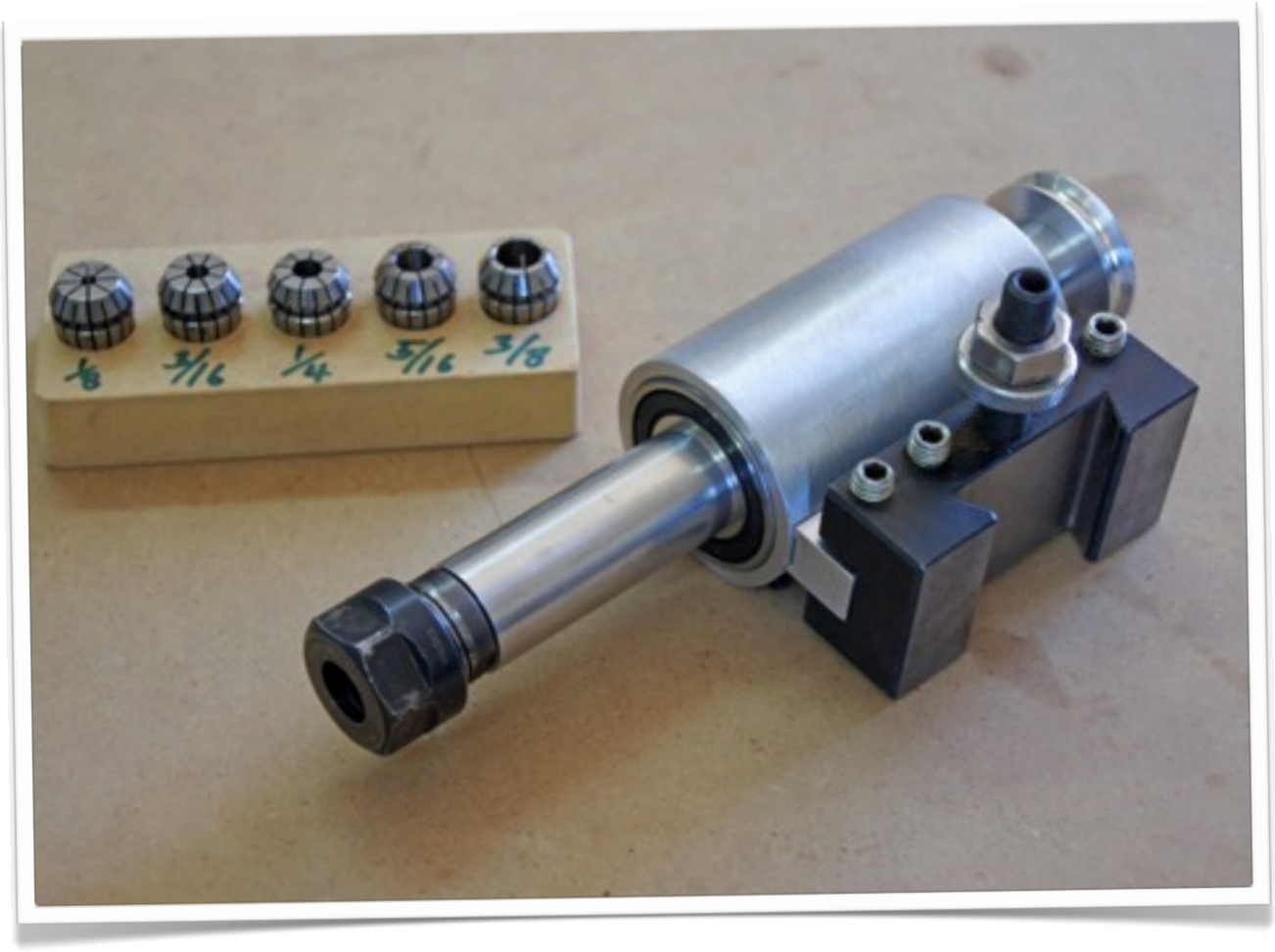
Precision Drill Frame Construction



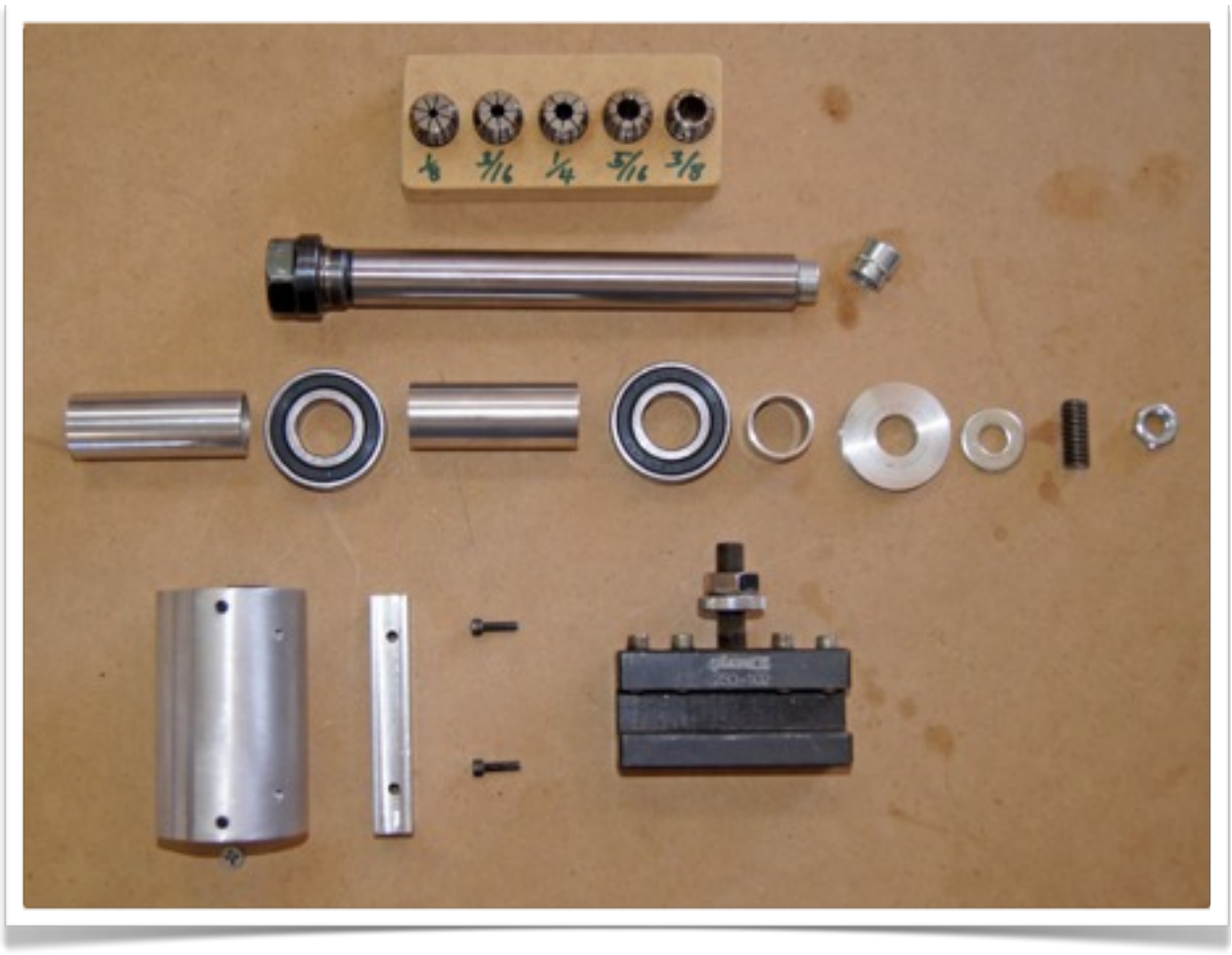
This article describes the construction of a precision drill frame (which can be used for an eccentric cutter) made from an ER16 extension chuck.

In the past, I used a modified Foredom 44T tool, but it had some limitations. First, the bearings on the Foredom are spring loaded. Under a heavy load (such as with an eccentric cutter) I got a lot of chatter as the tool is pushed back against the spring. Second, the collets in the Foredom are not very precise. If you use a pointed

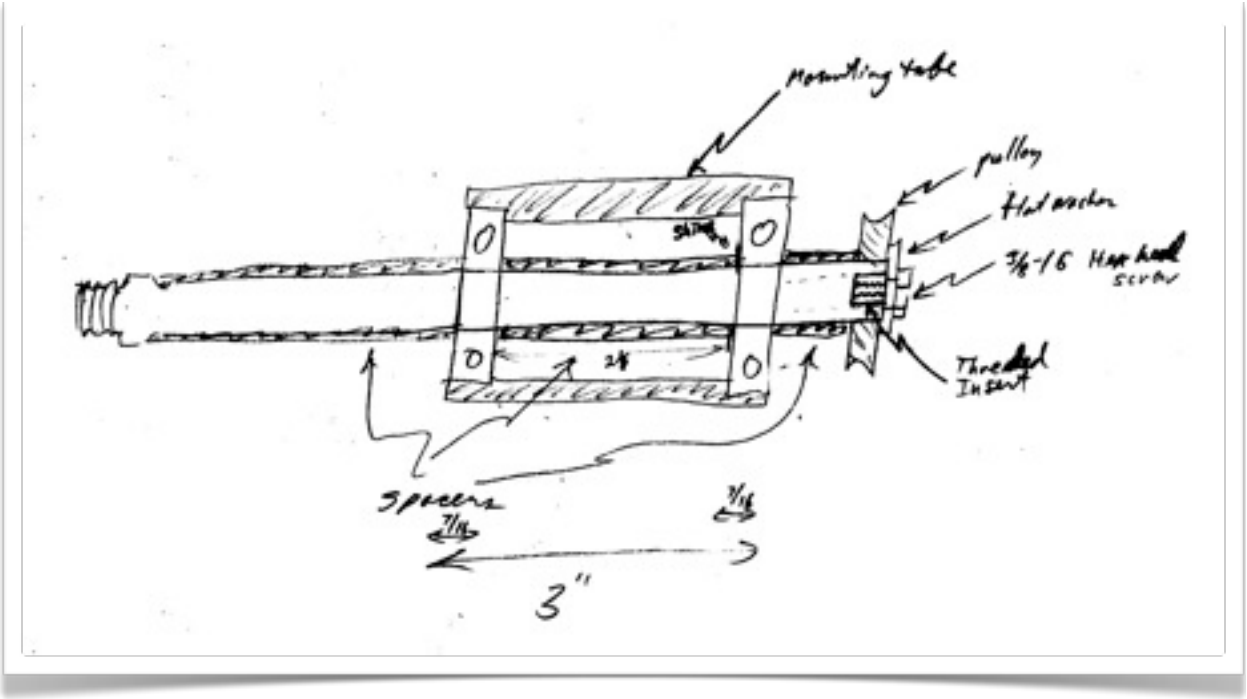
cutting tool, the shape of the cut is such that the bottom of the cut is not a sharp point as a result of the tool wobbling (i.e. it's not running truly concentric with the shaft). Third, I couldn't mount a 3/8" shank cutter that I prefer to use for cutting threads.

I bought a used ER16 extension on eBay for $34. This is an American-made Kennametal extension with a 3/4" shank that is 6" long. You can buy cheaper Chinese-made ER16 extensions at a low price, but I was concerned about the accuracy of the cheap pieces. It would have been nicer to have a smaller diameter shank (so the bearing would be smaller).

The photo below shows all the pieces that I made to put this together:



My hand-drawn plan is shown below:

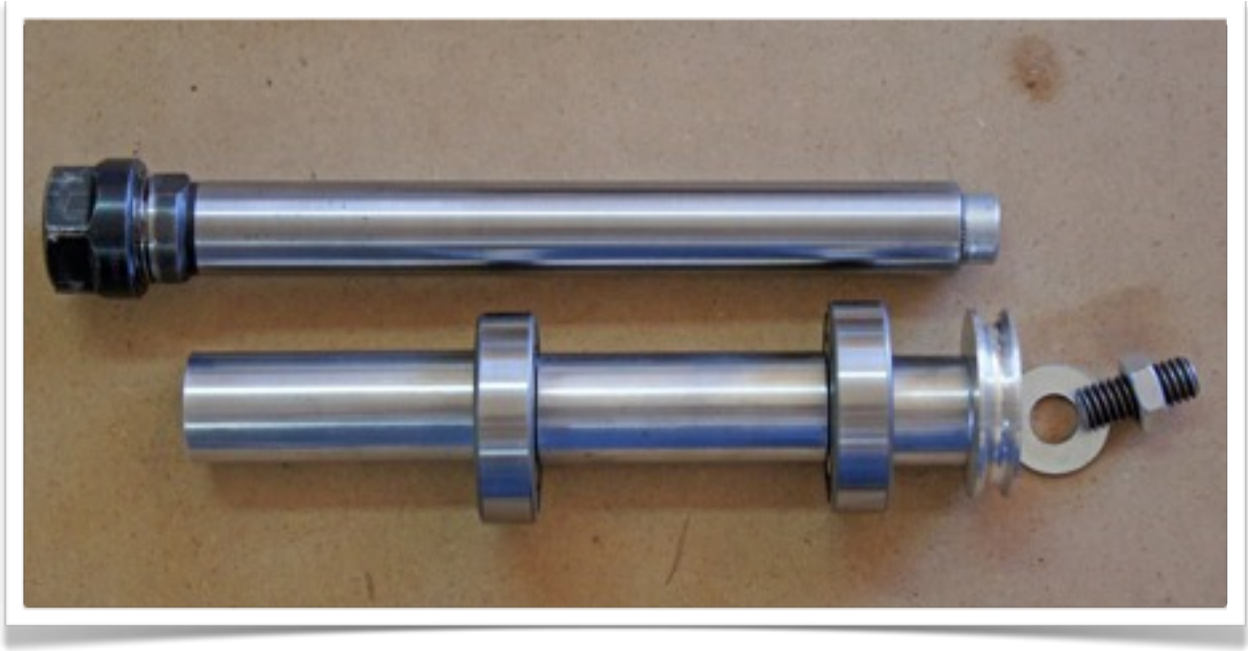


First, I press fit a threaded insert into the end of the ER16 extension (McMaster Carr #95185A330).

Then I made a pulley that mounted on the threaded insert so that I can use my overhead drive to power the drill frame. I lapped the

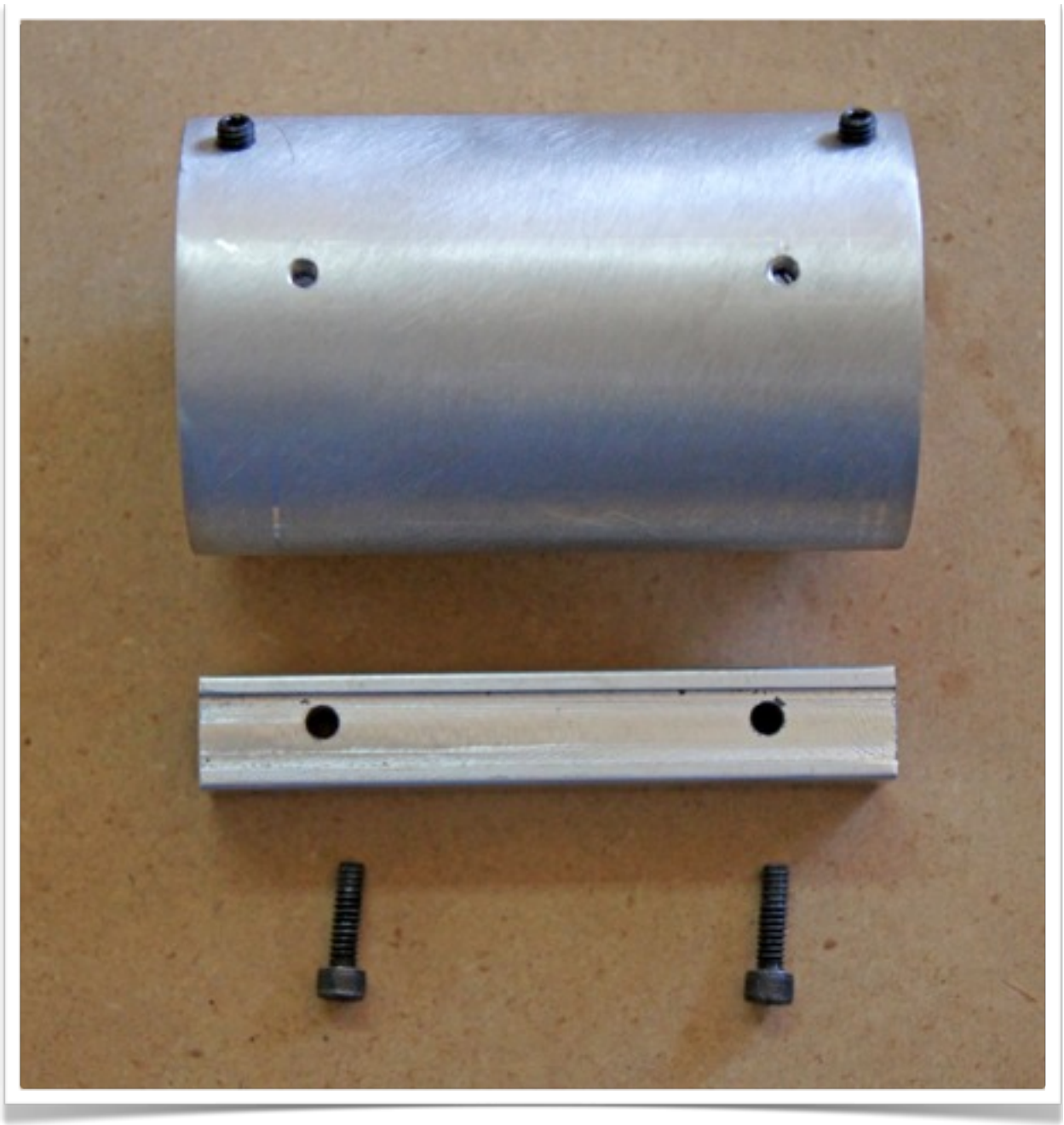
outside of the ER16 extension so that the bearings would slip easily over the shaft. I'm using spacers between the bearings, so I don't need to press fit the bearings onto the shaft. The bearings are McMaster Carr #60355K706 which have an outside diameter of 1-5/8". This is a bit large, but it's the smallest standard bearing for a 3/4" shaft. (If you had a smaller diameter shaft, you would use smaller bearings).

I cut the spacers from 6061 Aluminum tubing that had ID=0.759" and OD=0.875" (OnlineMetals.com). The spacers were cut then trimmed to length on my mini-lathe. Adding a flat washer on the end with a piece of 3/8-16 screw and a nut will hold the assembly together:



To hold the bearings, you could start with a solid piece of metal, but that's a lot of work. Instead, I used a piece of 6061 Aluminum pipe (schedule 80, ID=1.5", OD=1.9", 0.2" wall, from OnlineMetals.com). In the mini-lathe, I enlarged a recess in each end for the bearings. Ideally, you would want to use a boring head to get a tight tolerance and press-fit the bearings into the end. But I don't have a boring head, so I just got close and used a small set screw to keep the bearing from rotating. This is bad practice (but I'm not a machinist, so I still sleep well at night).

To mount the unit in the quick-change tool post, I used a piece of 1/2" x 5/8" 6061 Aluminum. On the edge, I milled a slot so that it would give me a stable fit to the outside of the round pipe and attached with 2 screws:



Pre-load on the bearings can be handled several ways. You can gradually trim the internal spacer to a point where tightening the end nut gives you the pre-load. If you take off too much, then you can add shims at the end of the internal spacer. Alternately, you can set the pre-load with the end nut in which case you will need a second locking nut (and you'll have to have a key between the pulley and the shaft or a set screw in the pulley).

There was one final problem which had to be addressed. On my ornamental lathe, the height of the tool post was such that the center of the drill frame was too high. This is because of the large diameter of the outer pipe. Fortunately, I only had to trim a bit off the outside on the bottom to allow me to set the height on center. (You may have wondered about the flat in the preceding photos).

Also, I've noticed that the double sealed bearings that I used don't turn too freely. I may try changing out the bearings to open or double shielded.