# Truing the Tailstock of a Mini-Lathe

The mini-lathe is a reasonably priced machine tool that is often under considered. Getting the tailstock properly aligned can be challenging. As one of the next steps in my modification plan is to add a taper turning attachment, I prefer to have a fixed tailstock. This paper will walk you through making this modification to your lathe (mini or otherwise).

## Preparing the Gauge Bar & Work:

The first thing step is to have a gauge bar that will allow you to verify the alignment of your bed and control the alignment of your tailstock. The components are simple: an appropriate collet (#3 Morse taper X ø.500 for most mini-lathes) and a matching piece of drill rod. [I show a toolholder here as I had one left over from some NBS work I did. You pay dearly for accurate toolholders, so collets tend to be the better choice.] The drill rod is cut to a length such that, when mounted in the tool holder, it will extend an inch or so past the end of your lathe bed.

Photo of a Gauge Bar

You will need adapter bushings to align the bore of your tailstock to the gauge bar. They will need to be a very close slip-fit to your gauge bar (+.001/-.000) and a fair wringing fit to the ID of the bore in your tailstock. I have found that starting with a very light press-fit between the bushing ID and the OD of the gauge bar and then lapping the fit using 600 grit lapping compound gives me the easiest way to assure a good fit.

Photo of the Alignment Bushings

As you disassemble the tailstock of a mini-lathe, you will find tapped holes that span the interface edge of the insert disk. Mark the alignment of this **before** you tap it out. This **is** the voice of experience! It is somewhat of a pain to realign the tapped holes, but if you know which one aligns where, you have a great advantage. The rest of the reassembly job is merely tedious.

Once you have taken care of the marking, remove the upper portion of the tailstock from the guide foot and layout (approximately) .200 inch (5 mm) *lips* around the edges of the interface between the upper and lower portions of the tailstock. You need to mill a pocket at least .025 inch (0.6 mm) deep to allow the epoxy a place to work. Verify that you have at least .025 inch clearance around the alignment guide in the tailstock foot casting. Epoxy expands a bit as it cures and without this clearance, you can be in a world of hurt.

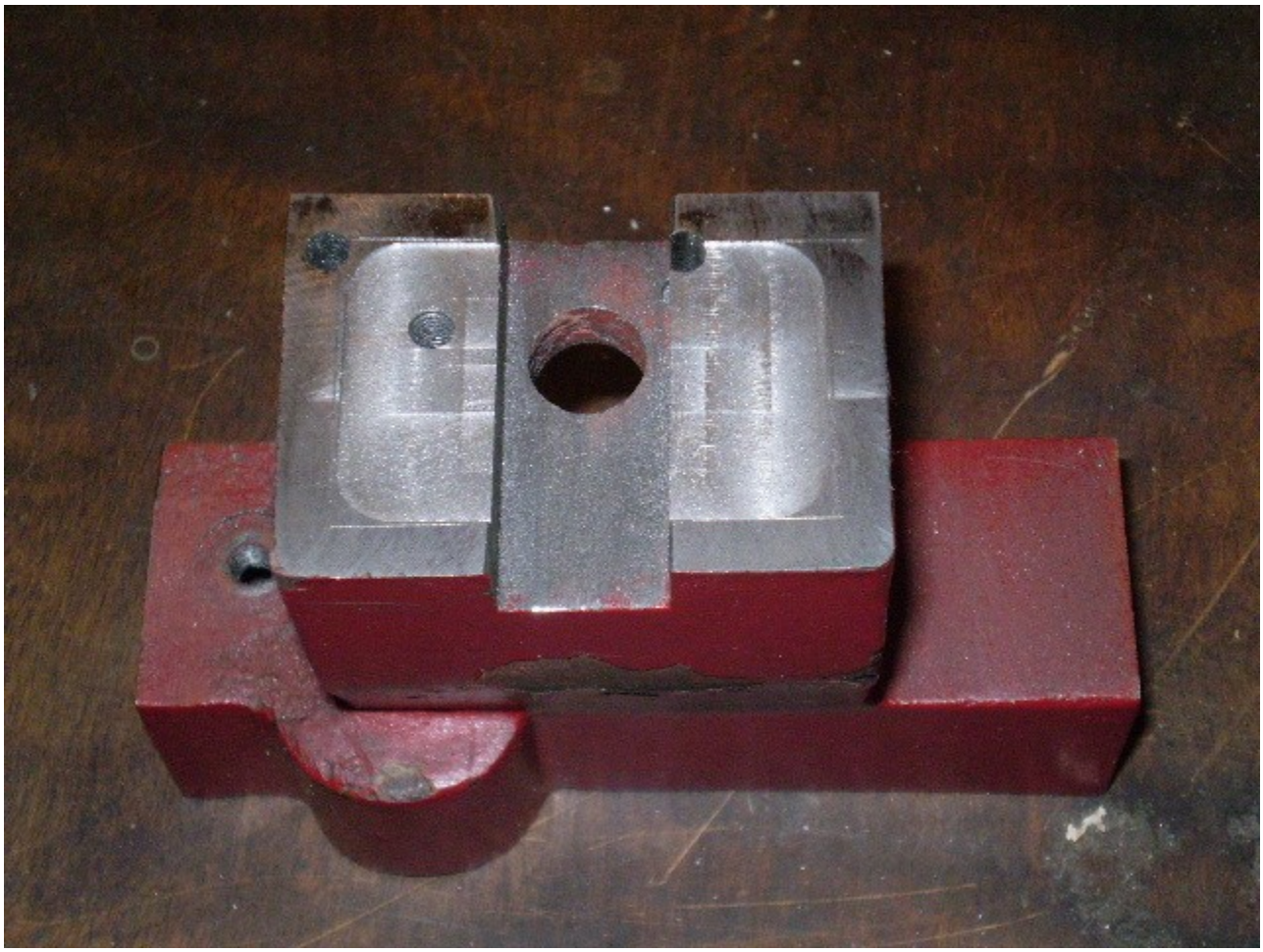


Photo of Epoxy Expansion Allowance in the Tailstock Base

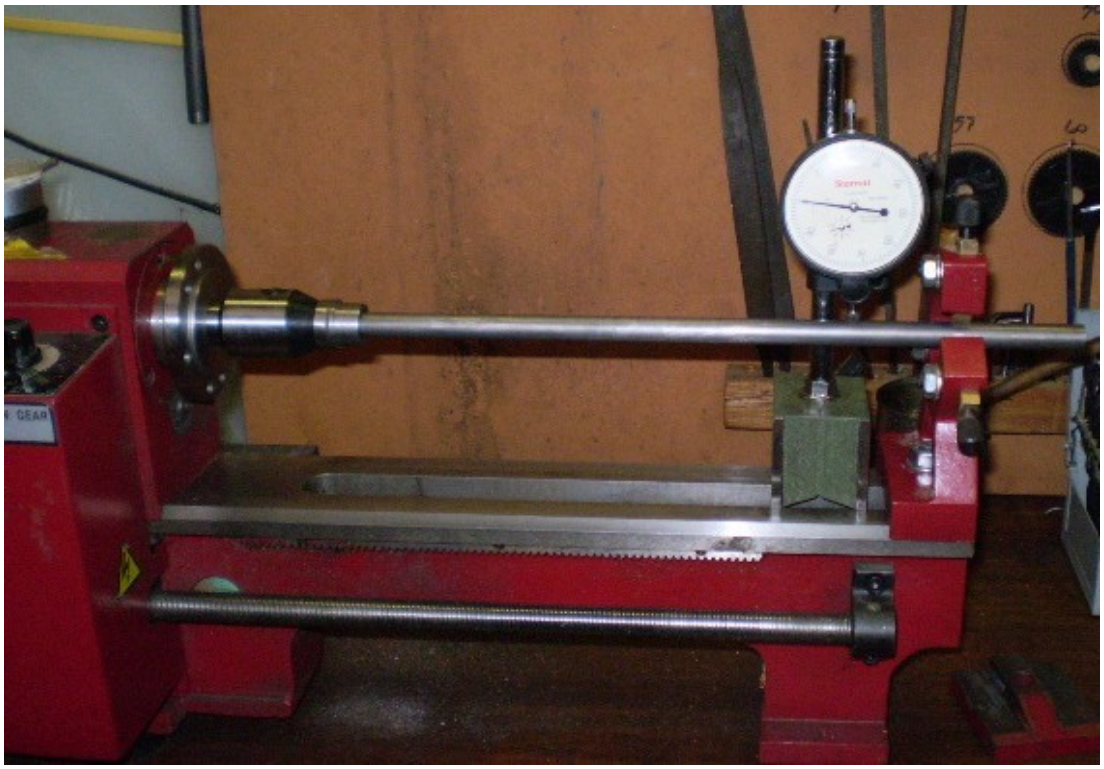
Clean up after machining with acetone and etch with acid (vinegar will work, but muriatic acid works a bit better) and neutralize the acid with baking soda. This will make the epoxy bond stronger. You will need to do the same thing to the top of the tailstock foot later.

## Setting-Up the Gauge Bar:

Before you proceed, take an appropriate set of files and stones and make sure that the bed of your lathe has no *dings* or *burrs* that will affect the use of dial indicators and magnetic bases. Even a very small burr or surface ding can throw off your readings as you move a dial indicator around. This **is**, once again, the voice of experience speaking.

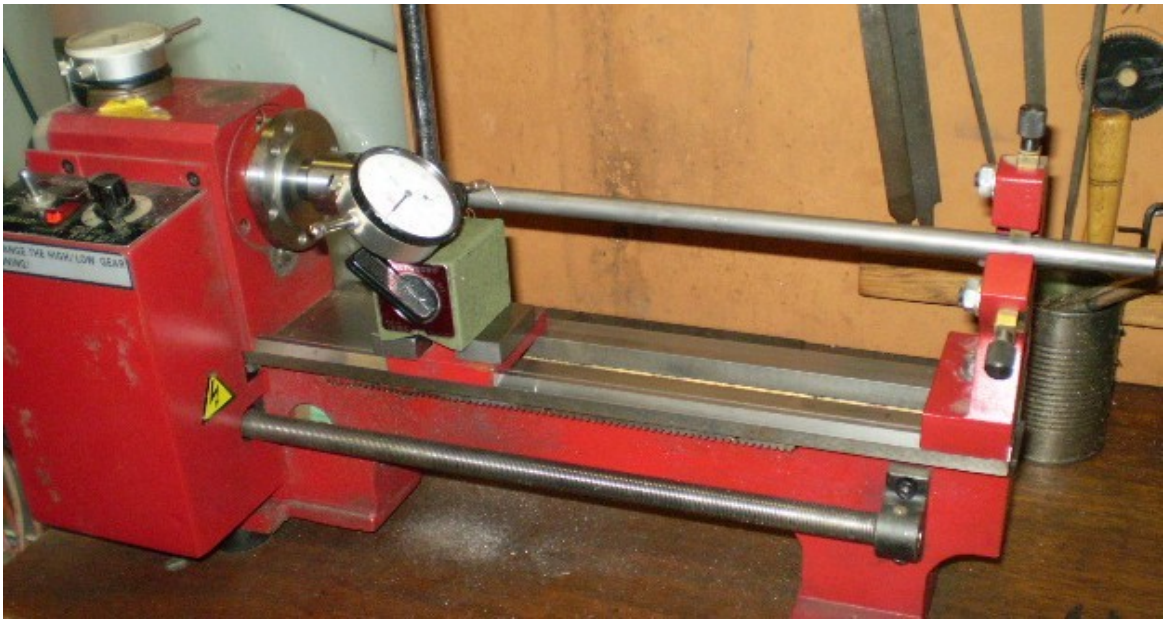
Firmly seat the toolholder end of the gauge bar in your spindle. Support the outboard end using your steady rest. Start by mounting a good dial indicator on a magnetic base and level the gauge bar down

the length of the bed as shown in the photo below. Use a broad, flat foot on your indicator to be sure that you are always contacting the *top* of the gauge bar. Please note that I have installed the *inboard* adapter bushing and left it on the gauge bar. This will prevent a screw up later when everything is coated with epoxy.



Gauge Bar Installed in the Lathe for Vertical Alignment Check

When you have only a few *tenths* of movement in the vertical attitude, set-up you can change set-ups to check the horizontal alignment as shown below.



Gauge Bar Installed in the Lathe for Horizontal Alignment Check

Please note that a pair of steel bars are used to interface between the magnetic base and the foot of the tailstock to bridge the alignment bar in the foot casting. Also note that I am using a 60° offset foot on my dial indicator to be sure that I am always touching the side of the gauge bar. This is where having a set of magnetic bases and dial indicators is a real time saver.

Adjust the end position of the gauge bar using the (two) lower jaws of your steady rest until there are only a few *tenths* runout as you move the dial indicator down the length of the bed. There is no point in "going for zero" at this point as you **will** have to repeat these steps several times before you get the alignment just right. Note: I find that using the "top" and "forward-lower" jaws as the primary control surfaces works best. I tighten the retaining nuts *snug* such that I can still move the jaws themselves with moderately strong hand pressure. The "back-lower" jaw is then used as a clamp to allow the steady rest to be removed when necessary.

Repeat this process until you have a zero-vertical and zero-horizontal runout in your set-up. Allow the set-up to sit for several hours before declaring victory. The heat from your hands **can** influence your readings. [Did you hear the voice of experience speaking there?] The gauge bar is now set-up.

## Setting the Tailstock:

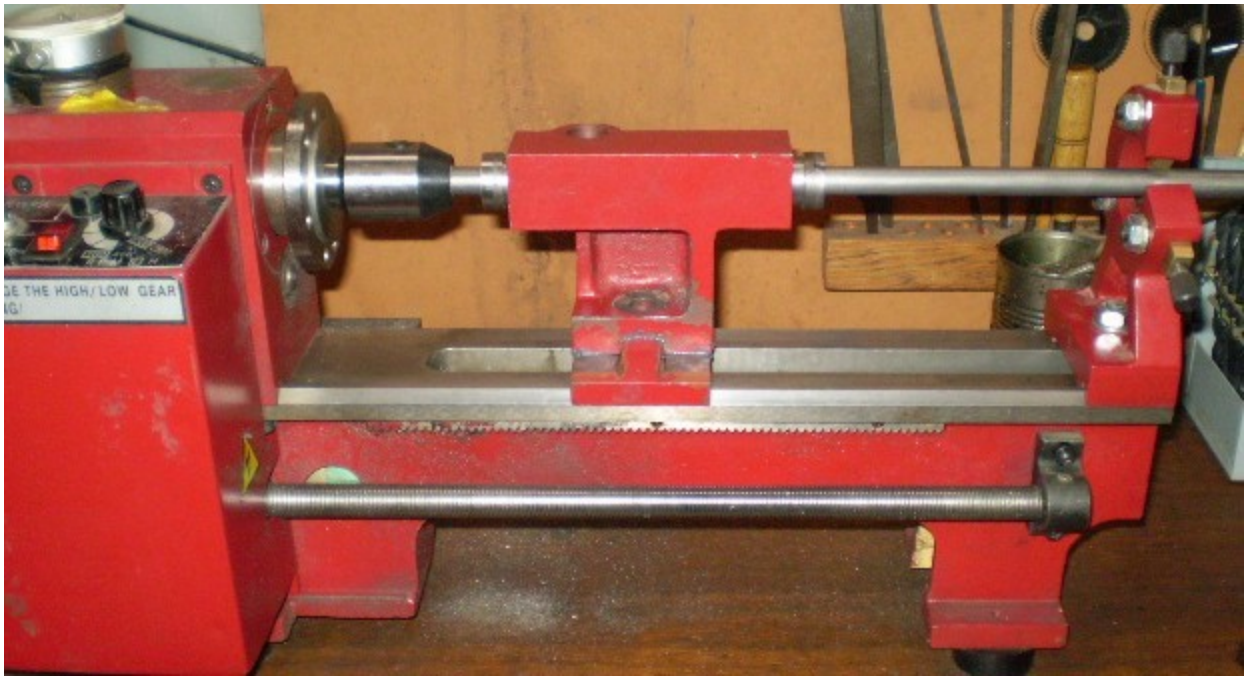
We are going to epoxy bond the upper portion of the tailstock to the tailstock foot. As noted above, you need to acid etch the bonding surfaces and neutralize the acid with baking soda. You will want to use a slow-cure, high strength epoxy for this work. 3M's 2216(A/B) is the industry standard. Retail hardware stores and home centers rarely carry this class of epoxy. Industrial supply companies are usually your best bet. Be sure to read and follow the instructions provided by the manufacturer. You will have only about 45 minutes from the time you **start** mixing the resin and hardener to complete positioning the components, so set a kitchen timer so you don't screw up here.

A thick, paste-type 5-minute epoxy should be used to fill the original socket head cap screw slot and clamp-screw clearance hole in the top of the tailstock foot. Waxed paper will help you keep this neat

so you aren't chasing pools of epoxy all over your bench. If you do not do this, epoxy will leak all over everything. Allow this to cure for at least one hour.

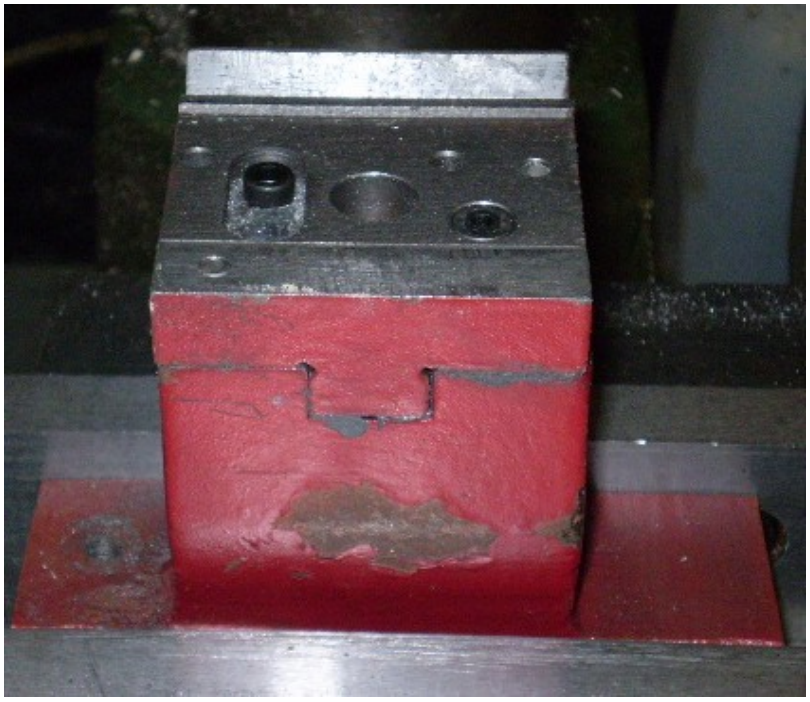
Loosen the *clamping jaw* and remove the steady rest. Wax up your lathe bed to prevent any squeeze-out epoxy from sticking to it. Place the outboard adapter bushing close to hand. Place rags and the bottle of acetone near to hand. Orient the body and foot of the tailstock so you are clear as to their installed orientation. **Now** you can start mixing a small (2-3 teaspoons) portion of epoxy.

Coat the base of the body of the tailstock with an even coat (call it .040 inches or 1 mm thick) of epoxy. Lightly assemble the body to the foot of the tailstock leaving an obvious gap. Slide this over the gauge bar and position it near the headstock end of the lathe. Carefully insert the inboard & outboard adapter bushings into the bore in the tailstock head. Clean up any epoxy squeeze-out. Slide the tailstock from end to end along the gauge bar to be sure that all your alignments are good. Clamp the tailstock foot to the bed of the lathe with a small C-clamp. Wait at least 24 hours before removing the epoxied tailstock from the bed of the lathe.



Tailstock Aligned and Bonded

Epoxy is good stuff. Don't get me wrong. But you need more than mere epoxy to hold this alignment. Screws and dowels do that.



Screwed & Doweled Tailstock

I added (2) dowel pins at diagonal corners of the assembly. Used a (#10-24 X ¾ long) socket head cap screw in place of the M5 screw supplied, and added a (#10-21 X ¾ long) flat head socket cap screw to complete the attachment of the tailstock body to foot. This will assure a solid fixivity (dowel pins) for the assembly and (screws) good positional clamping. It is best to insure that the dowel pin holes have access from the main body side of the tailstock as they may not be (easily) removed otherwise.

Take your modified tailstock and reinstall it over the gauge bar on the lathe. Reinstall the steady rest and check the vertical alignment using your dial indicator set-up. Side-to-side verification can only be done when turning a part unless you make a second *foot* to key from your bed (inverted vee) guide. If you have done this work carefully, you should be able to hold a diameter within .0005 inches (0.013 mm) over the full length of travel without significant effort. I have held as close as .0003 inches (0.08 mm) over a 6 inch (127 mm) long part.

I hope this helps you enjoy your lathe!

## Coming Attractions:

An Improved Tailstock Camlock Clamp

A Taper Turning Attachment