

Tramming a Square Column Benchtop Mill

– one user's experience and suggestions

The first step in this process is to run some alignment checks to get an understanding of how the mill is currently set up and aligned. The following link is to a video that goes through the best practices techniques for checking the mill tram and the relative alignment of the column and the quill movements.

<https://youtu.be/kF3Lp3W-Ec>

The movement of the head and the quill must be in alignment with each other to attain tight tolerances. Follow this example:

You square up a piece of material with the head at a low position – we'll call that Position A. Then you move the head upward 4 inches to accommodate a longer tool such as a drill bit in a drill chuck to Position B. You want the drilled hole 1.000 inches from one corner in both directions. But the head has not only moved up, but also sideways and forward because the column is not properly trammed. Your drilled hole position is not precisely where you expect/want it to be. Additionally, if the quill movement is not perpendicular to the XY table, your hole will be one distance from each corner edge at the top and a different distance from each corner edge where it exits the material and thus not perpendicular to either surface. If you then put in a tap, lower the head again, and attempt to power tap the hole, the tap will be off center and will likely break a few millimeters into the drilled hole.

Before you begin, make sure the dovetail gibs on the head-to-column and both X and Y directions on the table are properly fitted. Pull out the gibs, stone them and check for flatness, then reinstall and adjust the gibs so the surfaces move but exhibit minimal slop when force is applied. If you really want to go all out here, you will clean the dovetail and gibs, blue up the gibs and check the fit that way. Depends on the level of precision you are after. But the point is to start by making sure the dovetail surfaces and gibs are properly fitted. You don't want to start screwing with the column alignment, then discover the head-to-column connection is sloppy because of loose fitting gibs. Example videos that illustrate using indicators to check gib fit [are here](#).

The next step is to tram the column. This can be checked with a granite or machinist square on the XY table and indicating from the head to the vertical square face and moving the head up/down. Adjustment is done by breaking the column to base connection and shimming. Be sure to check column alignment in both X and Y axis directions and shim accordingly. And consistently lock or leave loose the head-to-column connection. I prefer to move the head, lock it with the provided levers, check the indicator, move/lock/check again. A quality head-to-column dovetail connection will alter head nod by 0.001-0.002" at the spindle end when the locking levers are secured – no more than that.

The process of aligning the column perpendicular to the XY table is not rocket science, but it is a tedious trial and error process that requires patience and a certain degree of mechanical aptitude to fully grasp the interactions between the head, quill, and column. For shimming the column, you will need access to some very thin shim stock to do it precisely. I use cigarette papers and aluminum foil for the final tweaking – 0.0003" level of adjustments.

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Below is an overview of the basic process and steps required.

1. Take the head off the column - it can rest on a shop-made saddle on the XY table. This photo illustrates a shop-made saddle to hold the head.



2. Remove the bolts that secure the column to the machine base, break the seal, clean up the mating surfaces and the fasteners. On some square-column mills, the bolts are easily accessed from above the machine, while on some mills, the bolts can only be accessed from under the main machine base.
3. Reassemble the column to the machine base, leaving the bolts loose, and reinstall the head.
4. Make changes to the column tilt first by adding shims between the bottom of the column and the machine base. This is an interactive trial and error process, selectively adding and removing shims, each time locking down the mounting bolts and testing the alignment. It can take several hours to get this right, and the shims required will at times need to be as thin as 0.0003" (the thickness of cigarette papers).

Then turn your attention to the nod - same process of trial and error with shims. When working on the nod, you must verify that the shims that are added or removed fix both the nod and do not cause the column to tilt off-axis again. The entire process can be done in about 8 hours if you have the tools and the necessary shim material on hand. This video is an excellent resource on making the tram alignments: <https://youtu.be/ftlXXKZKUyI>

If you wanted to do this the professional way, here is a link to a video of how to approach it - this is the technique I use, but the first few machines I did I used shims and I would not recommend the following process as your first attempt. <https://youtu.be/U7Qs-J2swlc?si=oXPgKzgWSZ3CYndb>