

Application Note 2

Machine Tool Alignment

Boring Mills, Gantries, Machining Centers, VTLs

System Recommendations

L-743 Machine Tool Alignment System

How the Alignment System Works

The following section describes how the laser is used to measure straightness, flatness, squareness, levelness and parallelism on a 6-axis horizontal floor mill. Note that if a machine is going to be aligned, rather than just measured, it is important to put the laser on an instrument stand. If the laser is on the machine bed or table, adjustments will likely move the laser and affect the setup.

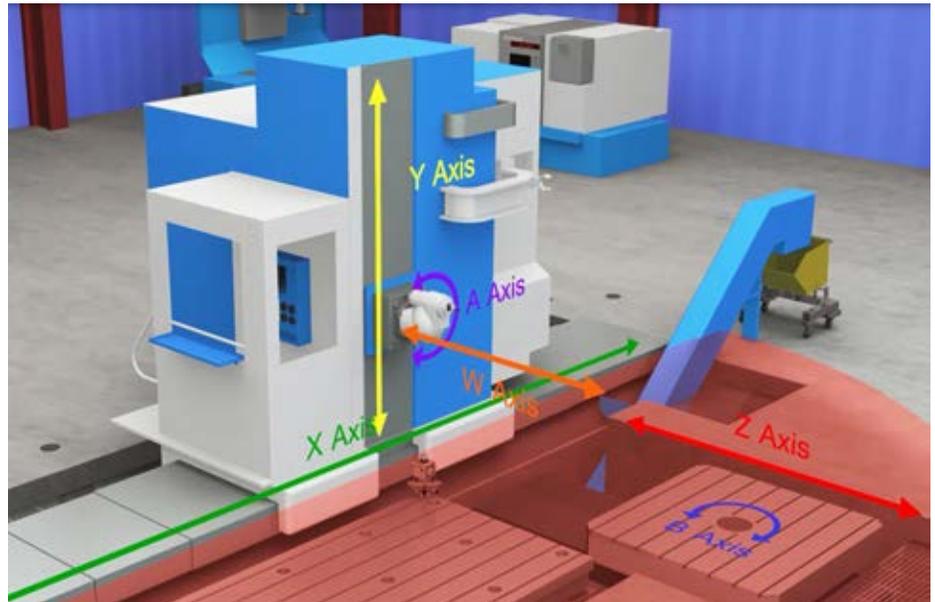
Setting Up (Bucking-in) the Laser

When setting up the laser to measure either straightness or flatness, you must first position the laser plane(s) so that they are parallel to the reference points on the machine. This process is called "bucking in" the laser. To speed up the setup process, the use of 3 reference targets is highly recommended.

- For measuring straightness, 2 reference points are needed.
- For measuring flatness, 3 reference points are needed.
- For measuring the flatness, straightness and squareness of a machining center, 5 reference points are needed.

In this procedure, we'll use 3 targets for the initial 3-point setup and one target for the 2-point setup.

Once the laser has been set up to its reference points, the targets can be repositioned to measure the various surfaces or lines of motion for deviation from the references. A plus (+) reading indicates a target is higher than the reference points, and a minus (-) reading indicates it is lower.

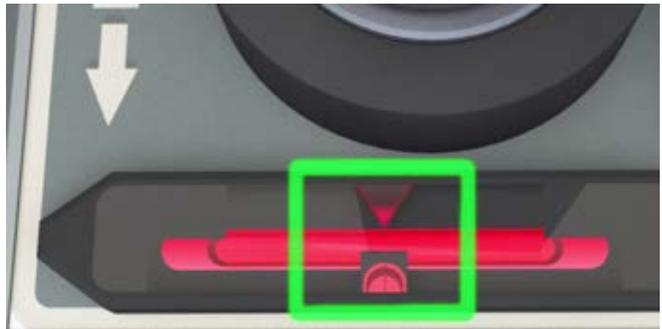


Procedure

1. Place the laser on the table at a spot that provides the ability to measure all the axes from the same setup.



2. Level the Pitch-Axis level via by using the coarse and fine adjustments to line up the edges of the bubble. Repeat the process with the Roll-Axis level vial. Now the red laser plane is level to earth



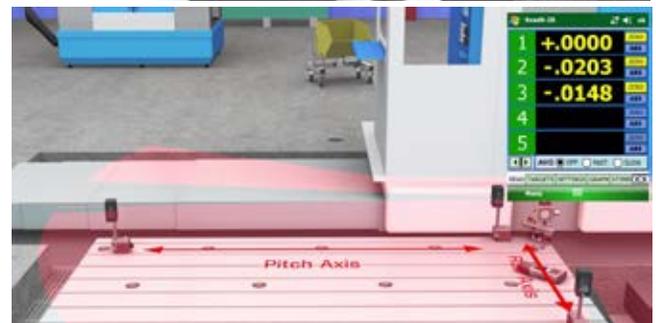
3. Place Target #1 at a location next to the laser and mark the outline of the magnetic base for good repeatability. Point the laser at the target window and adjust the target height until the laser beam is centered.



- Turn on the laser rotation (which also turns on the targets). Target #1 data displays in the Read9 software on the PDA. Zero the display. Remove Target #1 and replace it with Target #2. Zero the Read9 display for Target #2. Repeat the process for Target #3.



- Spread out the targets on the table on three reference points, two along the Pitch Axis and one on the Roll Axis.

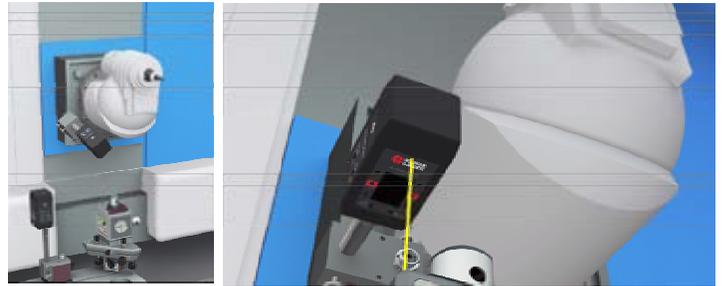


- Looking at the data for Targets #1 and #2, adjust the Pitch-Axis knobs on the laser until the two values are equal. Switch to Targets #1 and #3 and adjust the Roll-Axis knobs on the laser until those two values are equal. Now the target values for all three targets are equal and the laser plane is aligned to the table.

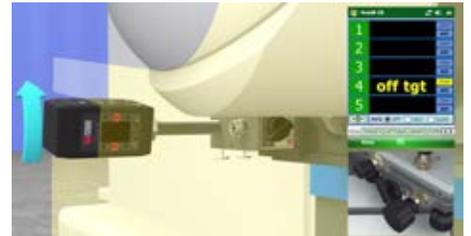


Aligning the Laser to the X-Axis Travel

1. Mount Target #4 on the ram, move the spindle and adjust the target height.



2. Power on the laser and zero the target in the Read9 PDA. Move the column down to the end of the X-Axis travel and rotate the target head to point towards the laser.



3. Turn the Yaw-Axis adjustment knob to center the laser to zero on the target.



4. Return the column to its starting position and rotate the target toward the laser. Zero the target.



5. Send the column back to the far end of travel and tweak the Yaw-Axis adjustment knob to zero the laser.



6. When the target reads zero at both ends, the laser is aligned to the X-Axis.



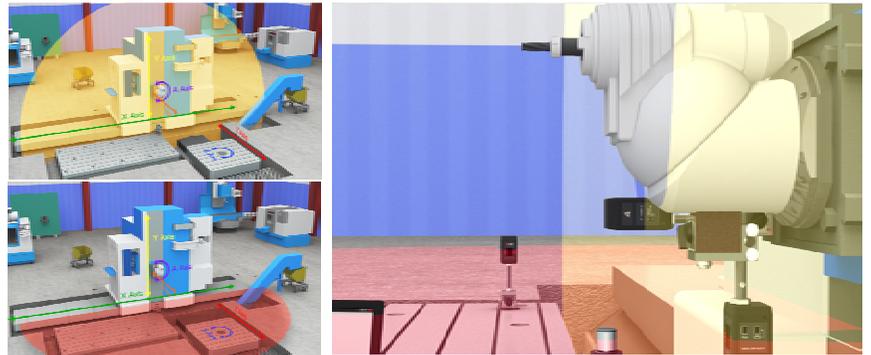
Measuring X-Axis Straightness and Flatness Simultaneously

The straightness and flatness for X can be measured simultaneously by adding a second measuring target to the bottom of the spindle ram. The targets come with a 3-piece post set, so a shorter post may be used to adjust the target height to pick up the red laser.

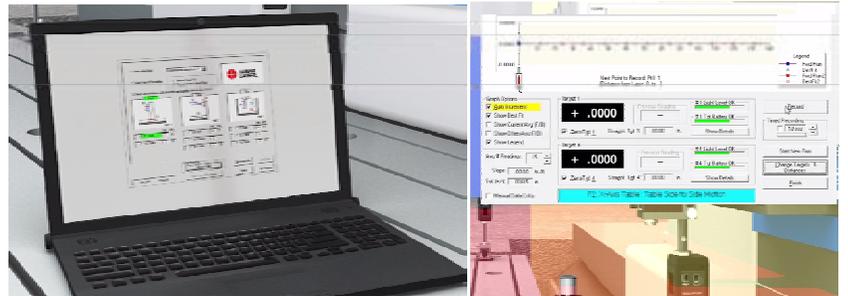
1. Attach a second measuring target to the bottom of the spindle ram with a short post. Adjust the target height to pick up the red laser.



2. Turn on the rotation for both laser planes. The Gold Laser (top left) measures X-Axis Straightness and the Red Laser (bottom left) measures Flatness.



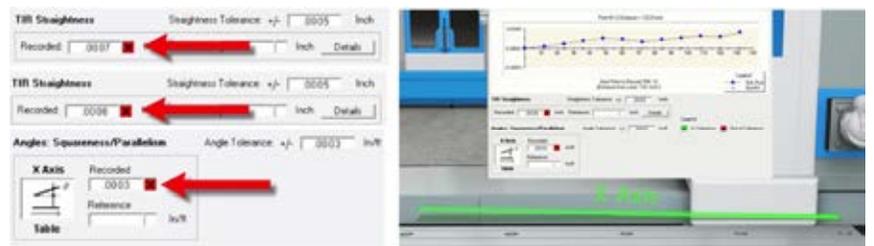
3. The target readings are sent wirelessly to a laptop computer, where our Machine Tool Geometry software records them. Select the axis, enter the length of travel and number of points, and ensure the targets are pointed at the laser. Hit the **RECORD** button and the Machine Tool Geometry software records both targets' data simultaneously and plots out straightness.



4. Continue to move the column to each point and hit Record. After the data has been taken, return the column to the home position.

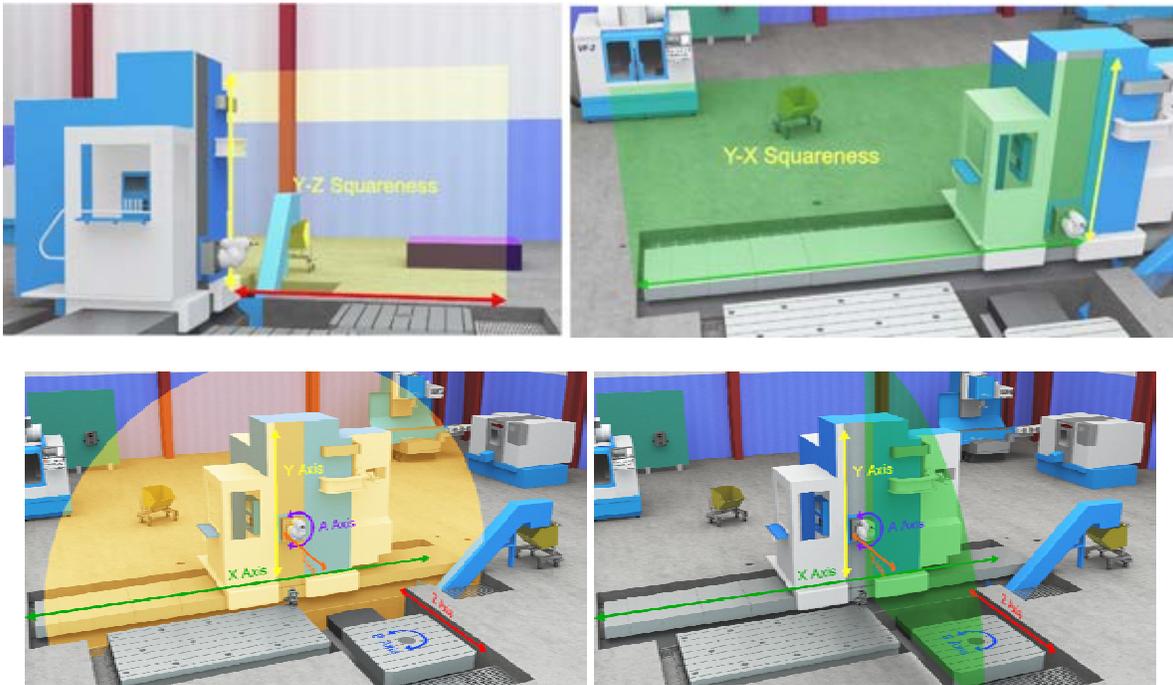


5. The X-Axis results show a Straightness error of .0007" TIR and a Flatness error of .0006" TIR. The slope of the Best Fit line is .0003 in/ft, which means the X-Axis is sloping UP relative to the table.



Y-Axis Flatness and Straightness and Y-Z / Y-X Squareness

After measuring the Y-Axis flatness and straightness, the Machine Geometry software calculates the Y-Z and Y-X Squareness. The Gold Plane (bottom left) measures Y Flatness and the Green Plane (bottom right) measures Y Straightness.



1. To measure the Y-Axis, move the second target to the side of the spindle and adjust the column and target height to center the laser in the window.



2. Turn on the laser rotation and zero the targets.

