Application Note 2

Machine Tool Alignment

Boring Mills, Gantries, Machining Centers, VTLs

System Recommendations

L-743 Machine Tool Alignment System

In the first Machine Tool Alignment application note, the following basic procedures for aligning a 6-axis horizontal floor mill were covered:

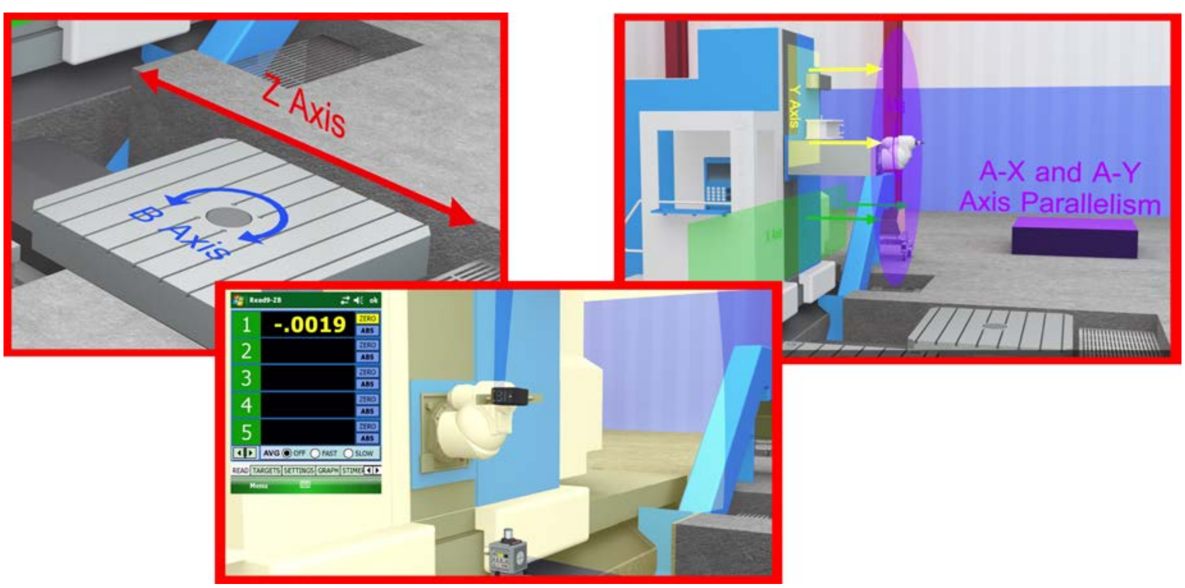
- Setting Up (Bucking-in) the Laser
- Aligning the Laser to the X-Axis Travel
- Measuring X-Axis Straightness and Flatness Simultaneously
- Y-Axis Flatness and Straightness and Y-Z / Y-X Squareness
- W-Axis Flatness and Straightness, W-Z (in X) Parallelism, W-Z (in Y) Parallelism
- Z-Axis Flatness and Straightness, Z-X and Z-Y Squareness, Z-W (in X) Parallelism, Z-W (in Y) Parallelism

In this application note, advanced alignment procedures are discussed, including the following:

Checking A and B rotary axes and tramming the spindle

- Rotation flatness of each axis
- Squareness and parallelism to main axes
  - A-X (in Z) Parallelism
  - A-Y (in Z) Parallelism
  - B-Z (in Y) Parallelism
  - B-X (in Y) Parallelism
  - Measuring the "tram" or squareness of the A spindle axis to X and Y

Please visit our website at www.hamarlaser.com for a complete system description with specifications and full procedural videos.



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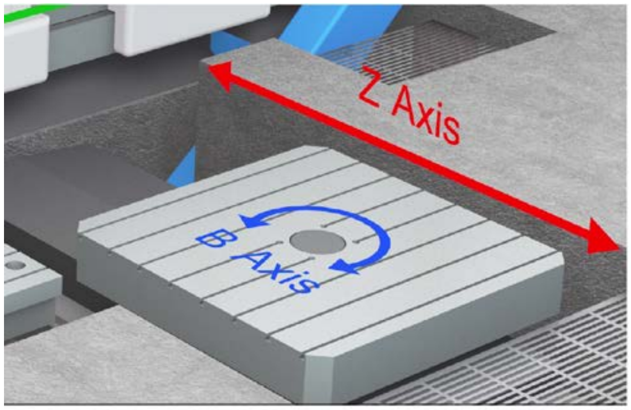
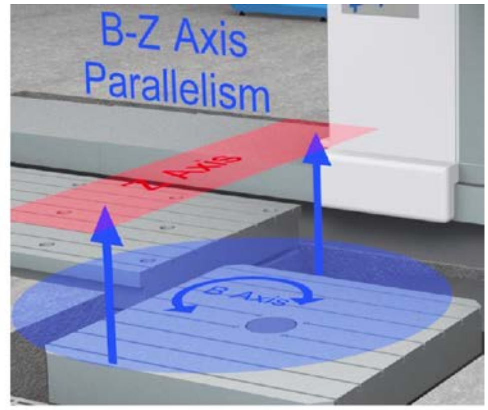
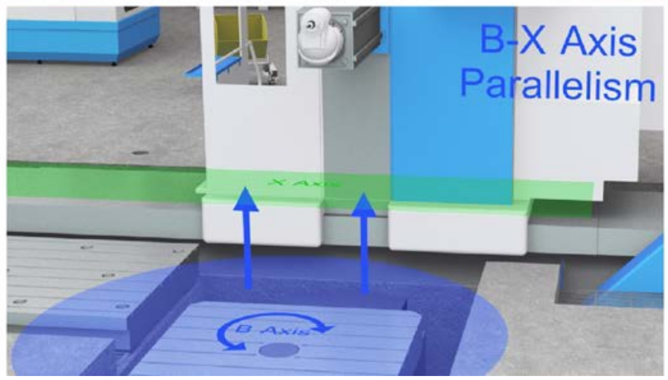
Checking the B-Axis Flatness of Rotation, B-Z (In Y) Parallelism and B-X (in Y) Parallelism

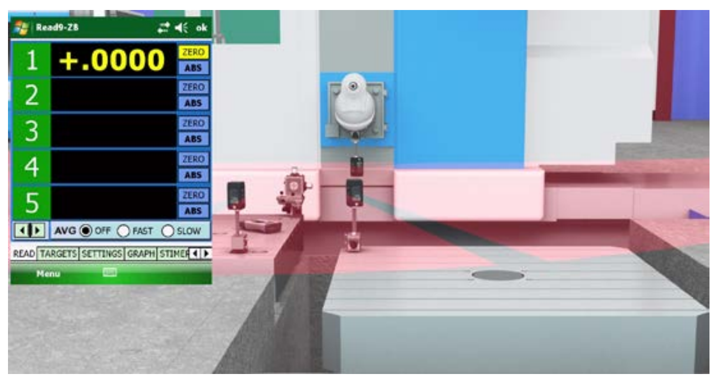
Please see Machining Center Application Note Part 1 for details on how the L-743 is set up on the floor mill. In part 1, we checked the flatness, straightenss and squareness of the X, Y, W and Z axes. In Part 2, we will continue the alignment check (assuming the laser is still bucked-in to the 5 points, as shown in Part 1) to show how to check the rotary axes for alignment.



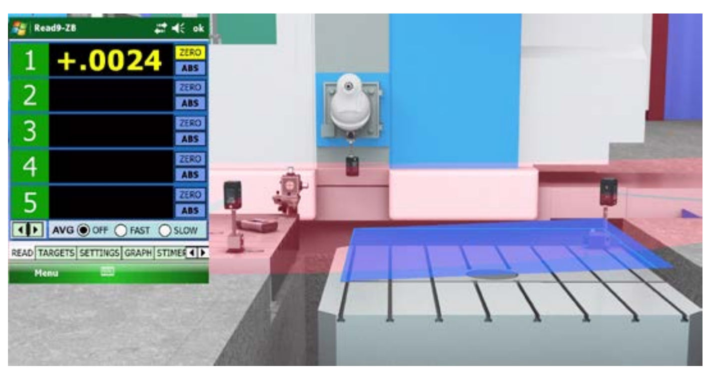




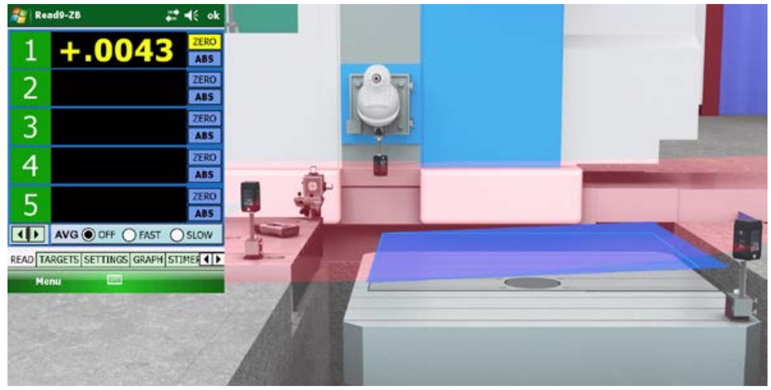
1. To check the B rotation, move the target to one of the corners of the table. Zero the display and then rotate the table 90 degrees.



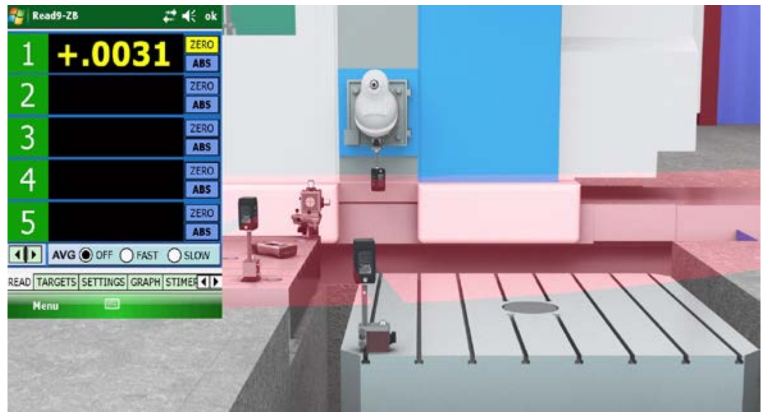
2. The display shows +.0024, indicating that the table rose by .0024 as it rotated. Therefore, the rotation plane is sloping up from left to right relative to the main table (recall that the main table was the reference for the horizontal red laser plane).



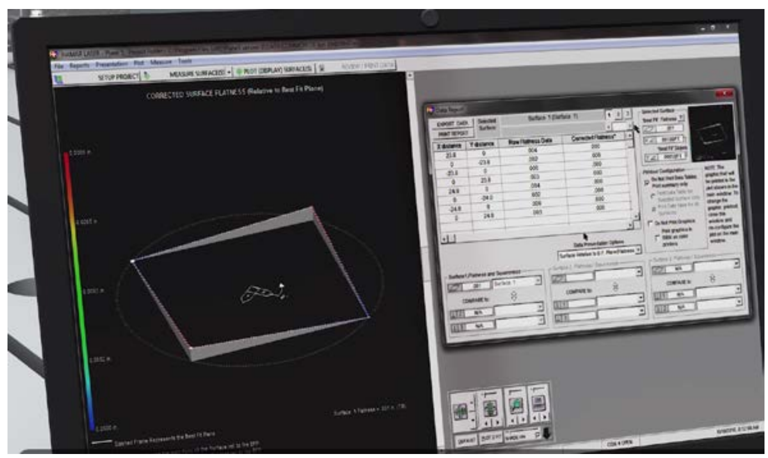
3. Again, rotate the table 90 degrees. The target now reads .0043, which is higher than the previous point and means the rotation plane is also sloping up and away from the spindle relative to the main table.



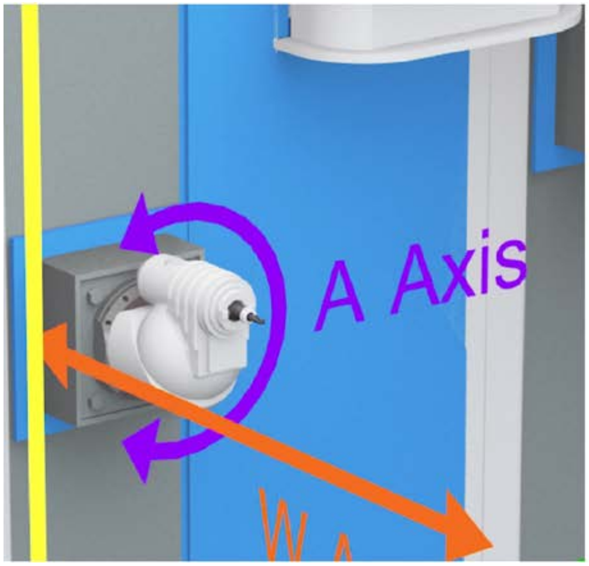
4. The last reading is .0031 and the data is uploaded to Plane 5 for analysis.

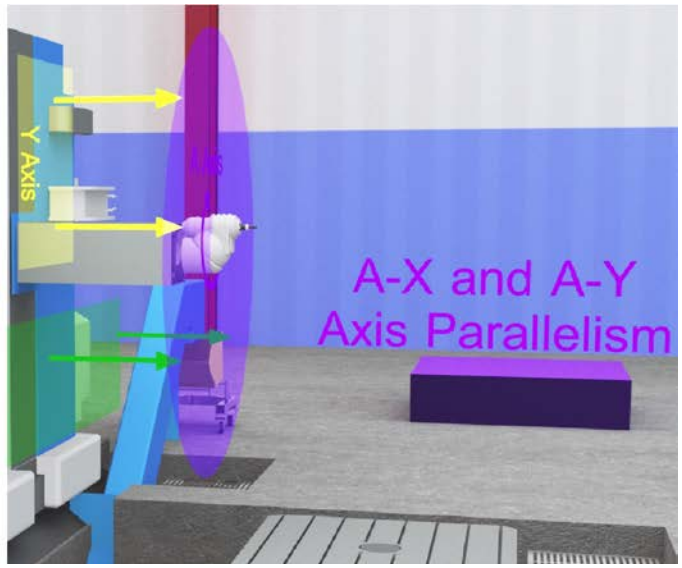


5. Plane5 analyzed the data and found that the flatness of rotation is .0010" TIR and the parallelism to X is .0011 in./ft. and .0002 in./ft. to Z.



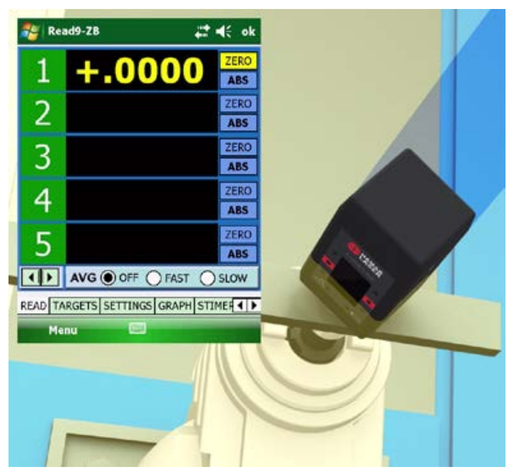
Checking the A-Axis Flatness of Rotation, A-X (In Z) Parallelism and A-Y (in Z) Parallelism



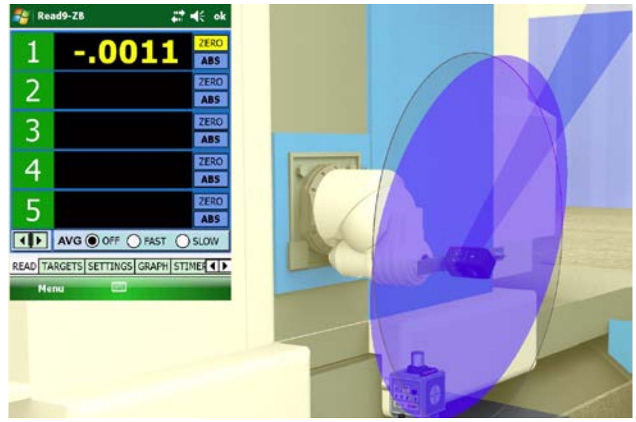


1. To measure the A rotation, we'll use the gold laser plane and a target mounted on the spindle. For both the A-Axis and the Tram measurements, a simple tram bar can be inserted into the spindle with a target attached.

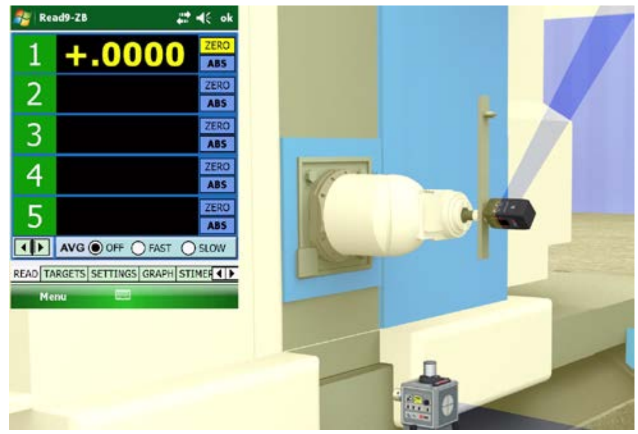
2. Adjust the ram and zero the target.



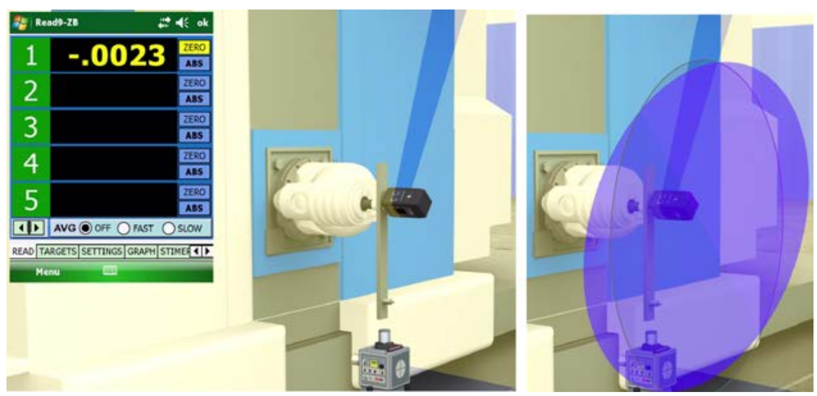
3. Rotate the A-Axis 180 degrees. In this case, the reading is -.0011, which means the A rotation axis is tilting forward relative to the Y-Axis by .0011 in 18 inches.
   Note: *In Steps 3 and 5, the purple ellipse represents the measured plane. The transparent ellipse behind it represents the reference plane.*



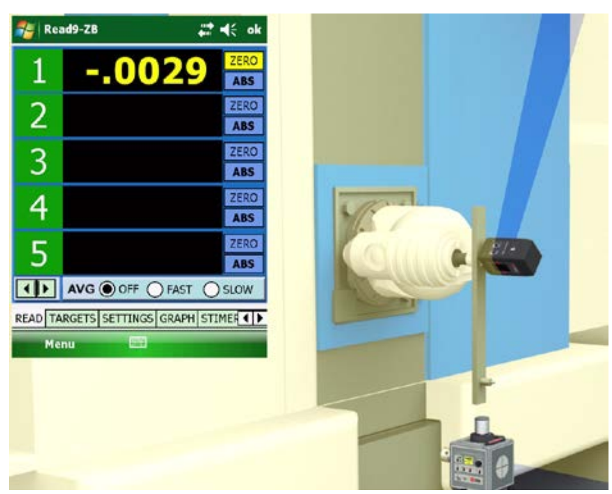
4. Rotate to 90 degrees and again, zero the target.



5. Rotate to 270 degrees. The reading is -.0023, which means the A rotation axis is tilting toward the X-Axis by .0023 in 18 inches.
   Note: *In Steps 3 and 5, the purple ellipse represents the measured plane. The transparent ellipse behind it represents the reference plane.*



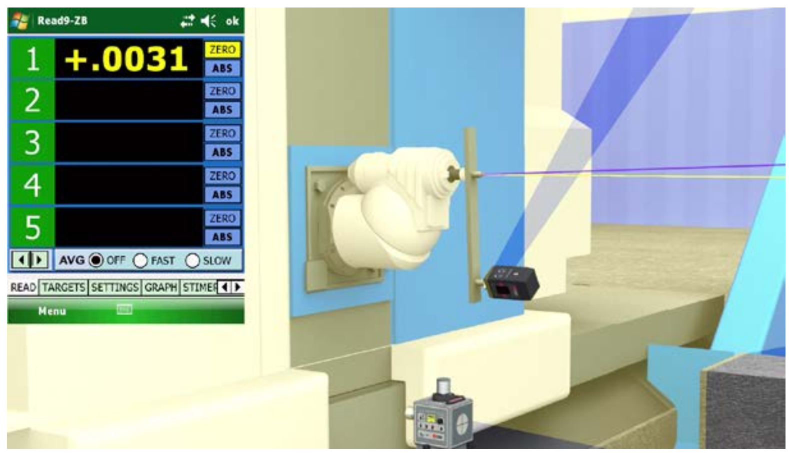
6. The last A-Axis check is to measure the flatness of the rotation. Take measurements every 45 or 90 degrees and use Plane5 to calculate the flatness.



Tramming the Spindle

1. To measure the "tram" (or squareness of the A spindle axis to X and Y), move the target to the end of the tram bar and rotate the spindle.

2. As with the A-Axis, begin at 0 degrees, zero and rotate 180 degrees. The .0031 reading indicates the spindle axis is pointed upward relative to the Y-Axis.



3. To compare to the X-Axis, start at 90 degrees and zero the PDA. Rotate to 270 degrees. The -.0019 reading indicates that the spindle axis is pointing to the left relative to the X-Axis.