

## Application Note 2

# Lathe Alignment

**System Recommendations**

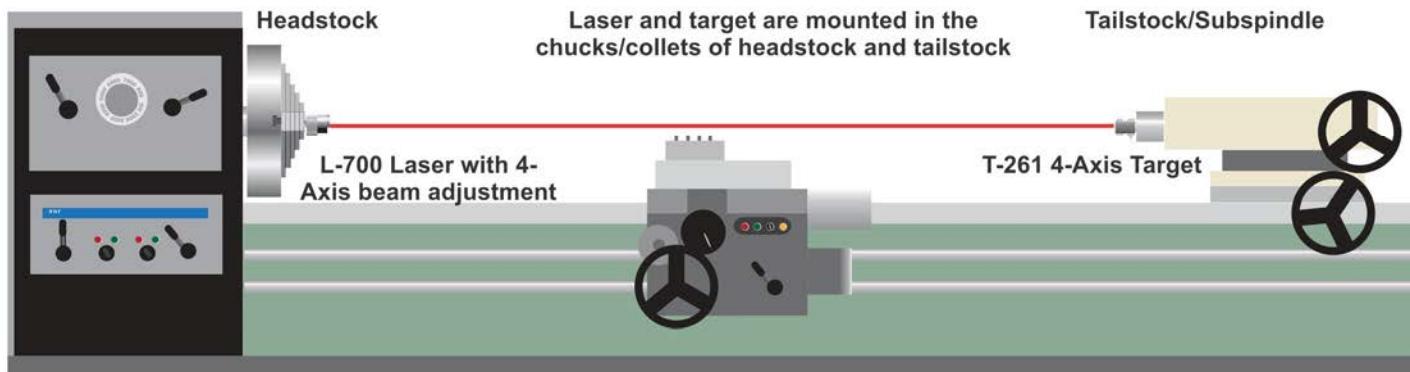
**L-700 Spindle Alignment System**

## How the Alignment System Works

The setup and use of an L-700 is quite easy and begins by following Lathe9's on-screen instructions to enter the dimensions, number of points, and tolerances. Next the laser is "qualified" or made co-linear (parallel and coincident), to the axis of rotation (AOR) of the spindle. Then Lathe9 measures the lathe bed for parallelism to the spindle's AOR. If out of tolerance, Lathe9 offers a live alignment screen to align the headstock to the lathe bed.

Once the spindle is aligned to the lathe bed, Lathe9 measures the headstock spindle alignment to the tailstock or subspindle following an easy 3 step process. If out of tolerance, Lathe9 offers a live 4-axis alignment screen to align the spindles horizontal and vertical centers (offsets) and horizontal and vertical angles. After aligning the tailstock, Lathe9 offers a printed report showing the lathe bed straightness, spindle parallelism to the bed and the headstock-tailstock alignment.

### L-700 Spindle Alignment System Basic Setup on a Lathe or Turning Center



### Lathe Spindle Alignment Procedure Using Lathe9 Software

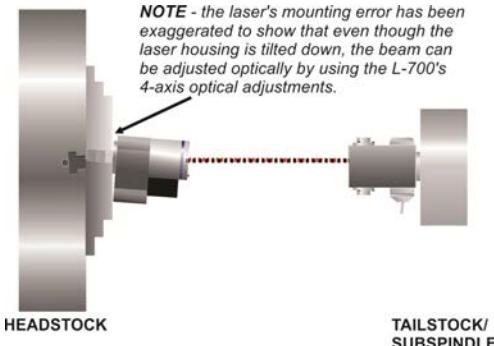


#### Step 1 - Setup

Enter the number of points to measure on the bed, the distance between points, the headstock and tailstock dimensions, and the alignment tolerances. Also select which side of the machine the laser is mounted in.

## Step 2 - Qualify Laser Showing the Laser Bucked-in to the Spindle AOR

- A) Using Allen key, turn the angular adjustments until the V & H Angular displays are zero.
- B) Using the Allen key, turn the center adjustments until the V & H Center displays are zero. The laser beam is not concentric to the Spindle AOR.

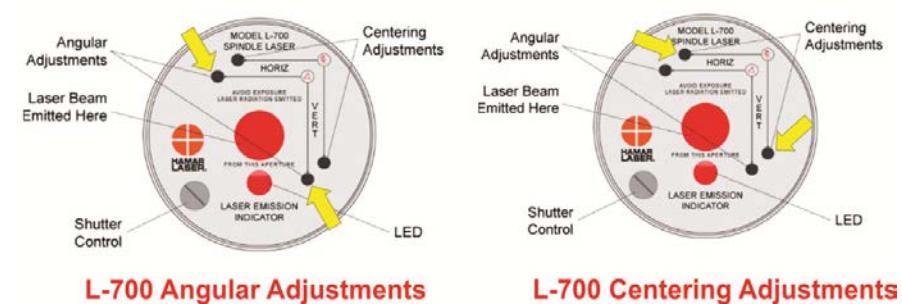


**NOTE:** the laser's mounting error has been exaggerated to show that even though the laser housing is tilted down, the beam can be adjusted optically by using the L-700's 4-axis optical adjustments.

**NOTE:**  
The laser does not have to be adjusted perfectly to zero since the final mounting errors will be removed in Lathe9, Step 5. This is because the target mounting errors also have to be measured and removed from the final alignment values.

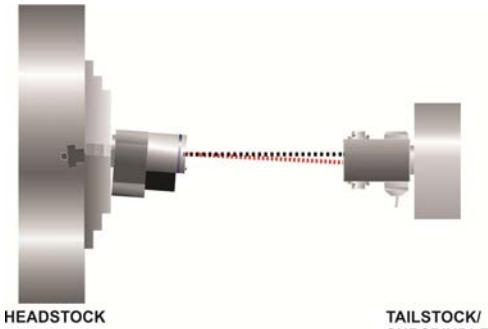
### Step 2 - Qualify Laser - Spindle Normal

- A) Rotate the spindle/laser to the NORMAL position.
- B) Click **Record**. Offsets are immediately applied to displays so the laser can be adjusted to the spindle's AOR.



L-700 Angular Adjustments

L-700 Centering Adjustments

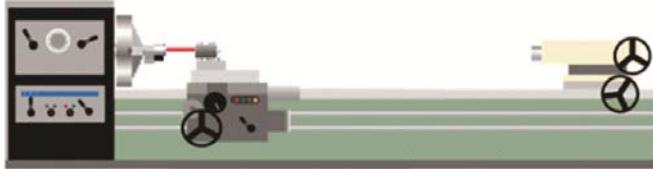


HEADSTOCK TAILSTOCK/ SUBSPINDLE

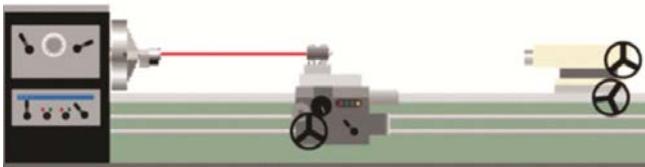


### Step 3 - Spindle AOR Parallelism to Lathe Bed

- A) Put T-261A Target on lathe saddle and move it to a distance from the headstock specified in for Point #1 in Step 1.  
 B) Click **Record** to record the first data point.



- C) Move saddle/T-261A to next point and click **Record**. Continue until all the points are recorded.



### Step 3 - Spindle AOR Parallelism to Lathe Bed Results

Click **Results** to display the Lathe Bed Parallelism Results table, which shows: a) lathe bed straightness, b) parallelism of the Spindle AOR to the lathe bed. If the Headstock Parallelism results are out of tolerance, click **Close** and then click **Move** to open the live Headstock Alignment screen.

**Note:** If the saddle and tailstock are on separate machine rails, the data can be taken a second time by moving the T-261A to the tailstock and taking a second set of lathe bed straightness data.



### Step 3 – Live Spindle-to-Bed Alignment Screen

Click **Move** in Step 3 to open the Spindle-to-Bed alignment screen, showing a live display of the vertical and horizontal parallelism (angular) values relative to the lathe's machine ways or bed. The data can be shown relative to the tailstock bed, saddle bed or an average of both.

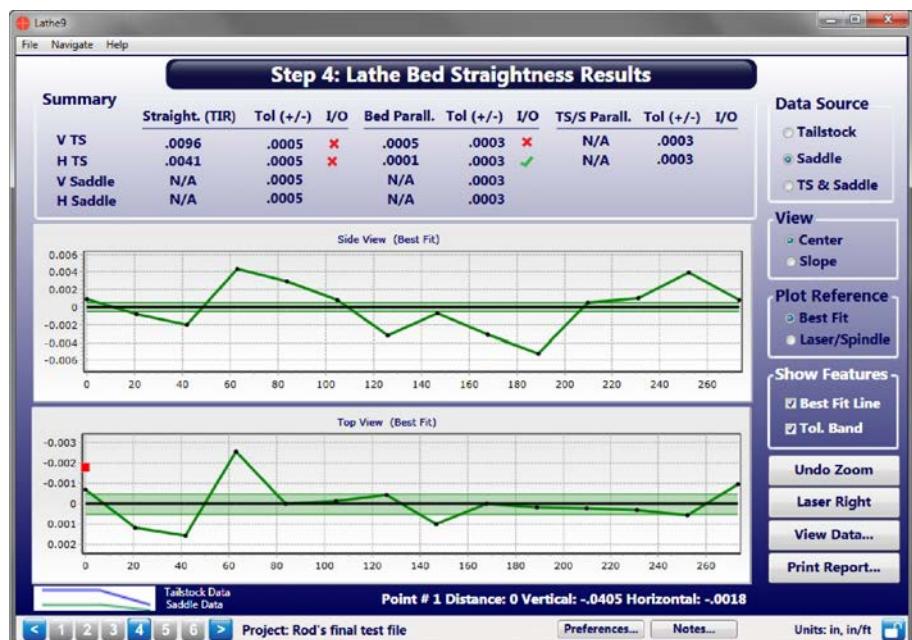
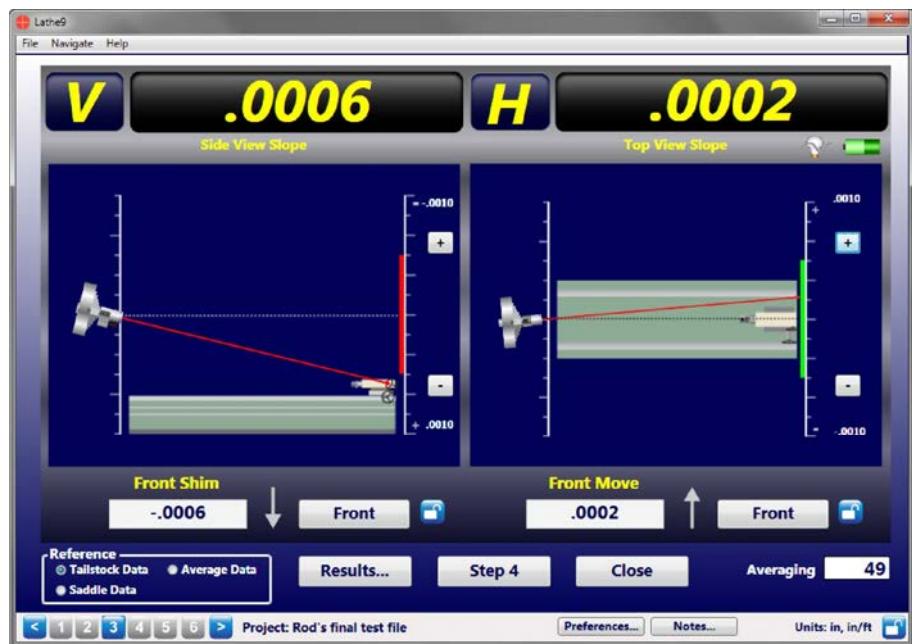
Lathe9 automatically calculates the shim values to align the headstock spindle to the tailstock or saddle beds and on-screen graphics and display values update continuously as the shim is added. The shims are color-coded and when they turn green, the alignment is complete. Click **Close** to return to Step 3 to retake the data and confirm the alignment.

### Step 4 – Lathe Bed Straightness Results

To view the Lathe-Bed Straightness results, click **Next** and Lathe9 displays a graph of the Vertical and Horizontal straightness results for the lathe's bed. A summary shows:

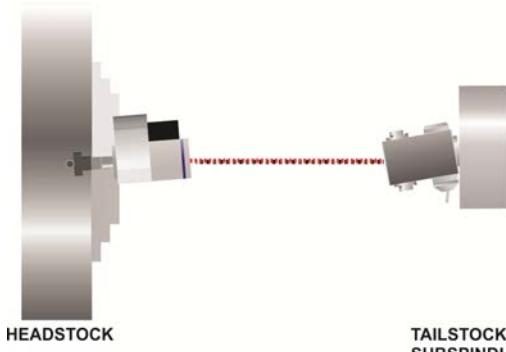
- The overall Vertical and Horizontal Straightness TIR for the tailstock rails and for the saddle rails (if the saddle has separate rails) and if the data is in or out of tolerance.
- Parallelism of the headstock spindle to the tailstock bed (rails) and if in or out of tolerance.
- Parallelism of the headstock spindle to the saddle (if separate from tailstock bed) rails and if in or out of tolerance.

The straightness data can be plotted for the tailstock rails, saddle rails or both. The plot can use the Best-Fit line as the reference or the laser beam. The graph also shows tolerance bands, the Best-Fit line, or pitch and yaw data for each point.



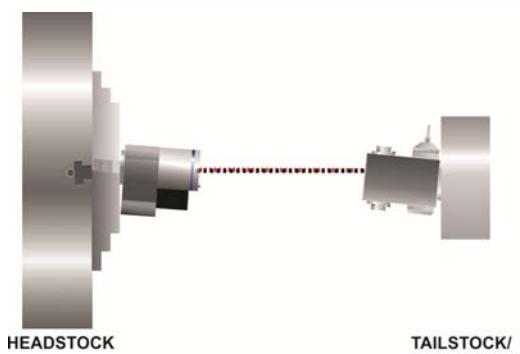
### Step 5: Record Data-Spindle: Laser Inverted/Target Normal

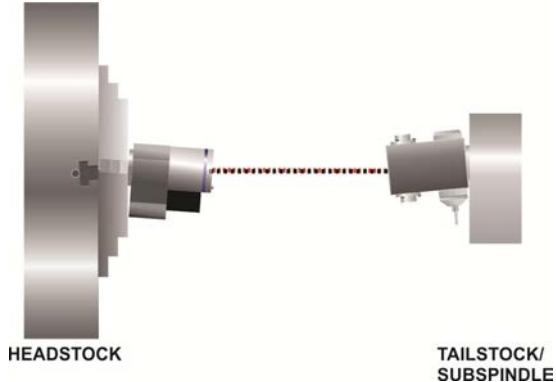
When the headstock is aligned to the bed, the tailstock (subspindle or turret) can then be aligned to the headstock. First, insert the T-261A into the tailstock or subspindle in the NORMAl position and ensure the bubble is centered in the vial. Rotate the headstock spindle so the L-700 is in the Inverted position, making sure it is level. Click **Record**.



### Step 5 – Record Data-Spindle: Laser Normal/Target Inverted

Rotate the headstock spindle so the L-700 is in the NORMAl position. Rotate the target in the tailstock chuck to the INverted position. Ensure both are level. Click **Record**.





### Step 5 – Record Data

#### Spindle: Laser Normal/Target Normal

Rotate the target in the tailstock chuck to the NORMAl position. Click **Record**.



### Step 5 - Record Data Spindle: Results

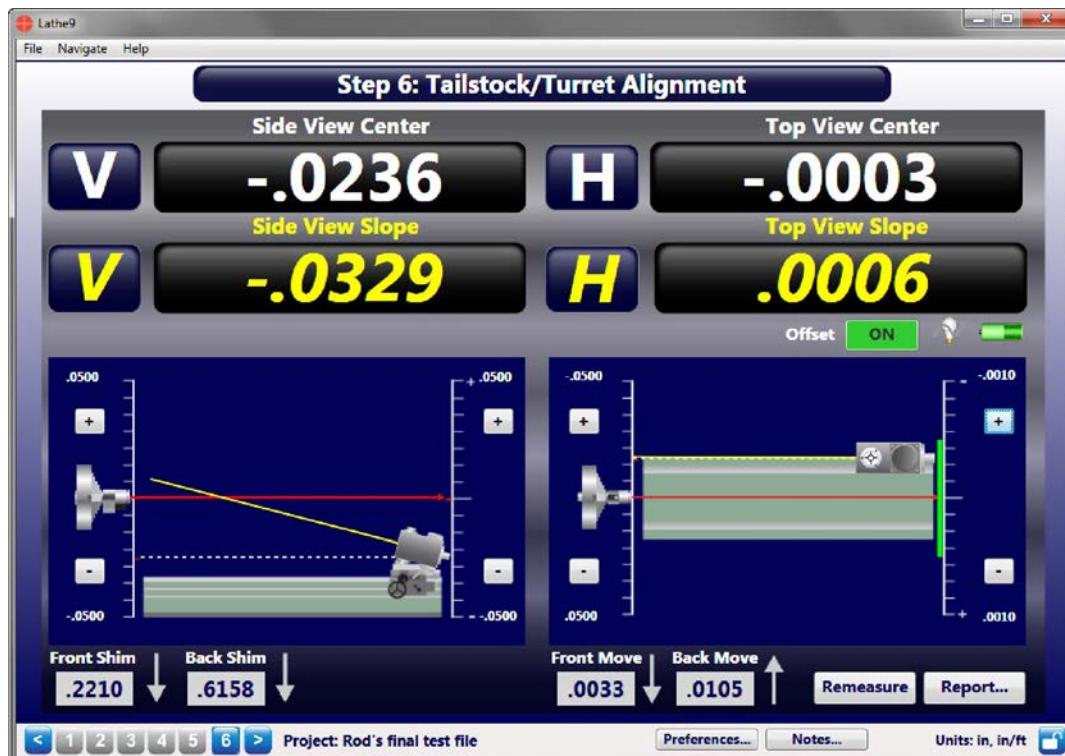
After taking the data, Lathe9 calculates mounting-error offsets and applies them to the display values. It also calculates the spindle alignment results and applies the tolerance. On-screen graphics illustrate the vertical axes of the alignment (Side View) and the horizontal axes of the alignment (Top View). If it is out of tolerance, click **Next** and go to Step 6 -- Tailstock/Turret Alignment Live Move Screen.

## Step 6 – Tailstock/Turret Alignment Live Move Screen

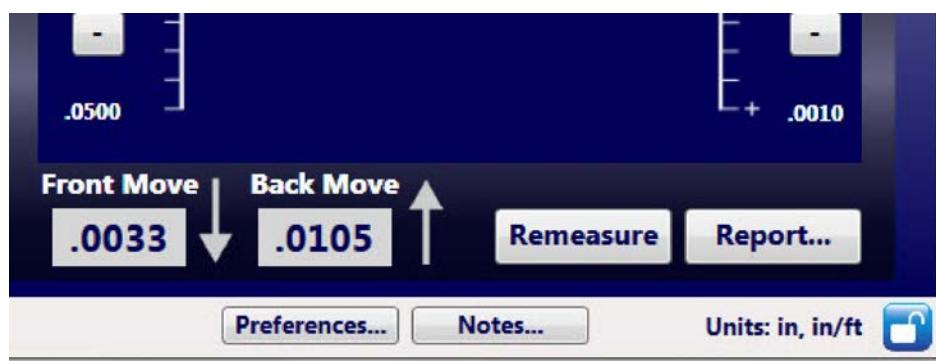
After taking the spindle alignment data in Step 5, click **Next** to go to the Tailstock/Turret Live Move Screen. In this screen, the mounting errors collected from Step 5 are applied as an offset to the data displays, showing the actual alignment in four axes: Side View, showing the Vertical Center and Vertical Angle and Top View, showing the Horizontal Center and Horizontal Angle.

The data is live and on-screen graphics illustrate either the tailstock or turret spindle alignment relative to the headstock's spindle axis (AOR). Shim and Move values are also calculated to fix the alignment. The displays turn red when the alignment is out of the tolerance selected in Step 1 or green if in tolerance.

Add the shim and spacers or make the horizontal move, watching the display update as you make each move. When the displays turn green, it's aligned!



It is always a good idea to go back to Step 5 and retake the data to confirm the alignment. After confirming the alignment, click **Print Report** for a report of the entire alignment.



## Alignment System Features

- Simple fixturing for mounting the laser and target
- L-700 mounts in the spindle to project its axis of rotation out to 100' (30.5 M)
- Visible-light beam aids setup
- Compact and rugged (4 in. L x 2.9 in. H x 1.75 in. W)
- Center resolution of 0.00002 in. (.0005 mm) and angular resolution of .00002 in./ft (.002 mm/M)

- Vertical and horizontal controls for both angle and center adjustment of the laser to the spindle's precise axis of rotation
- Needs only 10 in. (250 mm) of space between spindle and tailstock or subspindle.
- Laser runs for up to 8 hours on a standard, replaceable 9-volt battery
- Windows-based software with large color graphics that corrects mounting errors and calculates shim values

## The NORMIN Method The Relationship of the Three “Centers”

- You are seeking the *bore center* relative to the laser beam (TBM).
- The readout information provides the *target center* relative to the laser (TSCE).
- The NORMAL reading is taken with the target cable *down*.
- The INverted reading is taken with the target cable *up* ( $180^\circ$ ).

