Application Notes

Lathe Alignment

System Recommendations

L-700 Spindle Alignment System

Hamar Laser offers two types of lasers for machine tool alignment:

- *Straight-Line Laser Systems* - designed for lathe, turning center, bore and cylindrical grinding applications.
- *Multi-Plane, Continuously Rotating Laser Systems* - designed for machining center, vertical turning lathe, boring mill and surface grinding applications.

Our patented 4-axis L-700 Spindle Alignment System is a powerful alignment tool that will help you to align turning-center applications up to 70% faster than conventional or interferometer methods. With a resolution of .00002" (.0005 mm), live data output and large, color computer graphics, the L-700 is the perfect tool to align turning centers quickly and accurately.

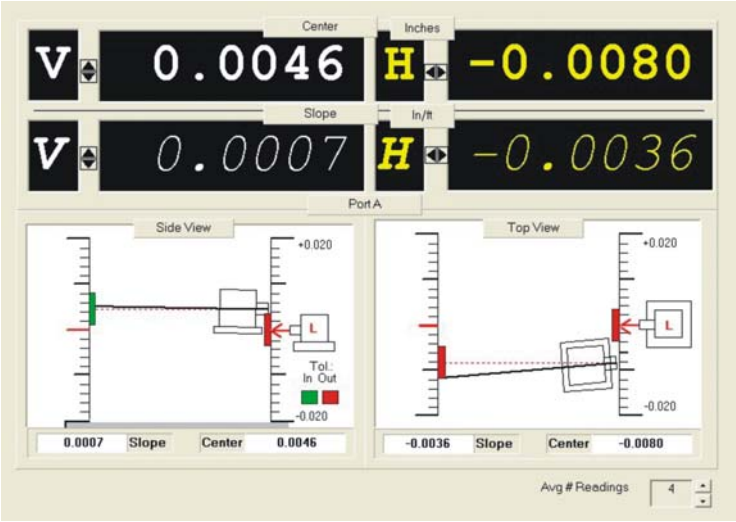
Turning Center Alignment Simplified Even on Large Lathes

The critical alignment of a lathe or other turning-type machine is the axis of rotation of the spindle to the tailstock, sub-spindle, turret or tool holder. Conventional methods are very cumbersome and time consuming and are practically useless on large lathes. The L-700 vastly simplifies the task by inserting the laser right into the spindle chuck and the T-261 4-Axis Target into the sub-spindle or tailstock. The laser is aligned to the spindle axis of rotation out to 100' (30.5 M). This becomes the reference from which the ways, tool holder and tailstocks can be measured and aligned using the T-261. The software displays a live reading of the horizontal and vertical center (offset) readings and the horizontal and vertical angular (slope) readings of the tailstock to the headstock.

Live Display of Misalignment Data in 10 minutes

The L-700 Spindle Alignment System is so easy to set up that you can have a quick measurement of misalignment data in 10 minutes. The Windows-based software speeds setup and data taking and even corrects for mechanical mounting errors!

As with all Hamar Laser products, the L-700 provides a live display in four axes of misalignment data, which means you can align the tailstock, sub-spindle, etc. while the laser is still in the machine. This is especially useful for tailstock alignment, as it requires 4-axis calibration (horizontal center and angle and vertical center and angle).



HAMAR LASER®

5 Ye Olde Road, Danbury, CT 06810 • Phone: (800) 826-6185 • Fax: (203) 730-4611
E-mail: sales@hamarlaser.com • Internet: http://www.hamarlaser.com

High Resolution (.00002") Improves Part Quality

ISO 9000, QS 9000, or whatever quality program you are following will *not* have the impact on part quality that a properly aligned machine can. The L-700 has a resolution of 0.00002" (0.0005 mm) or better for center measurements and 0.00002"/ft (0.002 mm/M) for angular measurements. This extremely high resolution provides the accuracy to dramatically improve your lathe's performance and scrap rates.

Align Lathes Up to 100 Feet

With the 100' (30.5 M) range of the L-700, even the largest lathes can be quickly aligned. Since the L-700 is aligned to the axis of rotation of the spindle, it projects that axis out to 100' (30.5 M), allowing the entire length of the lathe to be aligned without changing setups. This is of particular value to large lathes where alignment bars are not practical.

Cross Slide Squareness

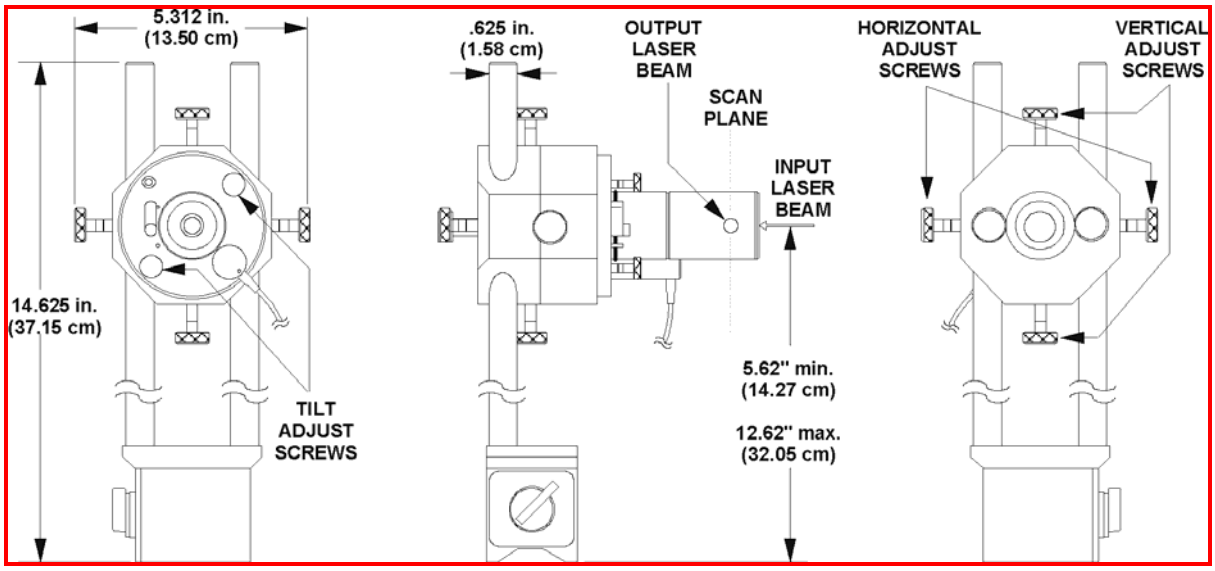
With our P-405 Remote Optical Square or our L-720M Laser System, measuring the squareness of the cross slide is a simple task. The P-405 is placed into the laser beam and made perpendicular to it. A penta prism then bends the input beam 90º and produces an automatically rotating laser plane that is square to axis of rotation of the spindle. A single-axis target then measures the cross-slide squareness.

Recommended System Configuration

L-700 Spindle Alignment Laser
T-261A 4-Axis Spindle Target
R-358 Computer Interface w/.05 Micron (.00002") Resolution
S-1380 Read8 Software
R-342 Laptop Computer
A-809 Shipping Case

Optional Accessories

P-405 Remote Optical Square
R-1342 Shop-Hardened Laptop Computer

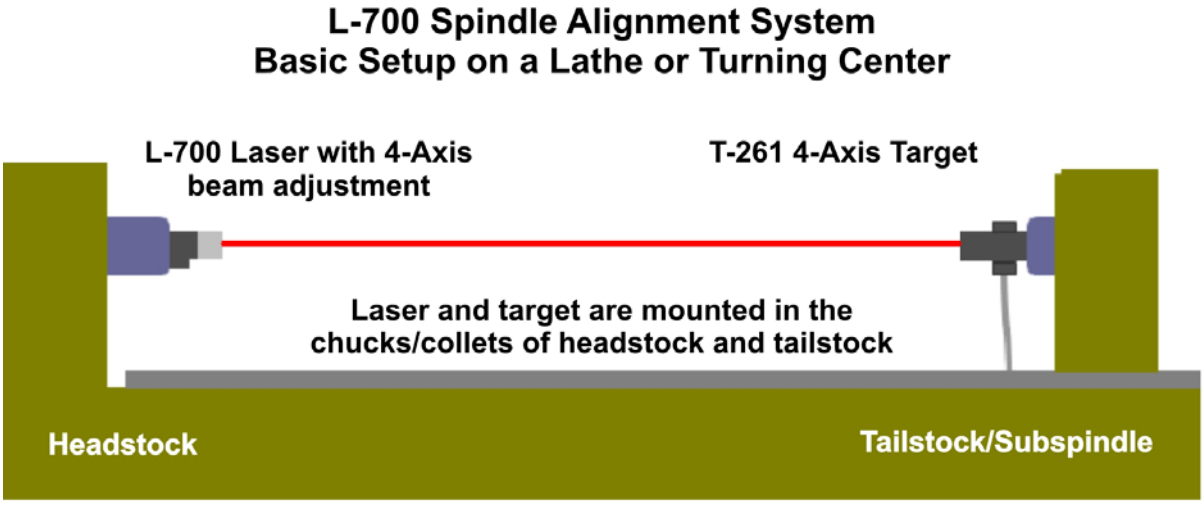


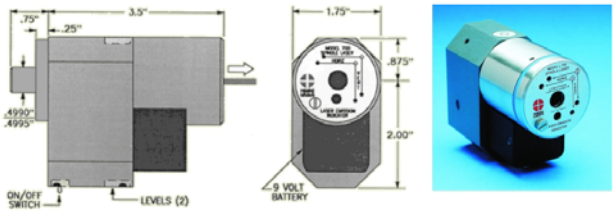
P-405 Remote Optical Square

How the Alignment System Works

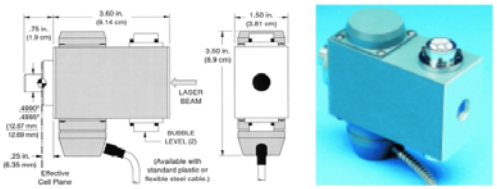
Laser Setup

The setup and use of an L-700 is relatively easy and begins by "qualifying" the laser beam or making it parallel and colinear to the axis of rotation of the spindle. The laser is inserted into the spindle and a 4-axis target is placed in the tailstock, sub-spindle, tool holder, or in a fixture. The target is connected to a computer and the NORMIN procedure (see illustration) is followed to center the laser beam on the axis of rotation (see the Read8 Align Laser Screen). The L-700 has angular and centering adjustments that make this process quite easy.

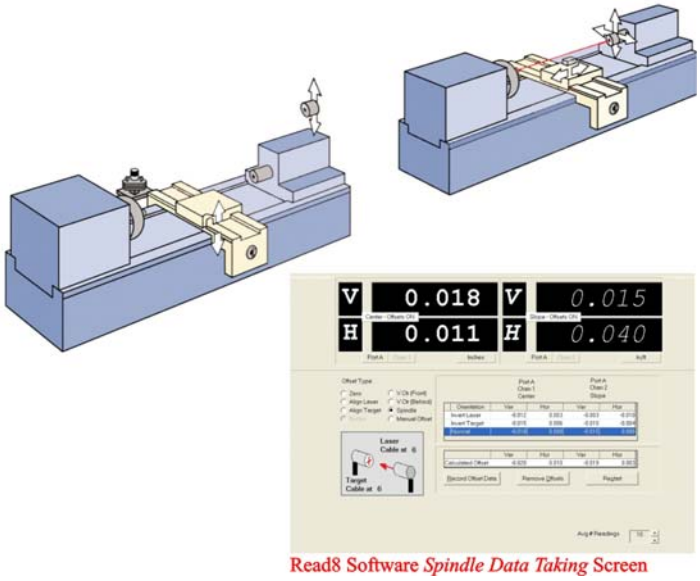




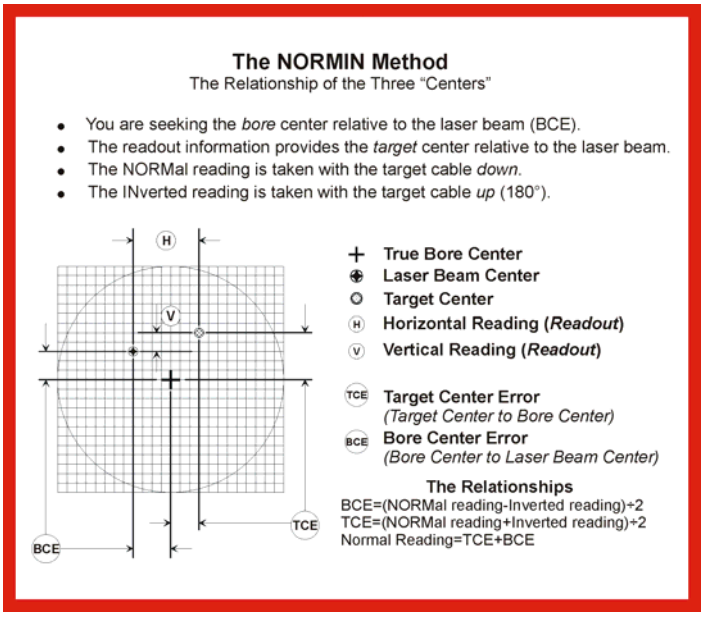
L-700 Laser with 4-Axis beam adjustment



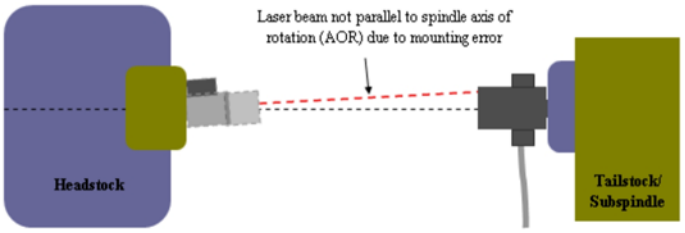
T-261A Target with four simultaneous alignment axes



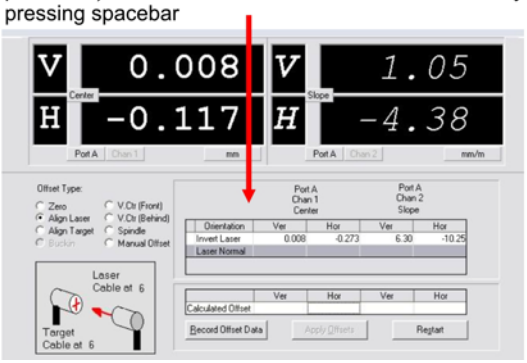
Read8 Software *Spindle Data Taking* Screen

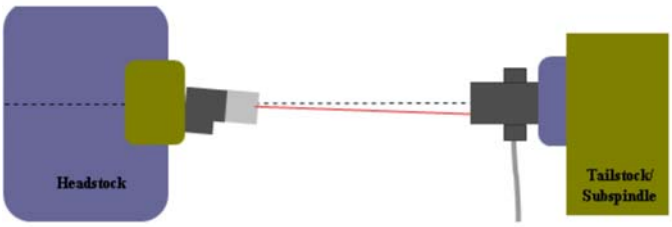


Mounting Error Correction Using NORMIN
(NORmal & INverted Procedure)

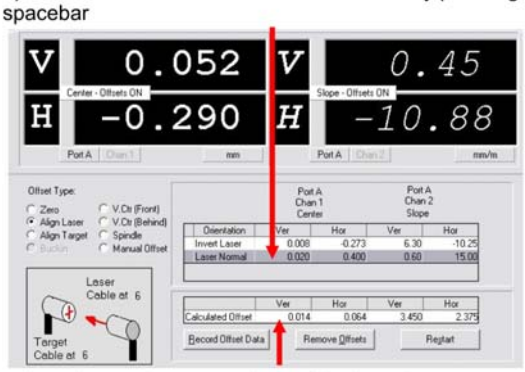


Step 1 - Laser Mounting Error Correction
Spindle is rotated 180 degrees to put laser in INverted position b) Data recorded in Read8 OFFSET screen by pressing spacebar



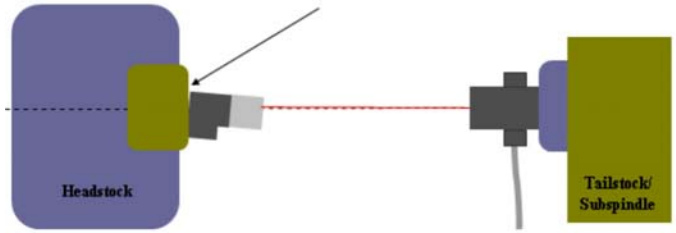


Step 2 - Laser Mounting Error Correction
A) Spindle is rotated 180 degree to put the L-700 in the NORMAL position
b) Data recorded in Read8 OFFSET screen by pressing spacebar



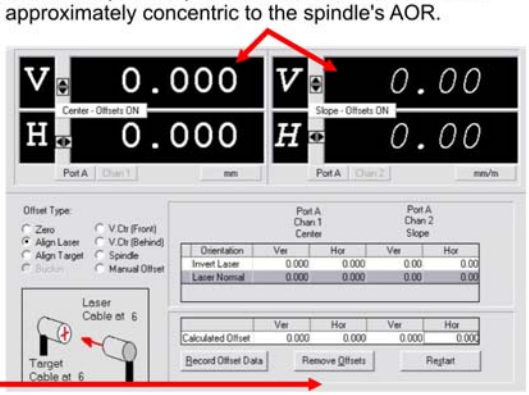
Actual mounting error values of the laser beam relative to the spindle's AOR

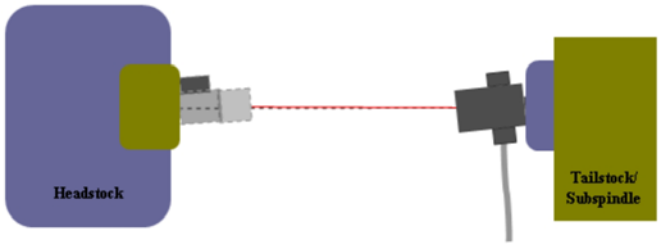
Note - the laser's mounting error has been exaggerated to show that even though the laser housing is tilted down, the beam can be adjusted optically by using the L-700's 4-axis optical adjustments.



NOTE:
- The laser does not have to be adjusted perfectly to zero since the final mounting errors will be removed in Step 4.
- If the OFFSETS were turned off, the displayed value would give an estimation of the misalignment of the tailstock/subspindle to the headstock. To determine the true misalignment, the final laser mounting errors and the target's mounting errors also have to be determined. See Step 4.

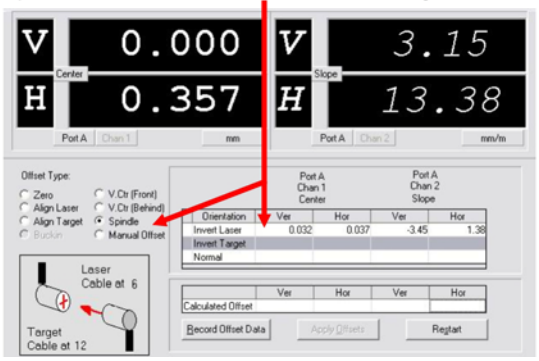
Step 3 - Adjust Laser Beam in 4 Axes
A) OFFSETS ON means the calculated mounting errors have been subtracted from the displayed readings.
b) With the OFFSETS ON, adjust laser beam in 4 axes using Allen key until all 4 alignment axes are within 0.005 mm (0.0002") of zero. The laser beam is now approximately concentric to the spindle's AOR.

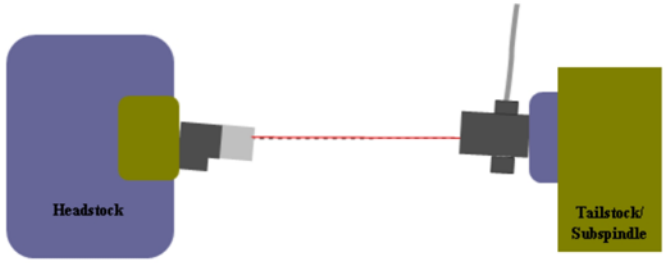




Step 4 - Switch to Spindle Mode and Perform Laser AND Target NORMIN

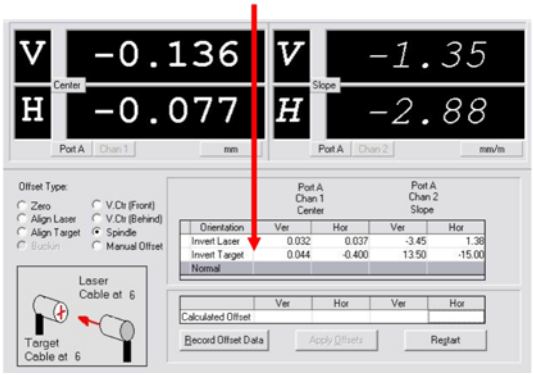
Rotate the headstock spindle 180 degrees and press the space bar to record the laser's final mounting errors.

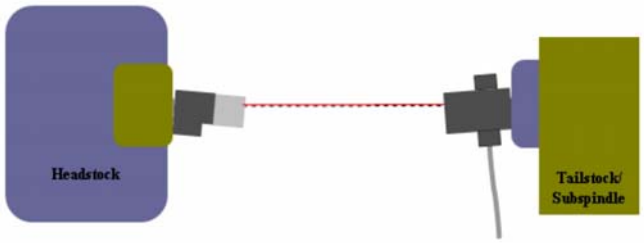




Step 5 - Perform Laser AND Target NORMIN

Return the laser to the normal position, rotate the tailstock/subspindle spindle 180 degrees and press the space bar to record the target's mounting errors.

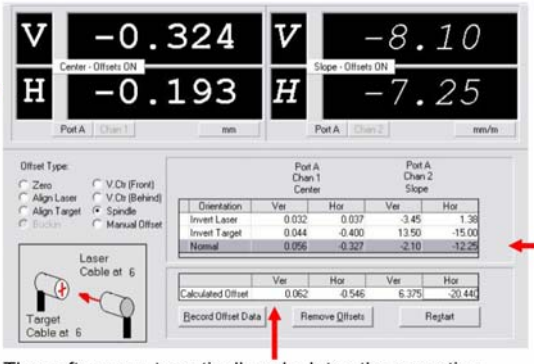




Step 6 -Perform Laser AND Target NORMIN

a) Return the target to the normal position and press the space bar to record the target's mounting errors.

b) With the OFFSETS ON, the 4 display values show how far out of alignment the tailstock is relative to the headstock. The user can then switch to the Spindle Plot (see below) to show in which direction the spindles are misaligned and perform the alignment.



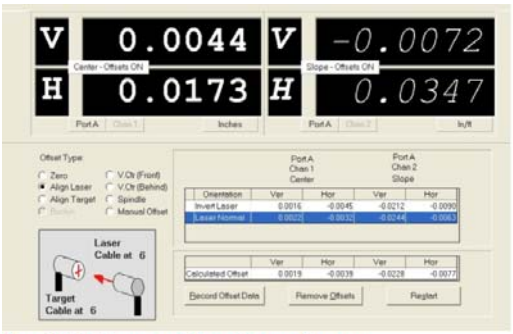
The software automatically calculates the mounting errors for both laser and target and subtracts them from the displayed values.

Headstock/Tailstock Bed Way Alignment

The alignment readings are taken as follows:
Invert the target, leaving the laser in the normal position and press the spacebar to record the data point (see Read8 Data Taking screen).
Put the target back in the normal position and invert the laser. Press the spacebar to record the data point.
Return the laser to the normal position and press the spacebar. The software automatically applies offsets to the displayed values to correct the mounting errors. The Spindle Plot screen (see the Read8 Spindle Plot screen) can be opened to display the live readings.

The resultant readings are the actual angular and center misalignment measurements of the headstock to the tailstock, or the spindle to the sub-spindle. At this point, the headstock, tailstock or sub-spindle can be aligned using the software as a 4-axis live indicator.

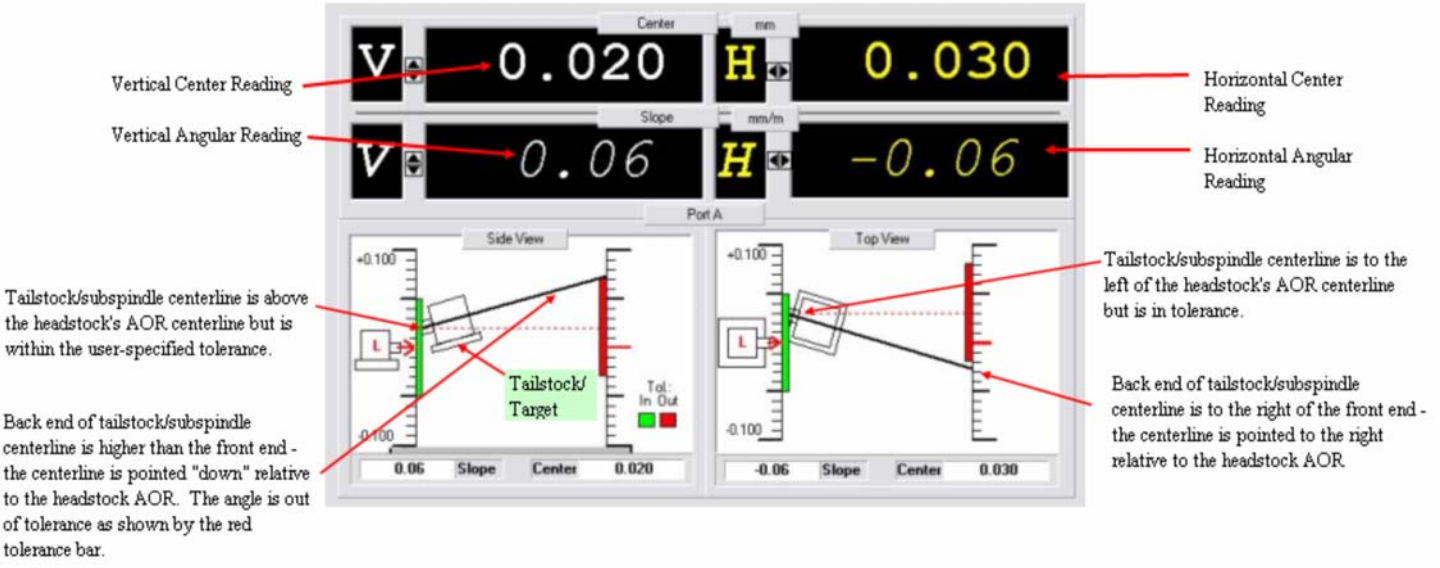
When the headstock/tailstock or spindle/sub-spindle misalignment has been corrected, the bed-straightness data can be taken using Quick Plot. The target is traversed along the ways in either the tailstock or tool holder, depending on preference and fixturing. Readings for horizontal and vertical straightness (and pitch and yaw if needed) are taken by using our 4-axis target, the T-261A.



Read8 Software *Align Laser* Screen

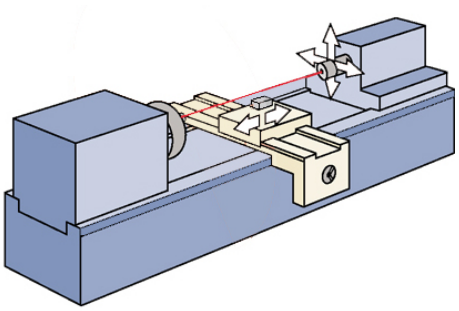
Read8 Software *Spindle Plot* Screen

Read8 Spindle Plot Screen



Cross Slide Squareness

Squareness of the cross slide can be easily checked by setting up a remote optical square (P-405). The optical square is put on a target stand and adjusted, using a 4-axis target, until it is exactly perpendicular to the input beam from the laser in the spindle. The optical square has an automatically rotating head that sweeps a laser plane that is perpendicular to the input beam. A single-axis target is placed on the cross slide and zeroed in the closest position to the spindle centerline. It is then traversed along its axis, and any deviation from zero is a squareness error. The straightness of the cross slide travel is also checked at the same time.



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" L x 2.9" H x 1.75" W)
- Center resolution of 0.00002" (.0005 mm) and angular resolution of .00002"/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" (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