

Application Note 1

Machine Tool Alignment

Boring Mills, Gantries, Machining Centers, VTLs

System Recommendations

L-743 Machine Tool Alignment System



Whether it's machining centers, boring mills, lathes or grinders, Hamar Laser has an alignment system to fit your geometric calibration needs. All Hamar Laser alignment systems use patented, state-of-the-art technology to align your metal cutting machinery as quickly and simply as possible. In almost all cases, the alignment process can be completed 60 - 70% faster than using conventional means (levels, squares, indicators, straight edges, etc.) or interferometry (linear measuring lasers).

Traditional Methods Too Time Consuming

Traditional alignment methods usually require days or even weeks to align a machine tool. That, combined with stack-up errors that can limit the machine's tolerance potential, makes aligning a machine tool to today's ever-tightening tolerances a very time-consuming and difficult exercise. In fact, most companies rarely check alignment of their machines because it takes too much production time.

Hamar Laser's alignment systems allow you the time to align your machines *and* keep pace with production. With accuracies

down to $\frac{1}{4}$ arc second (0.000015"/ft or 0.001 mm/M), Hamar Laser's alignment systems will also help your machines cut better parts, reduce scrap rates and increase productivity.

Alignment First, Linear Positioning Second

One of the biggest misconceptions in the machine tool industry is that proper linear positioning is all that is needed to make quality parts. Our customers have found out the hard way that making quality parts requires checking and calibrating the machine's geometry (flatness, straightness, squareness and parallelism) *first*. Only then should the linear positioning of a machine tool be checked and calibrated. Failing to follow this sequence will result in a costly trial and error period, poor part quality and reduced throughput.

Two Types of Machine Tool Lasers

Our lasers systems are available in two types:

- *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.

Two Levels of Accuracy

Our continuously rotating laser systems are available in two accuracy grades: the L-730 Precision Series and the L-740 Ultra-Precision Series. Each series offers several different laser systems with single, dual and triple-plane versions. The L-730 Series is designed for those with accuracy needs of 0.00012"/ft (0.01 mm/M) or higher and the L-740 Series is for those with accuracy needs of 0.00002"/ft (0.0017 mm/M) or higher.



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The L-743 Machining Center Alignment System

The L-743 Ultra-Precision Triple Scan® Laser is an ideal instrument to quickly and accurately calibrate the geometry of almost all machining centers. It is the only laser in the world to offer three automatically rotating laser planes that are accurate enough for today's ever-tightening tolerances. This creates a powerful tool that not only FINDS, but also FIXES geometry problems, all in a fraction of the time needed with conventional methods.

Align 70% Faster Than Other Methods

Continuously sweeping lasers and live data output create a powerful combination to align machining centers up to 70% faster than traditional or interferometer methods. Downed machines will be up and running, producing quality parts in record time. HLI's continuously sweeping lasers are far superior to other point-and-shoot laser systems that require time-consuming manual laser rotation and target setup for each point measured. They also allow the use of multiple targets, which is especially helpful for large machine tools.

Simultaneously Measure 3 Axes with One Setup

Another great time saver is the L-743's ability to measure the three main axes of a machine at the same time. Not only can you measure the flatness and straightness of each axis, but you can also measure the squareness of the three axes. And if there are any additional axes, such as a rotary table or extending quill, you can easily check the parallelism to the main machine axes with the same setup.

Reduces Machine Downtime and Part Setup Time

By providing live alignment data, misalignment errors can be quickly and easily fixed without having to change the setup. This is a tremendous benefit, especially if you are used to using an interferometer or autocollimator, where the entire length of an axis must be measured before the straightness or flatness can be determined and the data provided is not even live.

Reduces Stack-Up Errors

A major problem with aligning machine tools using conventional methods is that many different alignment tools must be used, requiring a lot of time and increased stack-up errors. An alignment is only as good as the tools used to perform it. The machinist level, for example, has a resolution of .0005" per foot, which is not very accurate for today's ever-tightening tolerances. The L-743's laser planes, by contrast, have a flatness of ½ arc second (0.00003"/ft or 0.0025 mm/M) in a 180° sweep and ¼ arc second (0.000015"/ft or 0.001 mm/M) in 90° sweep.

Squareness Made Easy

In addition, the L-743's three laser planes are square to each other up to 1 arc second (0.00006"/ft or 0.005 mm/M), providing a single reference from which to measure machine geometry. If you have ever tried to set up an interferometer to check squareness, you will be amazed at how quickly and easily the squareness of not just one axis, but *all* axes can be measured, usually with one setup. Where an interferometer may take hours just to set up a squareness check, the L-743 takes 15-25 minutes. And, unlike a cylindrical square, the L-743 can check the entire length of a machine's axis, up to 100 feet (30.5 meters), not just 12" (305 mm) or 24" (610 mm) of it.

Recommended System Configuration

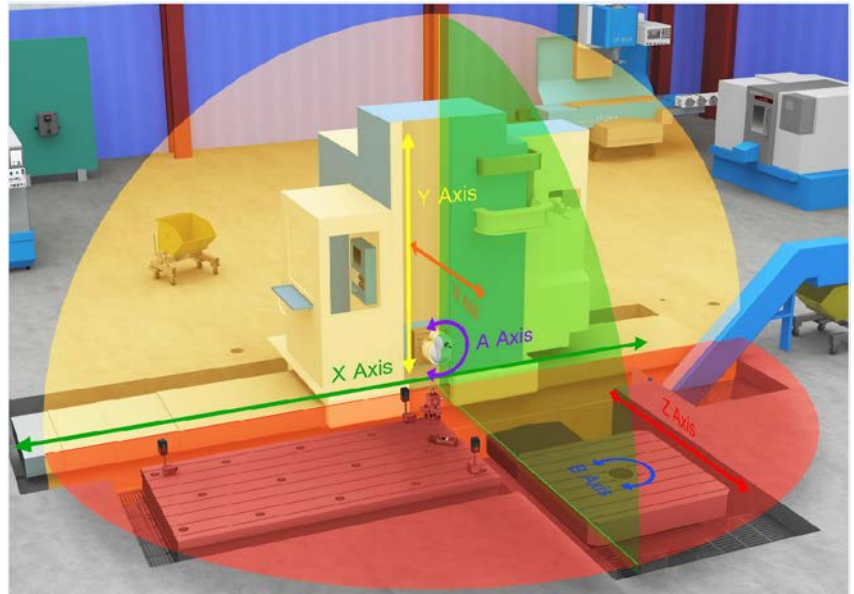
L-743 Ultra Precision Triple Scan Laser
(3) A-1519-2.4ZB Single-Axis Wireless Targets
R-1355-2.4ZB PDA Display w/Read9 Software
A-910-2.4ZB Computer Radio Interface
S-1387 Machine Tool Alignment Software for Windows
L-106 Instrument Stand
A-809XL Shipping Case

Computer Accessories

R-342 Notebook Computer
R-1342 Toughbook Laptop
S-1388 Plane5 Software

Optional Accessories

A-1520-2.4ZB Single-Axis Wireless Scan Target

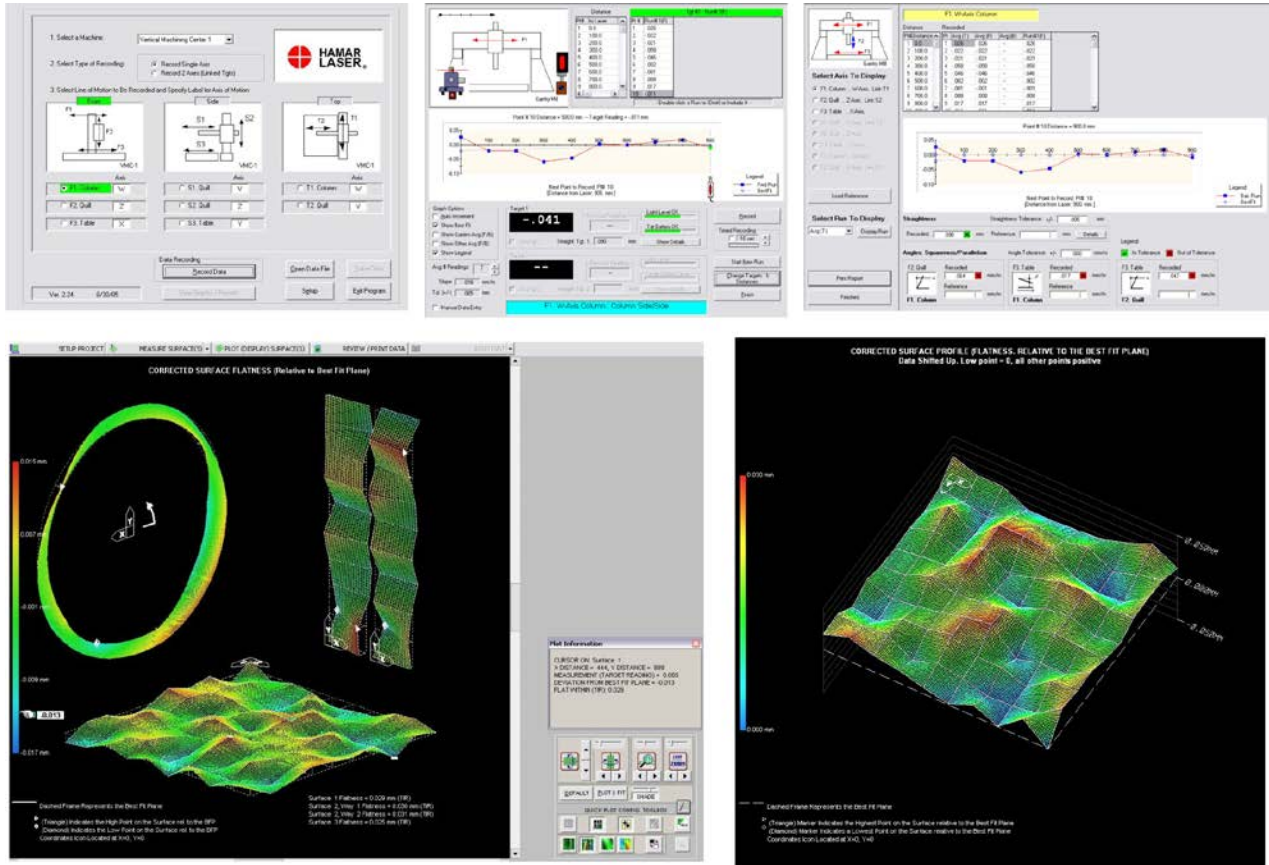


Wireless Targets and Readout Speed Setup

With Hamar's new wireless targets (A-1519-2.4ZB) there is no need to string long extension cords to reference targets. The targets have a measuring range of $\pm .5"$ (12.7 mm), a resolution as low as 0.00002" (0.00058 mm) and can be used up to 100 feet (30.5 meters) from the laser. The R-1355-2.4ZB Readout uses a PDA, color software and a wireless receiver to display up to 8 targets simultaneously. Other features like electronic zeroing and target averaging help to speed setup and alignment.

Software Quickly Collects and Analyzes Machine Tool Geometry Data

Hamar Laser's Machine Tool Geometry Software analyzes lines of motion for a machine tool, similar to the methodology used in ASME's B5.54 Standard. Our Plane5 Software analyzes multiple planes and surface types (squares, rectangles, frames, ways, circles and rings) and presents the analysis in 3D graphics. Both sets of software automatically download alignment data, save data analyses and produce alignment reports that clearly and concisely show the machine's condition (report summary only shown on following page).



Hamar Laser's Machine Tool Geometry Software and Plane5 Software

Alignment System Features

- 3 continuously rotating laser planes with operational range of 100' (30.5 meters) in radius.
- Laser planes flat to 1/2 arc second (0.00003"/ft or 0.0025 mm/M) in 180° sweep and 1/4 arc second (0.000015"/ft or 0.001 mm/M) in 90° sweep.
- Planes are mutually square up to 1 arc second (0.00006"/ft or 0.005 mm/M).
- Includes L-123 Pitch/Roll/Yaw base with coarse and fine adjustments.
- Standard Targets: A-1519 2.4ZB Wireless Target with $\pm .5"$ (12.7 mm) Measuring Range and 0.00002" (0.00058 mm) Resolution.
- Backlit levels accurate to 1 arc second (0.00006"/ft or 0.005 mm/M).
- Diode lasers 2 times more stable than HeNe based laser systems.
- Completely self-contained.
- Instant on with virtually no warm-up.
- Typical setup time 20 minutes or less.
- Battery or AC powered.