Laser Alignment Systems for Machining Centers
L-733/L-743 Triple Scan® Lasers

Ultra-Accurate & Fast
Simultaneous Multi-Axis
Easy to Learn
Why Laser Alignment?
Sooner or later everything goes out of alignment. Machinery and process lines, when properly aligned, run better, last longer, require less maintenance, lower production costs, reduce scrap rates and improve productivity and quality.

As the leader in laser alignment technology, we introduced the world’s first flat laser plane in 1974, and the first automatically sweeping laser plane in 1985. Today, no one can match our innovative systems for accuracy, versatility, fast setup, ease of use and the immediate, real-time generation of alignment data.

Industry’s Highest Accuracy. Period
The L-743 Ultra-Precision Leveling Laser offers the highest geometric accuracy in the industry with a plane flatness of up to .000015 in/ft (0.0013 mm/m). Squareness accuracy to .00006 in/ft (0.005 mm/m). For lower accuracy applications, the L-733 Precision Leveling laser offers a laser-plane flatness and squareness of .00012 in/ft (0.01 mm/m).

Multiple Targets Helps Reduce “Do-Overs”
With the capability of seeing the data from multiple targets simultaneously, reference targets can be used to monitor laser drift on long-distance applications, another time-saving feature that reduces “do-overs.” You can also see if aligning an axis has any effects on the other axes.

Reduced Downtime after Machine Crashes
Up to 70% faster than optics or levels, the L-730/L-740 lasers significantly reduce machine downtime especially after crashes. In less than 1 hour, the laser can be set up and preliminary measurements taken to determine if the machine needs to come off line or not.

Squareness Made Easy
Unlike the complicated interferometer setups, measuring squareness with the L-743/L-733 is quite easy due to the built-in squareness capability. Once you have the laser setup, measuring squareness is just a matter of moving targets to the other axes and start measuring. The software does the rest!

Advantages of L-733/L-743 over Interferometer Methods
- Same ultra-high accuracy but easier and faster to setup
- Up to 70% faster alignments
- 1-2 setups vs. 6-8 for 3-axis machining center
- No worries about “breaking the beam”
- Re-align errors with real-time data updating vs. static measurements
- Squareness measurements are built into the lasers, avoiding setup of finicky “squareness optics”
- Simultaneous multi-axis alignment checks vs. single-axis checks
- Check alignment of guideways and columns without machine power

Advantages of L-733/L-743 over Traditional Methods
- Up to 10x higher accuracy than levels, straight edges, indicators, etc.
- Ultra-high resolution up to .00001 in (0.00025 mm)
- Up to 75% faster
- Measure entire length of X, Y, W & Z axes up to 100 feet (30 m) for straightness and squareness
- Difficult alignment checks are made easy, such as: bed twist, vertical roll and rotary axes
- Simultaneous multi-axis alignment checks vs. single-axis checks
- Real-time data displays automatically update with each adjustment

Machine Applications
- Floor and Spar Mills
- Gantry Mills
- Guideway Flatness/Leveling and Straightness
- Horizontal and Vertical Boring Mills
- Horizontal and Vertical Machining Centers
- Large-Lathe Beds
- Machine Tool Assembly
- Roll-Forming Machines
- Transfer-Line Wing Bases
- Vertical and Horizontal Presses
- Vertical-Turning Lathes (VTLs)

Properly Aligned Machine Tools Run Better, Last Longer
Flatness (Level)
- Axis Travel for X, Y, W & Z Axes
- Machine Guideways
- Machine Bed Roll/Twist
- Pitch and Roll Angular Measurements
- Table Flatness
- Parallelism of Separated Surfaces
- Vertical Axis Roll/Twist

Squareness
- Columns to Tables or Rails
- Rotary Axes to Main Machine Axes

Capabilities Example: 6-Axis Horizontal Floor Mill
One Setup Does it All!

Red Laser Plane Measures:
- X-Axis Flatness (Straightness in Y)
- W-Axis Flatness (Straightness in Y)
- Z-Axis Flatness (Straightness in Y)
- X - Z Axis Parallelism
- B-Axis Rotation Axis Parallelism to X & W

Green Laser Plane Measures:
- W-Axis Straightness in X
- Y-Axis Straightness in X
- Z-Axis Straightness in X
- Y - X Axis Squareness
- W - X Axis Squareness
- Z - X Axis Squareness

Yellow Laser Plane Measures:
- X-Axis Straightness in W
- Y-Axis Flatness (Straightness in W)
- Y - Z Axis Squareness
- A-Axis Rotation Parallelism to X & Y

Straightness
- Axis travel for X, Y, W & Z Axes
- Fabrications and Other Large Parts
- Machine-Bed Guideways
- Yaw Angular Measurement

Parallelism
- A, B & W Axes to Main Machine Axes
- Machine Guideway Roll/Twist
- Master Guideway to Slave Guideway on Gantries
Different applications require different levels of accuracy which is why we developed two levels of accuracy for our Triple Scan® lasers alignment systems for machine tools:

**L-733 Precision Triple Scan® Laser**
Ideal for precision-level work but where tolerances are not as critical (e.g. laser-cutting machines, water-jet machines, etc.)

**L-743 Ultra-Precision Triple Scan® Laser**
Ultra-precise, used for more demanding “mission critical” tasks (e.g. aligning complex machine tool geometry, etc.)

**Both Systems Feature:**
- 3 continuously rotating laser planes with a range of 100 feet (30.5 m) in radius
- Built-in squareness measuring capability of up to .00006 in/ft or 0.005 mm/m
- Multiple targets displayed simultaneously for faster alignment and setup
- Real-time data output to measure - then fix - misalignments while watching machine moves update in real time
- Collect flatness and straightness data simultaneously to save time
- Work up to 70% faster than interferometers, theodolites, transits and other conventional methods
- Easy to learn, simple to operate
- Set up and start collecting data in 30-40 minutes
- Built-in, backlit, split-prism level vials with up to .00006 in/ft or 0.005 mm/m accuracy
- 3-axis adjustment base for fast setups

**Each System has 2 Wireless Target Options:**
- A-1519-2.4ZB Single-Axis Target with 2.4GHz wireless (to PDA or PC), 33x13 mm PSD, .00002 in. (0.0005 mm) resolution; and
- A-1520-2.4ZB Single-Axis Target with 2.4GHz wireless (to PDA or PC), 10x10 mm PSD, .00001 in. (0.00025 mm) resolution.

The data from the targets can be automatically downloaded into a PC laptop using our Windows-based software programs, S-1387 Machine-Tool Geometry, S-1388 Plane5 and S-1400 Read 11, via the A-910-2.4ZB USB Wireless Receiver. Or use our handheld PDA, the R-1356-2.4ZB Rugged PDA Wireless Readout, which can display up to 5 targets simultaneously.

### Which Laser System is Right for Your Application?

<table>
<thead>
<tr>
<th>Typical Applications</th>
<th>L-733</th>
<th>L-743</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boring Mills, Floor Mills</td>
<td>•</td>
<td></td>
</tr>
<tr>
<td>VMC’s &amp; HMC’s</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Gantry’s &amp; VTL’s</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Large-Bed Lathes</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Water Jet &amp; Laser Cutting Machines</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Injection Molding Machines</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Surface Plates</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Large-Part Geometry</td>
<td>•</td>
<td>•</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Alignment Capabilities</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>High-Accuracy Leveling</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Flatness</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Squareness</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Straightness</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Parallelism – Axes</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Parallelism - Guideways</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Parallelism - Rotary-Axis</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Spindle Tramming</td>
<td>•</td>
<td></td>
</tr>
</tbody>
</table>

### Alignment Accuracies

<table>
<thead>
<tr>
<th>Laser Plane Flatness</th>
<th>Up to .00006 in/ft. (0.005 mm/m)</th>
<th>Up to .000015 in./ft. (0.0013 mm/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beam Plane Squareness</td>
<td>Up to .00012 in/ft. (0.01 mm/m)</td>
<td>Up to .00006 in/ft. (0.005 mm/m)</td>
</tr>
</tbody>
</table>
## Comparison Matrix – Geometry Measuring Systems
(Machining Center Alignment)

<table>
<thead>
<tr>
<th>Feature</th>
<th>Hamar Laser</th>
<th>European Geo. Laser Manufacturers</th>
<th>Interferometers (Linear Distance Laser)</th>
<th>Laser Trackers</th>
<th>Traditional Methods (Straight edge, levels, squares, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automatically rotating laser planes?</td>
<td>Yes, 7 models</td>
<td>Yes for 2 mfgrs. Others use &quot;Point &amp; Shoot technology&quot;</td>
<td>No, laser line only</td>
<td>No laser line only</td>
<td>No</td>
</tr>
<tr>
<td>Can be used for alignment?</td>
<td>Yes</td>
<td>Yes</td>
<td>No, measurement only</td>
<td>No, measurement only</td>
<td>Yes, for some</td>
</tr>
<tr>
<td>Number of setups for machine tools</td>
<td>Usually 1-2</td>
<td>3-4</td>
<td>8+</td>
<td>1-3+</td>
<td>5+</td>
</tr>
<tr>
<td>Number of auto-rotating laser planes</td>
<td>3 with L-733/L-743</td>
<td>1</td>
<td>N/A – laser line only</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Estimated Slower Alignment Time vs. L-733/L-743</td>
<td>1</td>
<td>40-50% slower</td>
<td>70-80% slower</td>
<td>40-50% slower</td>
<td>60-70% slower</td>
</tr>
<tr>
<td>Real-time target data?</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Some, yes</td>
</tr>
<tr>
<td>Number of machine axes measurable with 1 setup</td>
<td>Up to 6</td>
<td>Up to 2</td>
<td>No</td>
<td>Up to 6 but at lower accuracy</td>
<td>Up to 2</td>
</tr>
<tr>
<td>Measure multiple machine axes simultaneously?</td>
<td>Yes, up to 6</td>
<td>Yes, up to 2</td>
<td>No</td>
<td>No</td>
<td>Yes, up to 2</td>
</tr>
<tr>
<td>Number of sensors used simultaneously</td>
<td>Up to 15 in PC software</td>
<td>1</td>
<td>1</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Wireless data delivery?</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td>Number of setups for flatness of a surface</td>
<td>1</td>
<td>1</td>
<td>8 setups</td>
<td>1</td>
<td>8 setups</td>
</tr>
<tr>
<td>Measurement resolution</td>
<td>0.00025 mm</td>
<td>0.001 mm</td>
<td>0.0001 mm</td>
<td>0.0001 mm</td>
<td>Varies up to 0.001 mm</td>
</tr>
<tr>
<td>Measure entire length of machine axis?</td>
<td>Yes</td>
<td>Yes, but very slowly and not to machine tool specs</td>
<td>Yes</td>
<td>Yes, but not to machine tool specs</td>
<td>Yes, but only for leveling</td>
</tr>
<tr>
<td>Measure parallelism of gantry mill rails?</td>
<td>Yes</td>
<td>Yes, but difficult setup and not to machine tool specs</td>
<td>No</td>
<td>Yes, but not to machine tool specs</td>
<td>Yes, if rails are &lt;1 M apart but at low accuracy</td>
</tr>
<tr>
<td>Measure bed twist?</td>
<td>Yes</td>
<td>Yes, but very slowly and not to machine tool specs</td>
<td>No</td>
<td>Yes, but not to machine tool specs</td>
<td>Yes with difficulty and low accuracy</td>
</tr>
<tr>
<td>Accuracy of laser plane</td>
<td>0.0013 mm/ m ±0.0025 mm</td>
<td>0.02 - 0.03 mm/m ±0.05 mm</td>
<td>n/a</td>
<td>0.02 mm + 0.005 mm/m</td>
<td>n/a</td>
</tr>
<tr>
<td>Squareness measurement capability</td>
<td>Up to 0.005 mm/m</td>
<td>Approx. 0.02 mm/m laser to beam</td>
<td>Not published</td>
<td>0.02 mm + 0.005 mm/m</td>
<td>Approx. 0.005 mm/m</td>
</tr>
<tr>
<td>Range of laser</td>
<td>30.5 m in radius</td>
<td>20 - 60 m in radius</td>
<td>40 m</td>
<td>40 m in radius</td>
<td>1 m</td>
</tr>
<tr>
<td>Display equipment for target data</td>
<td>Wired/wireless proprietary display box. Must transfer data to PC for analysis</td>
<td>Laptop only. No handheld device</td>
<td>Desktop computer only-no handheld device</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Machine tool alignment software?</td>
<td>Yes. 3D Plot runs on Windows PC</td>
<td>Yes but limited</td>
<td>Yes, for linear compensation</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Surface flatness software?</td>
<td>Yes. Plane5 runs on Windows PC</td>
<td>Yes. Runs on display box</td>
<td>Yes, but for lines only</td>
<td>Yes, 3D measurement</td>
<td>Yes</td>
</tr>
<tr>
<td>Measure roll angular error for each machine axis?</td>
<td>Yes, very easily</td>
<td>Possible, but difficult and time consuming</td>
<td>No</td>
<td>Possible, but difficult and time consuming</td>
<td></td>
</tr>
<tr>
<td>Measure roll angular error of vertical axes?</td>
<td>Yes, very easily</td>
<td>Possible, but difficult and time consuming</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Cost factor index</td>
<td>1.0</td>
<td>0.75</td>
<td>1.8</td>
<td>3.0</td>
<td>0.1-0.25</td>
</tr>
</tbody>
</table>
Hamar’s alignment software, combined with wireless data interface, makes collecting and analyzing alignment data fast and easy. Software is Windows® based, and provides large, readable color graphics. Shown below is just a sampling of typical data screens.

**S-1387 Machine Tool Geometry Software** – Primarily used to document and analyze the straightness, flatness, parallelism and squareness data for the axis lines of motion for common machine tool types. There are 6 types of machine tools to choose from or add your own.

**S-1388 Plane5 Flatness Software** – Used for recording flatness data of 1, 2 or 3 surfaces. Up to 9 different surface shapes to choose from. Flatness TIR’s and squareness between the surfaces are analyzed using the Least-Squares, Best-Fit algorithm.

### Machine Tool Geometry Software

<table>
<thead>
<tr>
<th>Machine Catalog</th>
<th>Axis Setup Screen</th>
<th>Data Taking Screen</th>
<th>Graph Screen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choose from 6 typical machine configurations.</td>
<td>Set up each line of motion for number of points to be measured.</td>
<td>Records up to 10 bi-directional runs for each axis with an auto-plotting graph.</td>
<td>Shows axis straightness TIRs, parallelism &amp; squareness and straightness graphs for each axis.</td>
</tr>
</tbody>
</table>

### Plane5 Flatness Software

<table>
<thead>
<tr>
<th>Projects Setup Screen</th>
<th>Plane5 — Data Taking Screen</th>
<th>Plane5 — Plot View Screen</th>
<th>Plane5 — Report Screen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configure shape and number of points for up to 9 surfaces.</td>
<td>Data grid where the data points are recorded with up to 5 real-time target displays</td>
<td>3-D plot of surface flatness of 3 or more surfaces.</td>
<td>Complete report showing flatness, squareness and parallelism of all surfaces measured.</td>
</tr>
</tbody>
</table>

### Accessories

<table>
<thead>
<tr>
<th>A-1519/A-1520 Wireless Targets</th>
<th>R-1356-2.4ZB Rugged PDA</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.4GHz Wireless data transmission with 2 resolution options and large measuring range.</td>
<td>Readout with Read15 Software and 2.4GHz Wireless communication displays up to 5 targets.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>A-910-2.4ZB USB 2.4GHz Radio</th>
<th>L-106 Instrument Stand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receiver for tablets and laptops.</td>
<td>Lightweight, variable-height stands for flexible setup.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>R-1308 Single-Axis Readout</th>
<th>R-1307W-2.4ZB 2-Axis Wireless Readout</th>
</tr>
</thead>
<tbody>
<tr>
<td>Designed to plug into the side of our A-1519/A-1520 targets, the R-1308 provides a real-time display of the target data.</td>
<td>Receives and displays the real-time data for up to 2 A-1519/1520 Targets without having to learn any software. Zero targets, change units and decimals.</td>
</tr>
</tbody>
</table>
Checking the alignment of machining centers, gantries, VTL’s etc. can be difficult and time consuming. The L-743/L-733 makes this process simpler and faster. Here’s how the L-743 is setup on a 6-Axis Floor Mill with a traveling column:

1. The laser is placed in a location that provides the best ability to measure all the axes from the same setup either on the table or on an instrument stand.

2. The laser is leveled and the horizontal (red) laser plane is “bucked-in” (aligned in pitch & roll) to 3 points on the table. This gets the laser plane close to the machine’s X and Z axes.

3. Next a vertical laser plane (yellow) is “bucked-in” (aligned in yaw) to the 2 end points of X Axis (in Z) with a target mounted horizontally on the spindle.

4. The L-743 is now aligned to 5 points on the machine: 3 points on the table and 2 end points on the X Axis and is ready to take data.

5. Using the Red and Yellow Laser planes, the X-Axis Flatness/Straightness data are recorded using 2 targets.

6. Next one of the A-1519-2.4ZB Targets is moved to the side of the ram and the Y-Axis Flatness/Straightness is measured using the Green and Yellow planes.

7. Switching to the Red and Green Planes, the 2 A-1519-2.4ZB Targets are repositioned onto the ram and the W-Axis Flatness/Straightness is measured.

8. Lastly, the Z Axis is checked by moving the 2 A-1519-2.4ZB Targets to the table, one mounted on the side and one on the top.

**Parallelism of Rotary Axes & Spindle Tramming**

Checking rotary axes for parallelism/squareness to main axes with the L-743 is a simple process of moving target to the rotary axis, zeroing and rotating the axis to check for deviation. Here we are checking the A-Axis rotation parallelism relative to the X & Y axes.

The same applies for spindle tramming by using a tram bar. Here we’re checking the tram of the main spindle relative to the X & Y axes.
Specifications

L-733/L-743 Triple Scan® Lasers

Laser Type
Class II visible diode, 635 nM wavelength
(Class I in scanning mode);
0.160 in. (4.06 mm) beam diameter

Beam Power
<0.9 mW for each beam

Laser Plane Flatness
L-733:
• 180/360° Sweep: 2.0 arc sec (0.00012 in/ft or 0.01 mm/m),
  plus translational error of ±.0003 in. (0.008 mm)
• 90° Sweep: 1 arc sec (.00006 in/ft or 0.005 mm/m),
  plus translational error of ±.00015 in. (0.004 mm).
L-743:
• 180/360° Sweep: 0.5 arc sec (.00003 in/ft or 0.0025
  mm/m), plus translational error of ±.0001 in. (0.005 mm)
• 90° Sweep: 0.25 arc sec (.00015 in/ft or 0.0013 mm/m)
  plus translational error of ±.0001 in (0.0025 mm).

Plane Squareness
L-733:
• Top-to-Left and Top-to-Back plane: 2 arc secs (.00012 in/ft or 0.01 mm/m);
• Left-to-Back Plane: 3 arc secs (.00018 in/ft or 0.015 mm/m)
L-743:
• Top-to-Left and Top-to-Back plane: 1 arc sec (.00006 in/ft or 0.005 mm/m);
• Left to Back plane: 3 arc secs (.00018 in/ft or 0.015 mm/m);

Operating Range
100 feet (30.5 m) in radius

Operating Modes
3 beams or 1, 2 or 3 continuously rotating laser planes in any
combination, individually switched

Operating Temperature
35° F to 95° F (2° C to 35° C)

Power Supply
• Lithium Polymer rechargeable battery pack with up to 16
  hours battery life for all 3 planes
• 115-240V AC adapter

Course Adjustment
Range
± 3 degrees (±.62 in/ft or 51.6 mm/m)

Fine Adjustment
Range
± 0.3 degrees (±.062 in/ft or 0.51 mm/m). L-743 only.

Coarse Adjustment
Resolution
.010 in. per 100 feet (0.25 mm in 30.5 meters)

Fine Adjustment
Resolution
.001 in. per 100 feet (0.025 mm in 30.5 m). L-743 only.

Weight
Laser: 5.0 lbs. (2.3 kg)
Base: 4.8 lbs. (2.2 kg)

Material
Laser: Aluminum and stainless steel
Base: Aluminum

A-1519/A-1520 Wireless Targets

Resolution
A-1519-2.4ZB: .00002 in. (0.0005 mm)
A-1520-2.4ZB: .00001 in. (0.00025 mm)

Linearized Accuracy
A-1519-2.4ZB: ±.00015 in.
  (±0.0038 mm) over ± .55 in. (±14 mm) of PSD
A-1520-2.4ZB: ±.00006 in.
  (±0.0015 mm) over ± .1 in. (2.5 mm) of PSD

Detector Size/Type
A-1519-2.4ZB: 2-Axis PSD 1.3x.51 in.
  (33x13 mm)
A-1520-2.4ZB: 2-Axis PSD .39x.39 in.
  (10x10 mm)

Operating Range
100 feet (30.5 m) from laser to target

Angle Acceptance Range
±10 degrees from pointing directly at laser

Auto On/Off Power
Targets automatically turn on when the
laser beam sweeps across the target and
turn off when the laser stops sweeping.

Battery Life
11.5 hours continuous duty

Operating Temperature
5° F to 140° F (-15° C to 60° C)

Power Supply
7.5-12vDC, 500mA

Size
2.00 x 4.11x 1.75 in.
  (50.8x78.5x105.2 mm)

Weight
13.5 oz. (0.38 kg)

Wireless Range
133 feet (40 m)

Magnetic Base
Size
2.00x 3.09x 4.14 in.
  (50.8 x78.5 x105.2 mm)

Magnetic Base Weight
2.78 lb. (1.26 kg)

Radio Frequency
2.4 GHz, DSSS (Direct Sequence Spread Spectrum)

Certification
Agency Certifications for the XBee® 802.15.4 Series 1
FCC (United States of America) Certification
Contains FCC ID: OUR-XBEE
IC (Industry Canada) Certification
Contains Model XBee 802.14.4 IC:4214A-XBEE
Complies with ETSI (Europe), C-TICK (Australia)
and Tkec (Japan)

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