

Laser Systems for Geometric Alignment L-730/740 Series

Single-Axis/Multi-Axis
Precision Alignment and Analysis



A Hamar Laser System For Every Alignment Need

Applications



Machine Tool

- Horizontal and Vertical Machining Centers
- Horizontal and Vertical Boring Mills
- Vertical Turning Lathes
- Large Lathe Beds
- Floor and Spar Mills
- Gantries
- Vertical and Horizontal Presses
- Transfer-Line Wing Bases
- Roll-Forming Machines
- Machine Tool Assembly and Calibration



Plastics

- Injection Molding Machines
- Film Lines
- Blown-Film Lines



Leveling

- Split Joints On Steam Turbines
- Machine Bed Leveling

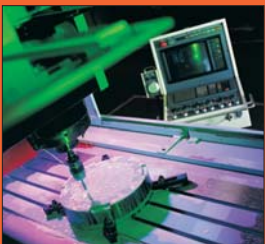
Roll Alignment

- Paper Mills
- Printing Presses
- Continuous Casting Machines
- Steel Mills
- Aluminum Mills
- Textile Mills



Quality Control

- Large-Part Flatness, Straightness and Squareness Checks
- Surface Plate Calibration
- Calibration of Large Fixtures and Jigs
- Checking Flatness when Scraping Machine Rails



Fabricating Machinery

- Tube-Bending Machines
- Routers
- Water Jet Machines
- Laser-Cutting Machines
- Woodworking Machines
- Saw Mills



Fabrication Alignment

- Wind Turbine Flange Parallelism
- Truck Bed Assembly
- Agricultural Machinery Assembly
- Large Construction Machinery Assembly
- Locomotive Assembly



Aerospace

- Body-to-Body Join Assembly Alignment
- Seat-Track Alignment
- Aircraft Interior Alignment (Storage Bins, Gallies, etc.)
- Wing-to-Body Joining Alignment
- Floor Beam Alignment
- Jig/Tooling Calibration and Leveling



Ship Building

- LNG Tanker Hull Construction
- Section Alignment and Layout
- Elevator Shaft Alignment
- Gun-Bearing Alignment



Properly Aligned Machinery And Process Lines Run Better, Last Longer

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 and improve productivity.

Hamar Laser systems offer significant advantages over traditional alignment devices:

- Up to 70% faster
- Simultaneous multi-axis alignment
- Ultra high accuracy and reduced setups
- Target data automatically updates with each adjustment

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.

Hamar's Geometric Alignment Capabilities

Flatness (Level)

- Tables and Separated Surfaces
- Machine Beds and Lines of Motion
- Rail, Vertical-Column and Cross-Rail Twist
- Surface Plates
- Pitch and Roll Angular Measurements

Squareness

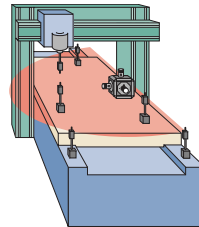
- Columns to Tables or Rails
- X to Y Axis, Z to X Axis and Z to Y Axis
- Gantry Stagger

Straightness

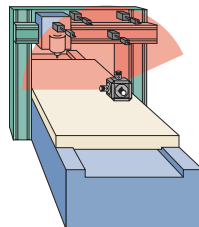
- Machine Beds and Lines of Motion
- Column Travel
- Yaw Angular Measurement
- Beams or Other Structures

Parallelism

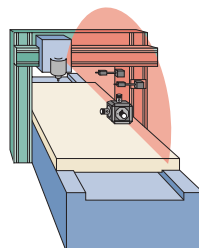
- Master Rail to Slave Rails on Gantries
- A, B, C & W Axes to Main Machine Axes
- Roll-to-Roll
- Platen to Platen, Ram to Ram



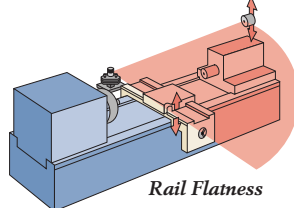
Flatness



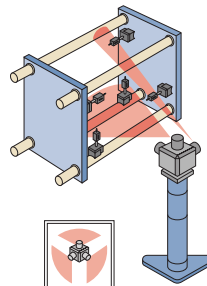
Squareness



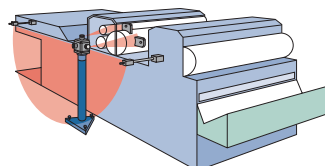
Straightness



Rail Flatness



Parallelism and Tie-Bar Squareness



Roll Parallelism

Case Histories

1 Aircraft Assembly

An aerospace company needed a reliable way to keep a large tooling fixture constantly level during production. They evaluated a laser tracker and Hamar's L-740 Leveling Laser. Since the laser tracker only measured one point at a time, it required multiple operators and setups, and took over four hours to measure and adjust all leveling locations. It also had to measure each point several times to verify if adjusting one location had caused another to move.

Hamar's L-740, using multiple wireless targets simultaneously feeding data into a laptop computer (and just one operator), was able to level the fixture in 10 minutes! Hamar's system also allowed the leveling process to be fully automated by feeding data into the PLC that was driving the actuators and adjusting the fixture — something that was not possible with a tracker. Hamar's L-740 system did the job 18x faster than the laser tracker, and at 1/3 the cost.

2 Adhesive Tape Manufacturing

Here's what a large tape products manufacturer had to say: "We are getting great results from Hamar's (L-742) roll alignment system. We trained four technicians how to use it, and they now travel from plant to plant doing alignments. In 10 months, our ROI is 3x, based on the fees we use to pay to optical alignment sub-contractors. And, that doesn't include all the downtime we've saved. Hamar's system is also more accurate than other alignment methods we've used. Thanks for a top-shelf 'rubber meets the road' solution."

3 Aluminum Mill

An ingot-producing machine at an aluminum mill needed aligning, a job normally assigned to an in-house team using an optics-based leveling system. Wanting to do the job faster, the mill decided to evaluate Hamar's L-743 Triplescan™ Laser. Two optics crews worked alongside the Hamar technician using the L-743. The task was to align the central ram in the pit to machine rails running parallel along the edge of the pit 15' away, to a tolerance of .005".

Hamar's laser was able to measure five points for every one the optics crew could measure. Laser alignment did the job in 36 hours compared to the normal 72 to 96 hours. Using Hamar's system the mill recovered \$250,000 in lost production, and ingot quality went up dramatically.

How Lasers Work: Principles of Operation

LASER is an acronym for Light Amplification by Stimulated Emission of Radiation. Lasers radiate in a single wavelength, in one direction and in a straight line, and are detected by position sensing detectors (PSDs). PSDs detect and convert the center of energy of the laser spot into a calibrated digital reading for output to a hand-held readout or computer interface.

Continuously sweeping laser planes are produced by bending a laser beam precisely 90° using an optical pentaprism. Hamar Laser applies a patented correction process to the pentaprisms to produce ultra-flat, continuously sweeping laser planes.

Laser planes are used as references to measure the flatness, straightness or squareness of surfaces or machine axes. Three reference points are needed to make the laser plane parallel to a surface. However, only two points are needed to measure the straightness of an axis or a machine way.

The laser plane is made parallel (“bucked in”) to a surface or line of motion by adjusting the pitch, roll or yaw of the laser base until the target displays the same reading at each reference point.

The targets are then used to measure the deviation from the reference points up to 100 feet (30.5 meters) away from the laser. The data provided by the targets is automatically — and instantly — updated so the machine can be adjusted and the readout will show the movement. When it shows zero, it’s aligned!

Hamar’s multi-plane lasers all feature laser planes that are orthogonal to each other and thus can be used to measure the squareness between surfaces or machine axes. In most cases with one setup, the laser can measure the squareness between all the axes of the machine tool. Please visit www.hamarlaser.com under “How Lasers Work” for a more detailed description.

Comparison Matrix — Geometry Measuring Systems

	Feature	Hamar Laser	European Geo. Laser Manufacturers	Interferometers (Linear Distance Laser)	Laser Trackers	Traditional Methods (Straight edge, levels, squares, etc.)	
Machining Center Alignment	Automatically rotating laser planes?	Yes, 7 Models	Yes for 1 mfr., others use “Point & Shoot technology”	No, laser line only	No, laser line only	No	
	Can be used for alignment?	Yes	Yes	No, measurement only	No, measurement only	Yes, for some	
	No. of setups for machine tools	Usually 1	3–4	8+	1–3+	5+	
	No. Auto Rotating Laser Planes	3 with Triple Scan	1	0	0	n/a	
	Estimated time savings (vs. traditional methods)	50–70%	10–20%	10–20% longer!	5–10%	0%	
	Does target data update with alignment?	Yes	Yes	No	No	Yes	
	Measure multiple machine axes with 1 setup?	Yes, up to 5	Yes, up to 2	No	Yes	Yes, up to 2	
	Measure multiple machine axes simultaneously?	Yes, up to 5	Yes, up to 2	No	No	Yes, up to 2	
	Sensors used simultaneously	Up to 8 in PDA	1	1	1	n/a	
	Measurement range of targets:	Up to 25 mm	10 mm	5–10 mm	n/a	n/a	
	Wireless data delivery?	Yes	No	No	No	No	
	No. of setups for surface plate	1	1	6 setups	n/a	6+ setups	
	Accurate for machine tools?	Yes	Straightness: Yes. Flatness, Squareness, Parallelism: No	Yes	No	Yes, but depends on instrument	
	Target resolution:	up to 0.00025 mm	up to 0.001 mm	up to 0.0001 mm	up to 0.0001 mm	0.001 mm	
Measure entire length of machine axis?	Yes	Yes, but very slowly and not to machine tool specs	Yes	Yes, but not to machine tool specs	No		
Measure parallelism of gantry mill rails?	Yes	Yes, but very slowly and not to machine tool specs	No	Yes, but not to machine tool specs	Yes, if rails are <1 M apart		
Measure bed twist?	Yes	Yes, but very slowly and not to machine tool specs	No	Yes, but not to machine tool specs	Yes, with difficulty & low accuracy		
Cost factor index	1.0	0.8	1.8	5.0	0.5		
	Feature	Hamar Laser	Company A	Company B	Company C	Interferometers (Linear Distance Laser)	Laser Trackers
Other Differences	Accuracy of laser plane:	0.0025 mm/M for plane 0.001 mm/M for line	Not specified	0.03 mm/M	Approx. 0.02 mm/M	N/A (Laser line only)	Not readily available
	Step error in laser plane:	+/- 0.0013 mm	Not specified	+/- 0.05 mm	Not specified	n/a	n/a
	Laser beam straightness:	0.001 mm/M	Not specified	Not specified	Not specified	0.001 mm/M	Not specified
	Squareness measurement capability	0.005 mm/M	Approx. 0.01 mm/M laser to beam	0.03 mm/M laser to beam	Cannot measure squareness	Not specified	Not specified
	Range of laser:	30.5 meters in radius	40 meters in radius	20 meters in radius	20 meters	40 meters total	40 meters total
	Display equipment for target data:	Wireless PDA or PC interface – up to 8 targets simultaneously	Wired display box – can download data into PC – one target at a time	Wired/Wireless Display box – must transfer data to PC for analysis	Wired display box – can download data into PC – one target at a time	Laptop only – no handheld device	Desktop computer only – no handheld device
	Offer machine alignment software?	Yes, 3D Plot runs on Windows PC	no	no	no	Yes, for linear compensation	No
	Offer surface measurement software?	Yes, Plane5 runs on Windows PC	Yes, runs on display box	Yes, runs on display box	Yes, runs on display box	Yes, one axis at a time	Yes, 3D measurement
	Offer deflection monitoring software?	Yes, Read8 runs on Windows PC	No	No	No	Not possible with interferometer	Yes, but not automatically
	Measure roll for each machine axis?	Yes very easily	Possible but difficult & very time consuming	Possible but difficult & very time consuming	Possible but difficult & very time consuming	No	No
Measure roll of machine’s vertical axis?	Yes very easily	Possible but difficult & very time consuming	Possible but difficult & very time consuming	Possible but difficult & very time consuming	No	No	
Roll alignment:	Yes	Yes, but very time consuming & low accuracy	Yes, but very time consuming & low accuracy	No	No	Yes, with difficulty & low accuracy	

L-730 Series Systems

Laser System Options

Different applications require different levels of accuracy which is why we developed two basic families of laser alignment systems:

L-730 Series. Ideal for precision-level work but where tolerances are not as critical (e.g. simple fabrication alignment checks, etc.)

L-740 Series. Ultra-precise, used for more demanding "mission critical" tasks (e.g. aligning complex machine tool geometry, etc.)

Each family of lasers is available in single, dual and triple-plane versions. Many of the features and accessories within the two families are the same. The key difference is the degree of accuracy. For example, with the L-730 Series, laser plane flatness is accurate to 2 arc seconds (.00012"/ft or 0.01 mm/M). With the L-740 Series it's a more stringent 0.5 arcsec (.00003"/ft or 0.0025 mm/M).

As would be expected, the tighter the tolerances and greater the accuracy level, the higher the price. Accordingly, the L-730 Series is an economical choice perfectly suitable for a wide range of alignment applications that do not require the ultra-precision attainable in our L-740 Series lasers.

L-730 & L-740 Series Features

- Live data output to measure — then fix — misalignment, in real time.
- Continuously sweeping laser planes with a range of 100' (30.5 m) in radius.
- Built-in squareness measuring capability of up to .00006"/ft or 0.005 mm/M (multi-plane lasers only).
- Multiple targets displayed simultaneously for faster alignment and setup.
- Collect flatness and straightness data simultaneously.
- Work up to 70% faster than interferometers, theodolites, transits and other conventional methods.
- Easy to learn how to use, simple to operate.
- Able to collect complete geometry data on most machines in under 90 minutes.

Additional specifications are listed on the back panel, or for more details visit our web-site at: www.hamarlaser.com.

High-Accuracy, Economically-Priced Laser Alignment Systems

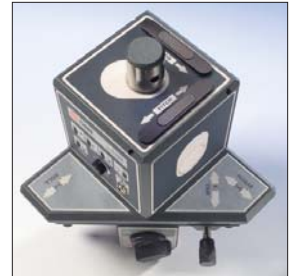
Features and Benefits

The L-730 Series of single, dual and triple-plane laser systems adapts Hamar's metrology innovations to applications with less stringent alignment requirements like fabrication alignment, textile roll alignment, woodworking, and the water-jet/laser-cutting machine tool industries. You get the benefits of our high-accuracy laser systems, at a price that is easier to justify.

L-730 Series Features:

- One, two or three auto-rotating laser planes
- Accurate to .00012"/ft or 0.01 mm/M
- Laser plane orthogonality: .00012"/ft or 0.01 mm/M
- Built-in, backlit level vials with .00012"/ft or 0.01 mm/M accuracy
- Dimension measuring capability with target height-gage feature
- 3-axis adjustment base for fast setups

In addition, the L-730 Series lasers feature two target options: a) The A-1532 or A-1533 with a built-in readout, up to 3" (75mm) measuring range, and .001" (0.02 mm) resolution, or b) the A-1519 with wireless communication (to PDA), up to 1" (25 mm) measuring range, resolution to .00002" (0.0005 mm) and automatic data downloading into our machine geometry or surface analysis software.



L-730 Precision Leveling Laser System



L-732 Precision Roll Alignment System



L-733 Precision Triple Scan[®] Geometry Alignment System

L-740 Series Systems



L-740 Ultra-Precision Leveling Laser



L-741 Ultra-Precision Leveling Laser (with Plumb Beam)



L-742 Ultra-Precision Dual Scan Laser



L-743 Ultra-Precision Triple Scan Laser

Laser Alignment Systems for Complex, Ultra-Precise Applications

Features and Benefits

Our ultra-precision L-740 Series Laser Alignment Systems represent the pinnacle of achievement in laser alignment technology. With the L-743 Triple Scan® laser, measure flatness, straightness, and squareness simultaneously, with one setup! Powerful machine geometry analysis software automatically downloads alignment data, corrects laser-slope and poor-reference-point errors and produces comprehensive alignment reports.

L-740 Series Features:

- One, two or three auto-rotating laser planes
- Accurate to .00003"/ft or 0.0025 mm/M
- Laser plane orthogonality: .00006"/ft or 0.005 mm/M
- Built-in, backlit level vials with .00006"/ft or 0.005 mm/M accuracy
- 3-axis adjustment base for fast setups

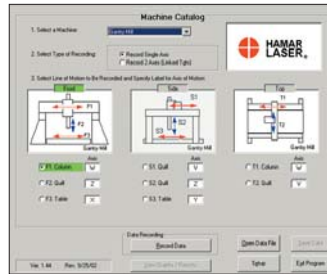
The system comes with 2 wireless target options: A) the A-1519 with 1" (25mm) measuring range and .00002" (0.0005 mm) resolution; or B) the A-1520 with .25" (10 mm) measuring range and .00001" (0.00025 mm) resolution. Our R-1310 wireless readout can display up to eight targets, four simultaneously. The A-910 wireless PC base station can download data from up to 99 targets at the same time.

Which Laser System Is Right For You?

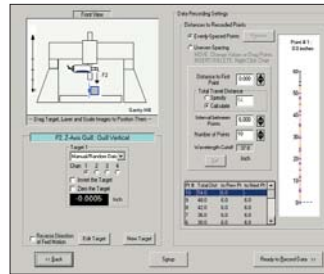
	Precision Series			Ultra Precision Series			
	L-730	L-732	L-733	L-740	L-741	L-742	L-743
# of Laser Planes	1	2	3	1	1	2	3
Measurement Tasks							
Flatness/Leveling	•	•	•	•	•	•	•
Machine Bed Flatness	•	•	•	•	•	•	•
Squareness	•	•	•	•	•	•	•
Straightness	•	•	•	•	•	•	•
Parallelism	•	•	•	•	•	•	•
Rail Parallelism	•	•	•	•	•	•	•
Typical Applications							
Machine Tool Geometry				•	•	•	•
Roll Alignment		•	•			•	•
Inj. Molding Mach.		•	•			•	•
Aerospace Assem.	•	•	•	•	•	•	•
Surface Plates				•	•	•	•
Large-Part Align.	•	•	•	•	•	•	•
Fabrication Alignment/Equip.	•	•	•				
Accuracy Levels							
Laser Plane Flatness	.00012"/ft or 0.01 mm/M			.00003"/ft or 0.0025 mm/M			
Beam Plane Squareness	n/a	.00012"/ft or 0.01 mm/M		n/a	0.0006"/ft or 0.005 mm/M		
Adjustment Parameters							
Coarse Adjustment Range	+/- 3.0 degrees			+/- 3.0 degrees			
Fine Adjustment Range	n/a			+/- .03 degrees			
Course Adjustment Resolution	.010" (0.25 mm) in 100 feet (30.5 meters)			.010" (0.25 mm) in 100 feet (30.5 meters)			
Fine Adjustment Resolution	n/a			.001" (0.025 mm) in 100 feet (30.5 meters)			
Target/Readout Options							
Target:							
A-1532 & A-1533	std.	std.	std.	n/a	n/a	n/a	n/a
A-1519 & A-1520 Wireless	opt.	opt.	opt.	std.	std.	std.	std.
Recommended #:	1	2-3	3-4	1	1	2-3	3-4
Readout:							
Built-in	std.	std.	std.	n/a	n/a	n/a	n/a
Wireless	opt.	opt.	opt.	std.	std.	std.	std.
Price Range							
	\$	\$\$	\$\$\$	\$\$	\$\$	\$\$\$	\$\$\$\$

Powerful Data Analysis Software

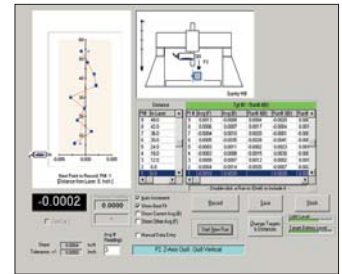
Hamar's alignment software, combined with newly-designed wireless interfaces, makes collecting and analyzing alignment data fast and easy. Software is Windows based, and provides large, readable color graphics. Shown below is just a sampling of typical data screens.



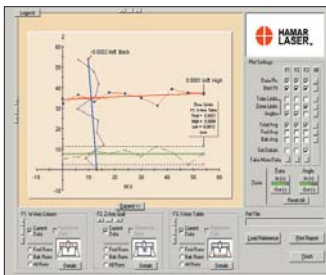
Machine Tool Geometry — Machine Setup Screen.
Choose from multiple machine configurations. Used for machining center calibration.



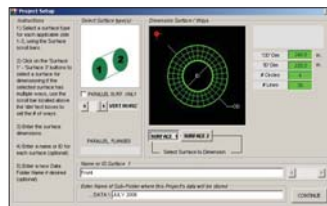
Machine Tool Geometry — Axis Setup Screen.
Set up each line of motion for number of points to be measured.



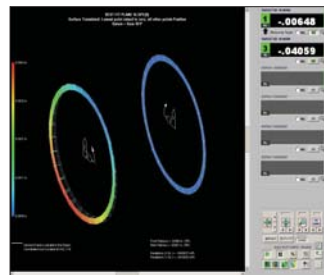
Machine Tool Geometry — Data Taking Screen.
Records up to 10 bi-directional runs for each axis.



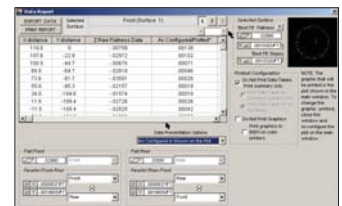
Machine Tool Geometry — Graph Screen.
Shows axis TIRs, parallelism and squareness between axes.



Plane5 — Projects Setup Screen.
Configure shape and # of points for up to 7 surfaces. Used for measuring flatness, squareness and parallelism of machined surfaces.



Plane5 — Plot View Screen.
3-D plot of surface flatness of 3 or more surfaces.



Plane5 — Report Screen.
Complete report showing flatness, squareness and parallelism of all surfaces measured.

Accessories



A-910 Radio Receiver
Wireless (900 MHz or 2.4 GHz) data retrieval for laptop analysis.



R-1310 PDA Readout
Wireless (900 MHz or 2.4 GHz), displays up to 4 targets simultaneously.



A-1519/A-1520 Universal Targets
Wireless (900 MHz or 2.4 GHz) data transmission with 2 resolution options and large measuring range.



L-106 Instrument Stand
Lightweight, variable-height stands for flexible setup.

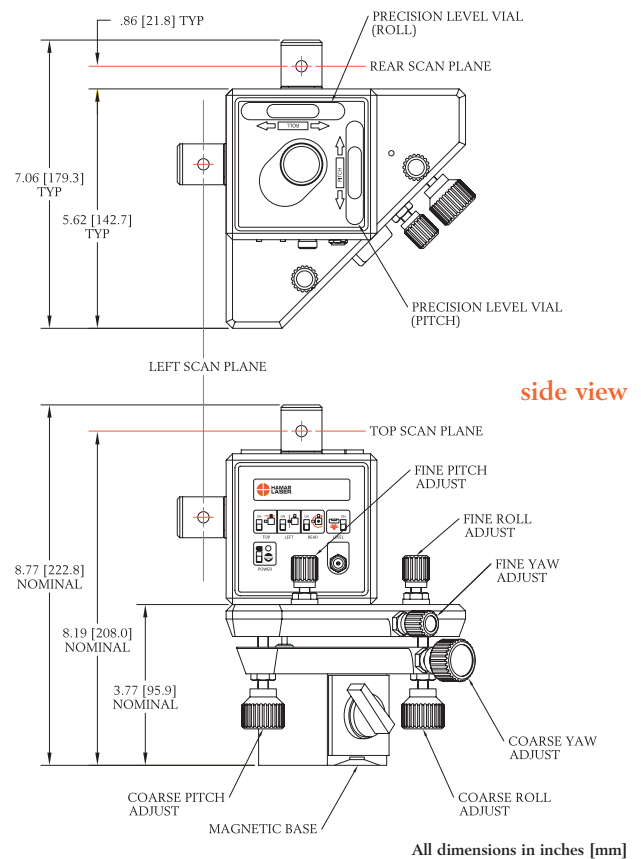
Specifications

L-743 Triple Scan Laser with Coarse/Fine Adjust Base

L-733 Triple Scan Laser with Coarse Adjust Base

Weight	Laser: 3 lbs. (1.3 kg) Base: 4.8 lbs. (2.2 kg) Battery Pack: 1 lb. (0.45 kg)
Material	Laser: Aluminum and stainless steel Base: Aluminum
Laser Type	Class II visible diode, 635 nm wavelength (class 1 in Scanning Mode); 0.160" (4.06 mm) beam diameter
Beam Power	0.9 mW per straight beam
Beam Stability	.0001"/hr/°F (0.005 mm/hr/°C) translational 0.2 arc sec./hr/°F (0.36 arc sec/hr/°C) angular
Beam Straightness	.00001 in/ft (0.0008 mm/M)
Laser Plane Flatness	<u>For L-740 Series:</u> 360° Sweep: 0.5 arc second (0.00003 in/ft or 0.0025 mm/M), plus maximum translational error of +/- .00005" (0.0013 mm) 90° Sweep: 0.25 arc second (.000015 in/ft or 0.0013 mm/M) plus maximum translational error of +/- .00005" (0.0013 mm). <u>For L-730 Series:</u> 2 arc seconds for flatness
Beam/Plane Squareness	<u>For L-740 Series:</u> 3 (or 2) planes mutually square to within 1.0 arc second (.00006 in/ft or 0.005 mm/M) <u>For L-730 Series:</u> 3 (or 2) planes mutually square to 2 arc seconds
Operating Range	100 feet (30.5 meters) in radius
Operating Modes	1, 2, or 3 beams and/or 1, 2, or 3 continuously sweeping planes in any combination, individually switched
Power Supply	9V DC external battery pack (4 cells) or 115V AC adapter
Power Draw	(See chart)
Coarse Adjustment Range	+/- 3 degrees
Coarse Adjustment Resolution	.010" (0.25 mm) in 100 feet (30.5 meters)
Fine Adjustment Range	+/- 0.3 degrees (L-740 Series Only)
Fine Adjustment Resolution	.001" (0.025 mm) in 100 feet (30.5 meters) (L-740 Series Only)

L-743 Triple Scan® Ultra-Precision Machine Tool Alignment System*



* See www.hamarlaser.com for a drawing of the L-733 Triple Scan Laser.

Power Draw	Laser Only	Laser & Scanner	Battery Life*
1 Beam	100 mA	130 mA	2.5 hrs.
2 Beams	180 mA	230 mA	1.4 hrs.
3 Beams	260 mA	330 mA	1.0 hrs.

* Per 9V alkaline battery (500 mA hrs.). Multiply battery life figure by the number of batteries used (external battery pack uses 4 cells).



Hamar Laser Instruments, Inc.

5 Ye Olde Road, Danbury, CT 06810

Phone: +1.203.730.4600 • 800.826.6185 • Fax: +1.203.730.4611

E-mail: sales@hamarlaser.com

www.hamarlaser.com