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

Ultra-Accurate & Fast
Simultaneous Multi-Axis
Easy to Learn

HAMAR LASER®
ALIGN WITH THE BEST

Properly Aligned Machine Tools 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, 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"

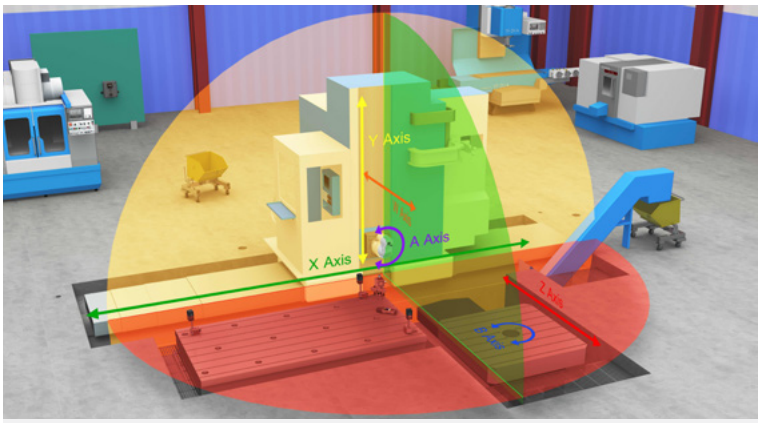
With the capability of seeing the data from multiple targets simultaneously, reference targets can be used to monitor laser drift on long-distance applications, another time-saving feature that reduces "do-overs." You can also see if aligning an axis has any effects on the other axes.

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)

L-743/L-733 Geometric Alignment Capabilities

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

- Axis Squareness: X-Y, X-W, X-Z, Y-W, & Y-Z
- Columns to Tables or Rails
- Rotary Axes to Main Machine Axes

Straightness

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

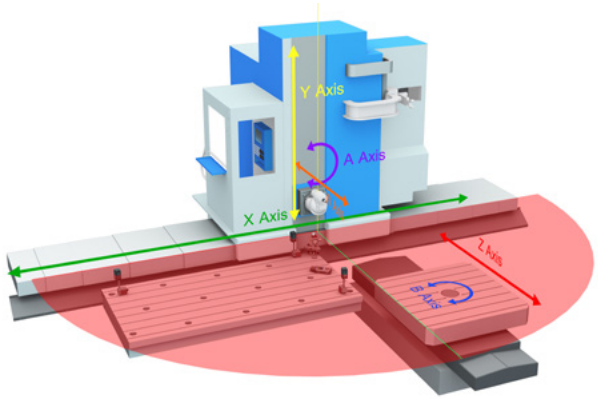
Parallelism

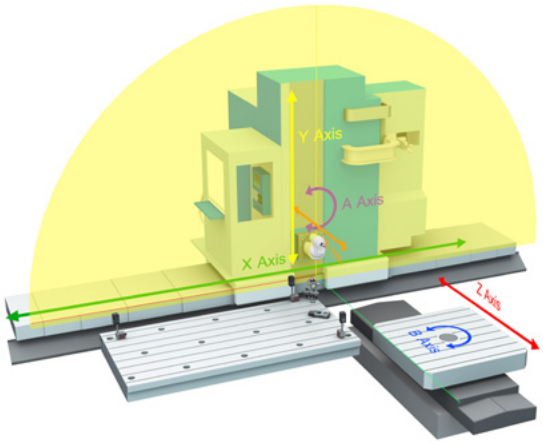
- A, B & W Axes to Main Machine Axes
- Machine Guideway Roll/Twist
- Master Guideway to Slave Guideway on Gantries

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



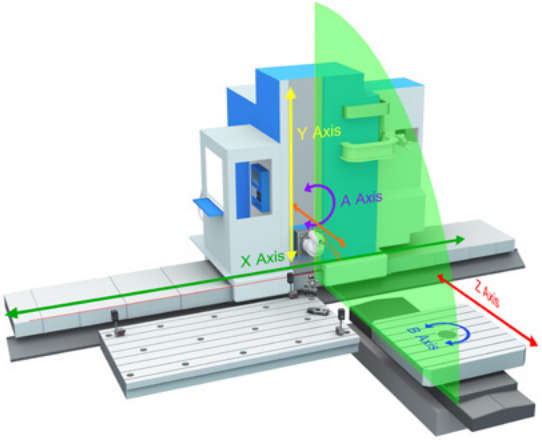


Yellow Laser Plane Measures:

X-Axis Straightness in W
Y-Axis Flatness (Straightness in W)
Y - Z Axis Squareness
A-Axis Rotation Parallelism to X & Y

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



L-733 & L-743 Laser Systems Features

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.)

L-733 Precision Triple Scan® Laser

L-743 Ultra-Precision Triple Scan® Laser

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?

	L-733	L-743
Typical Applications		
Boring Mills, Floor Mills		•
VMC's & HMC's		•
Gantries & VTL's		•
Large-Bed Lathes		•
Water Jet & Laser Cutting Machines	•	•
Injection Molding Machines	•	•
Surface Plates		•
Large-Part Geometry	•	•
Alignment Capabilities		
High-Accuracy Leveling		•
Flatness	•	•
Squareness	•	•
Straightness	•	•
Parallelism – Axes	•	•
Parallelism - Guideways	•	•
Parallelism - Rotary-Axis	•	•
Spindle Tramming		•
Alignment Accuracies		
Laser Plane Flatness	Up to .00006 in/ft. (0.005 mm/m)	Up to .000015 in./ft. (0.0013 mm/m)
Beam Plane Squareness	Up to .00012 in/ft. (0.01 mm/m)	Up to .00006 in/ft. (0.005 mm/m)

Comparison Matrix – Geometry Measuring Systems

(Machining Center Alignment)

Feature	Hamar Laser	European Geo. Laser Manufacturers	Interferometers (Linear Distance Laser)	Laser Trackers	Traditional Methods (Straight edge, levels, squares, etc.)
Automatically rotating laser planes?	Yes, 7 models	Yes for 2 mfgrs. 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
Number of setups for machine tools	Usually 1-2	3-4	8+	1-3+	5+
Number of auto-rotating laser planes	3 with L-733/L-743	1	N/A – laser line only	N/A	N/A
Estimated Slower Alignment Time vs. L-733/L-743	1	40-50% slower	70-80% slower	40-50% slower	60-70% slower
Real-time target data?	Yes	Yes	No	No	Some, yes
Number of machine axes measureable with 1 setup	Up to 6	Up to 2	No	Up to 6 but at lower accuracy	Up to 2
Measure multiple machine axes simultaneously?	Yes, up to 6	Yes, up to 2	No	No	Yes, up to 2
Number of sensors used simultaneously	Up to 15 in PC software	1	1	N/A	N/A
Wireless data delivery?	Yes	1 - yes; the rest, no	No	N/A	N/A
Number of setups for flatness of a surface	1	1	8 setups	1	8 setups
Measurement resolution	0.00025 mm	0.001 mm	0.0001 mm	0.0001 mm	Varies up to 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	Yes, but only for leveling
Measure parallelism of gantry mill rails?	Yes	Yes, but difficult setup and not to machine tool specs	No	Yes, but not to machine tool specs	Yes, if rails are <1 M apart but at low accuracy
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 and low accuracy
Accuracy of laser plane	0.0013 mm/ m ±0.0025 mm	0.02-0.03 mm/m ±0.05 mm	n/a	0.02 mm + 0.005 mm/m	n/a
Squareness measurement capability	Up to 0.005 mm/m	Approx. 0.02 mm/m laser to beam	Not published	0.02 mm + 0.005 mm/m	Approx. 0.005 mm/m
Range of laser	30.5 m in radius	20-60 m in radius	40 m	40 m in radius	1 m
Display equipment for target data	Wireless PDA or PC interface – up to 15 targets simultaneously	Wired/wireless proprietary display box. Must transfer data to PC for analysis	Laptop only. No handheld device	Desktop computer only-no handheld device	n/a
Machine tool alignment software?	Yes. 3D Plot runs on Windows PC	Yes but limited	Yes, for linear compensation	No	No
Surface flatness software?	Yes. Plane5 runs on Windows PC	Yes. Runs on display box	Yes, but for lines only	Yes, 3D measurement	Yes
Measure roll angular error for each machine axis?	Yes, very easily	Possible, but difficult and time consuming	No	Possible, but difficult and time consuming	
Measure roll angular error of vertical axes?	Yes, very easily	Possible, but difficult and time consuming	No	No	
Cost factor index	1.0	0.75	1.8	3.0	0.1-0.25

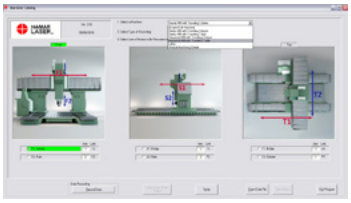
Powerful Data Analysis Software

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.

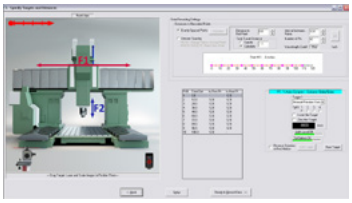
S-1387 Machine Tool Geometry Software – Primarily used to document and analyze the straightness, flatness, parallelism and squareness data for the axis lines of motion for common machine tool types. There are 6 types of machine tools to choose from or add your own.

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.

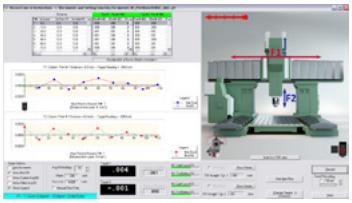
Machine Tool Geometry Software



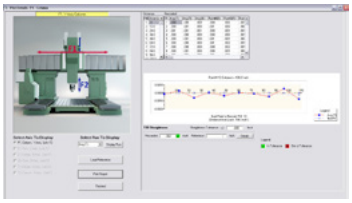
Machine Catalog
Choose from 6 typical machine configurations.



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

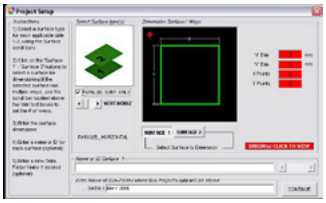


Data Taking Screen
Records up to 10 bi-directional runs for each axis with an auto-plotting graph.

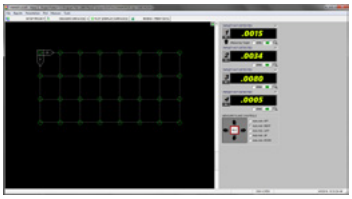


Graph Screen
Shows axis straightness TIRs, parallelism & squareness and straightness graphs for each axis.

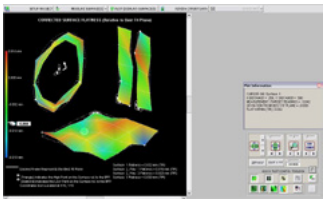
Plane5 Flatness Software



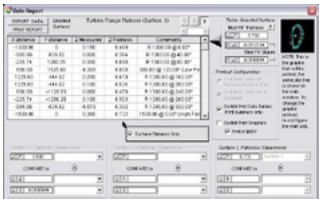
Projects Setup Screen
Configure shape and number of points for up to 9 surfaces.



Plane5 — Data Taking Screen
Data grid where the data points are recorded with up to 5 real-time target displays



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-1519/A-1520 Wireless Targets
2.4GHz Wireless data transmission with 2 resolution options and large measuring range.

R-1356-2.4ZB Rugged PDA
Readout with Read15 Software and 2.4GHz Wireless communication displays up to 5 targets.

A-910-2.4ZB USB 2.4GHz Radio
Receiver for tablets and laptops.

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

R-1308 Single-Axis Readout
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.

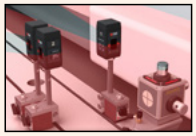
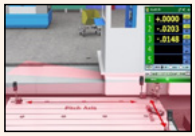
R-1307W-2.4ZB 2-Axis Wireless Readout
Receives and displays the real-time data for up to 2 A-1519/1520 Targets without having to learn any software. Zero targets, change units and decimals.

How the Alignment System Works

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:

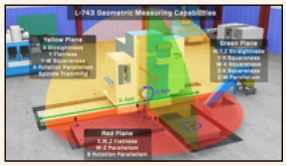
1. The laser is placed in a location that provides the best ability to measure all the axes from the same setup either on the table or on an instrument stand.

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.

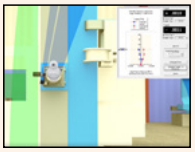
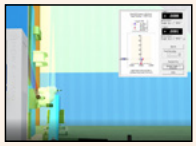
3. Next a vertical laser plane (yellow) is "bucked-in" (aligned in yaw) to the 2 end points of X Axis (in Z) with a target mounted horizontally on the spindle.

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.



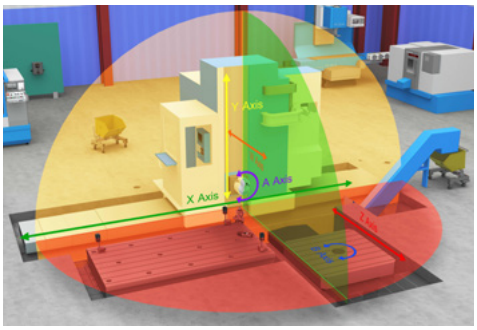
5. Using the Red and Yellow Laser planes, the X-Axis Flatness/Straightness data are recorded using 2 targets.

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 repositioined 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 using the Yellow laser plane.

A Axis with A-1519-2.4ZB at 12:00

A Axis with A-1519-2.4ZB rotated to 6:00

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.

Spindle Tram Bar with with A-1519-2.4ZB at 12:00

Spindle Tram Bar with A-1519-2.4ZB rotated to 6:00

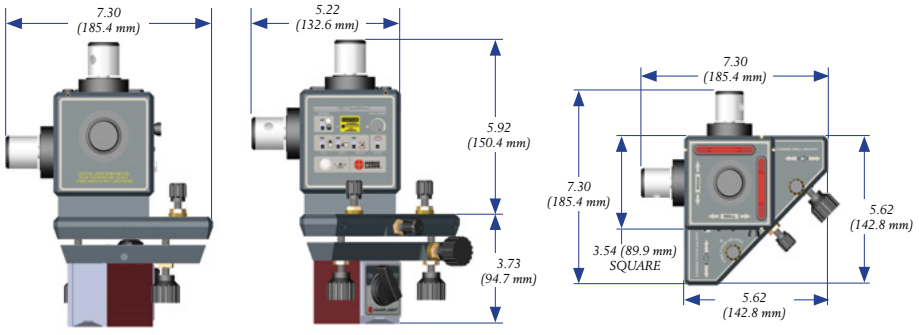
Specifications

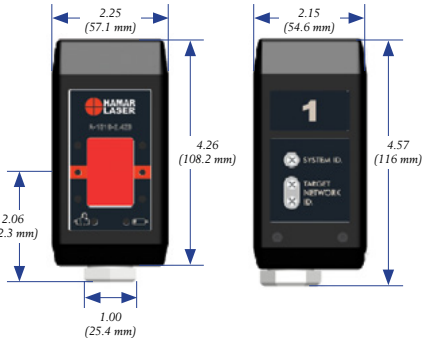
L-733/L-743 Triple Scan® Lasers

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. (0.0025 mm) • 90° Sweep: 0.25 arc sec (.000015 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 Telec (Japan)





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