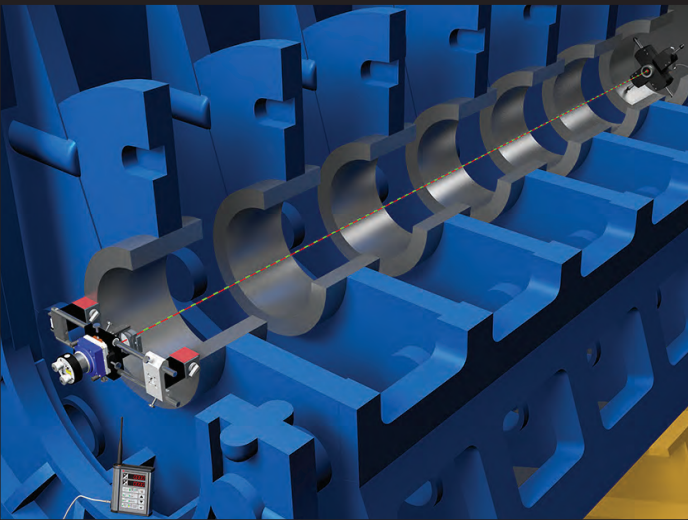


# L-706 Bore Alignment Laser System

Aligning Crank-Case  
Bores and Bearing  
Journals is Now Faster  
and Easier Than Ever



# L-706 Bore Alignment Laser System



## The Leader in Laser Bore Alignment Technology

Hamar Laser has been making bore alignment lasers for over 40 years. In fact, we designed the very first bore alignment laser for Westinghouse back in 1973! We know bore alignment. Our systems are known for their high accuracy, innovative design and fast setup.

Our patented, self-centering bore alignment targets are the easiest and fastest way to check bore alignment because they do not require a bore "sweep" or a reversal procedure to eliminate bore measurement problems due to diameter changes. To measure the alignment, simply insert the bore target and self-centering adapter into the bore, let the weighted handle set the target in the bore and immediately the real-time alignment results are displayed on a simple 2-axis readout. In most cases, you can achieve accuracies down to .0002" (0.005 mm) in 10 feet (3 m).

## Bore applications include:

- Engine Blocks
- Compressor Bores
- Shaft Bearing Bores
- Stern Tubes
- Plus many more

## Results 3x Faster Than Optical Bore Scopes or Tight Wire

With the L-706, alignment of bores is fast and easy: Setup takes 15 to 20 minutes, and overall alignments are done up to 3x faster than with optical bore scopes or tight, and because alignment data is real time, misaligned bores can be brought into tolerance very quickly. After setup, a 10-foot (3 m) long bore can be measured for straightness

every foot (300 mm) in under 5 minutes!

## Self-Centering Target Adapters Reduces Measurement Points by 50%

With typical bore alignment lasers, you either need to sweep the bore to center an alignment fixture or take the measurement twice, once with the target mounted normally and once with it inverted, to take into account diameter changes and centering errors. With our self-centering bore adapters, you only need to take the measurement once because diameter changes do not affect the alignment. This results in 50% fewer measurements and a very fast alignment check!

## More Accurate and Repeatable Measurements Than Optics

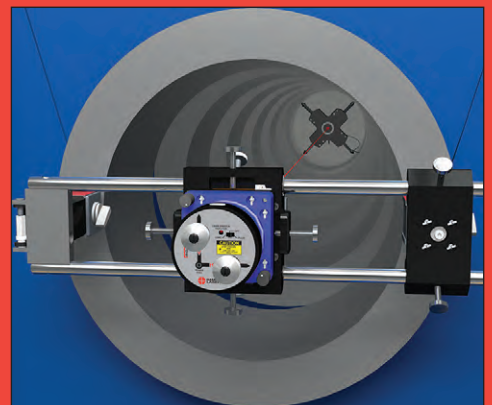
With optics, the measurement process can be more of an "art" than a science, since one operator will "see" a different set of values than another. The L-706 System uses sophisticated electronic sensors to detect the laser and thus offer greater accuracy and repeatability. The system offer a resolution of .00002" (0.0005 mm) and bore measurements are repeatable to .0002 in. (0.005 mm).

## Extend Component Life, Reduce Downtime

Misaligned bearing bores will cause premature failures, requiring frequent replacement, more downtime, and higher maintenance costs. Proper and more accurate alignment helps components to last longer and prevent big problems — before they occur.

## Key Features:

- 15-minute setup time. Measure each bore in seconds.
- Self-centering adapters are easy to insert into tight spaces and require no sweeping
- For diameters from 3.75" (95 mm) to 40"+ (1 M)
- Optional Small-Bore Targets can align bores as small as .70 in (17.5 mm)
- Adjustable legs fit a large range of bore diameters
- Leg-Setting Gage centers adapters to .0002" (0.005 mm)
- Readouts update in real time as the bore is adjusted
- Add a second readout to transmit readings wirelessly up to 200' (61 M)
- Optional Bore9 software aids with setup, records bore data and analyzes the results
- L-706 Operational Range: 100' (30.5 M)
- Durable and rugged design



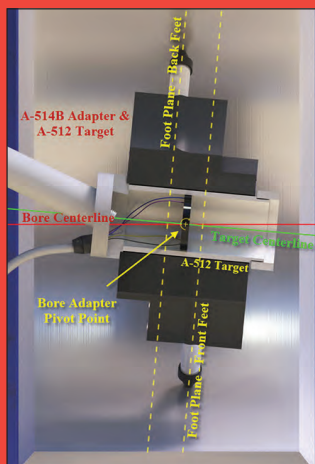
*The L-706 can be mounted on the face of a bore or on an instrument stand to easily handle any bore application.*



# Features Designed With Versatility in Mind

## Self-Centering Adapters — The Key to Speed

The A-512 Target and A-514 Adapter Hubs are designed so that the PSD (position sensing detector) is centered axially between the adapter's 4 feet, two of which are offset axially from the other two feet. This puts the PSD on the pivot point of the adapter and allows the target's angle of incidence to the laser to vary by up to 45° without changing the adapter's centering. To insert the target/adapter into the bore, a weighted handle is attached to the target/adapter and the adapter is tipped forward, which allows it to be inserted into the bore. The



weight of the handle forces the target to tip backward and seat the target legs into the bore, centering the adapter/target.

## 4-Axis Laser Adjustment Fixture

The L-111 Laser Stand and L-102 Beam Translator provide 4-axis adjustment capability to quickly align the laser beam to any two reference bores for fast alignment checks. The fixture can be mounted either on the face of a bore or on an instrument stand.



## Adjustable Target Adapter Legs

Self-centering laser and target adapters have adjustable legs that allow adapters to be used for diameters ranging from 3.75" (95 mm) to 40" (1 M) (see specifications for details).

## Precise Angular Adjustment

Precision angular adjustments provide angular pointing control of the laser beam so it can be tilted with a resolution of .0015" in 100' (0.038 mm in 30.5 M).

## 2.2495" Mounting Diameter Fits into Boring Bar Bearings for Quick QC

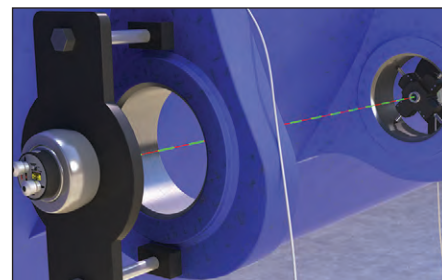
The L-706 Laser and T-218 Target have been designed with a standard boring-bar diameter of 2.2495" (57.137 mm). This means the L-706 and T-218 can be inserted directly into bearings after machining for a quick check of the bore straightness when using our A-512/A-514 Self-Centering Bore Target and Adapters.

## T-218 Target Measures Bore Diameter Change

The T-218 2-Axis Bore Target and T-225L Large Bore Flange are used to measure the bore diameter change from a nominal measurement. Simply measure one of the bores for a reference diameter and then insert the T-218/T-225L into the bore. Take two measurements, one in the normal orientation and one in the inverted and Bore9 does the math to determine the difference in bore diameter from the nominal measurement.

## Large-Range Targets

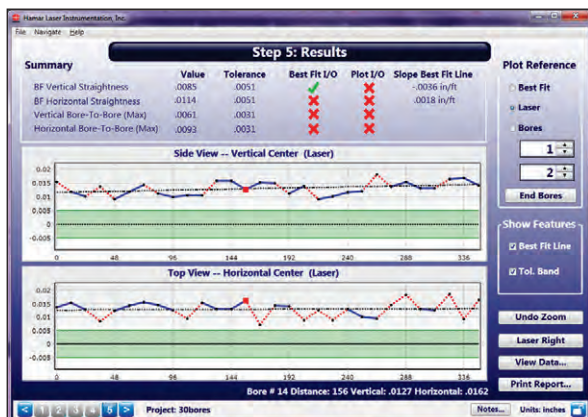
For long-distance application that require a large measuring range, our T-1218 2-Axis Target offers a 20x20 mm PSD. It has a hardened, stainless steel body with a 3" (76.2 mm) diameter mounting surface. Use with the T-1225L Bore Adapter to measure bores from 5.75" (146 mm) to 40"+(1 M).



L-706 Laser Mounted in Boring-Bar Bearing

## Optional Computer Upgrade

Data can be collected and displayed in real time with our Bore9 Software for Win 7/8 tablets and laptops. Bore9 plots bore misalignment: 1) relative to end bores, 2) relative to two user-defined bores or 3) relative to Best Fit line.



Bore9 Software showing plot of bore straightness.

# How HLI Bore Alignment Systems Work - Engine Block Bearing Bores

## Setup Laser, Enter Dimensions, Measure Bore Alignment and Generate Report in 30 Minutes or Less! Here is how:

1. The bore diameter, dimensions between bores and tolerances are entered into Bore9.

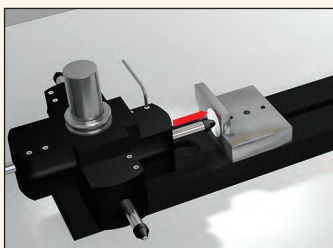


2. The L-706 Laser is mounted externally either on an instrument stand or on the face of the reference bore using the L-111 Laser Stand.



L-705/L-111 Laser and Stand Mounted on Bore Face

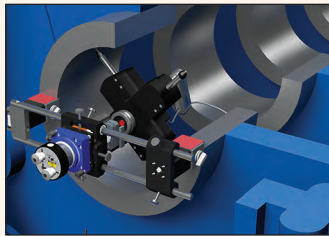
3. Next, the A-514 Adapter legs are set to the nominal bore ID using the A-514GS Leg-Setting Gage.



A-514GS Leg-Setting Gage

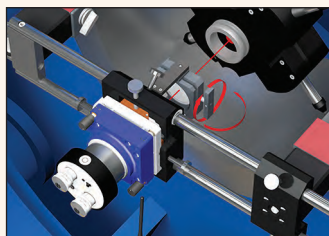
4. Then the A-512 Target is inserted into the A-514 adapter and the R-1307B-2.4ZB Readout is connected.
5. The A-512/A-514 are then inserted into the end bore

closest to the laser.

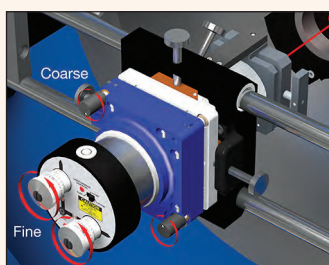


L-706 Laser and L-111 Mounting Fixture with A-512/A-514

6. The laser beam will not be on center, so the L-102 Beam Translator V & H center adjustments are used to align the laser to the center of the A-512 target in the near reference bore.
7. Now the A-512/A-514 are moved to the far reference bore and the H & V values are noted.
8. If the laser is not hitting the PSD sensor in the target, the L-111 coarse angular adjustments are then used to roughly center the laser on the target. Then the fine angular adjustments on the L-706 are used to adjust the laser to zero.

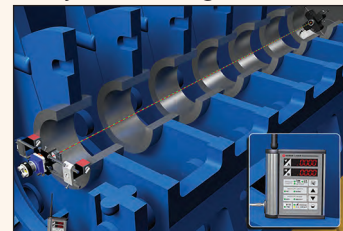


Adjusting L-102 Beam Translator to Center Laser Beam to Near Bore



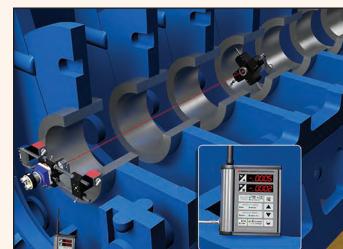
Adjusting Laser Angle with L-111 and L-706

9. The A-512/A-514 are returned to the near bore and the L-102 is again used to center the laser to the target. Again the target is moved back to the end bore to fine tune the angle.
10. When the target reads zero in both the near and far bores, then the laser is aligned to the end bores and the L-706 is ready to take alignment data.



L-706 with A-512/A-514 in Far Bore

11. To take data, the A-512/514 are then moved to the first inner bore and the alignment value is recorded. This is repeated for each bore.



A-512/A-514 Moved to Inner Bore

12. The alignment data is live so if the bore is out of alignment, it can be adjusted to zero while watching the R-1307 update with each move.
13. Optional Bore9 Software can be used to aid in the laser setup, record the bore values and plot the straightness data



# Alignment Solutions for Even the Most Difficult Bore Applications

## Applications Overview

Hamar Laser bore systems can handle a wide range of bore alignment and straightness determination and measurement tasks. Even extremely difficult bore alignment challenges, like spherical bearings, can be done easily. If you do not see your application listed, please contact us to discuss your requirements. We will be more than happy to provide a solution that's right for your unique alignment problem.

### Automotive, Marine & Locomotive Engine Blocks

- Crankshaft and camshaft line bores
- Cylinder straightness

### Manufacturing & Metalworking

- Boring-bar bearing alignment
- Deep-bore straightness checks on parts
- Workpiece bore-to-spindle alignment

### Marine

- Propeller shaft bearing bores
- Stern tube alignment

### Power Generation

- Steam turbines
- Gas turbines

### Plastics

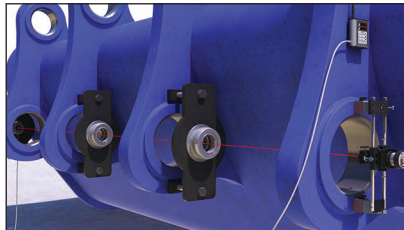
- Extruder barrel alignment
- Extruder bore straightness and wear

### Aerospace

- Hinge-line spherical bearing bores

### In-Situ Bore Machining QC Checks

The L-706 with the T-218 Target have 2.2495" mounting OD's that fit right into a standard boring-bar bearing to not only quickly align the bearings to the target bores, but to also do a post-machining QC straightness check.



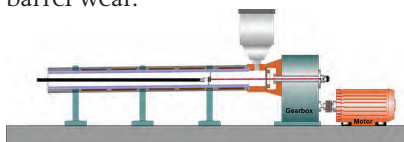
*L-706 Aligning Boring-Bar Bearings in Bucket Loader*

### Stern Tube & Propeller Shaft Bearings

The L-706 can quickly and easily check stern tube and propeller shaft bearing alignment. With the addition of the L-111 Laser Stand for flanges, the L-706 can even check the gearbox shaft's axis of rotation alignment to its bearings, saving tons of time versus a tight wire. It can also be used to set up boring bar bearings for line boring equipment.

### Extruder Barrel Alignment

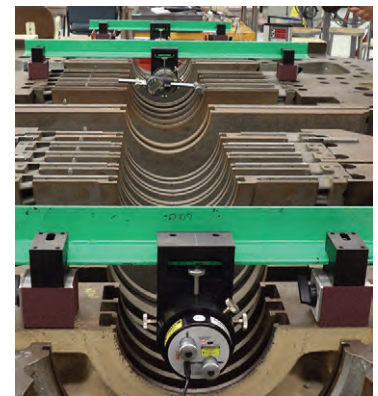
With a 10 minute setup time and simple procedure, extruder barrels can be aligned in less than 1 hour using our L-705 Bore Laser. The adapters can also be used to measure barrel wear.



### Turbine Alignment

Since 1975, our Steam Turbine Alignment System has cut alignment times by 50% and increased accuracy

vs. tight wires. With the introduction of the L-705, alignment times have been further reduced. We also offer lasers to check split joint flatness and motor couplings.



*The L-706 Laser can be combined with our T-218T Turbine Target, half-bore fixtures and a bore sweep unit to make it the ideal system for aligning steam turbines*

### Hinge-Line Bearing Alignment

Smaller spherical bearings in commercial aircraft hinge-lines are aligned using the L-705 and T-271 2-Axis Virtual Center Target. For larger spherical bearings (2.25" and above) the T-218 Target and T-225X Flange are used. Now extremely difficult alignment tasks can be done in one-tenth the time!

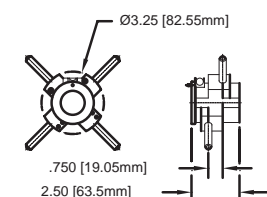
### Bore Straightness on Large-Bore Gun Barrels and Hydraulic Cylinders

Checking the bore straightness of a long cylinder is a simple procedure. After setting up the laser, a special, self-centering target with roller bearing measuring feet is inserted into the bore using an insertion pole and the readings are recorded at predetermined increments. Cylinders and barrels up to 10 meters can easily be measured for straightness.

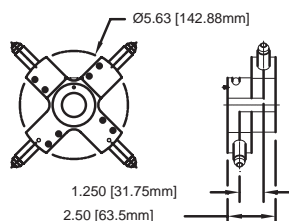
# Specifications

## Target and Bore Adapters

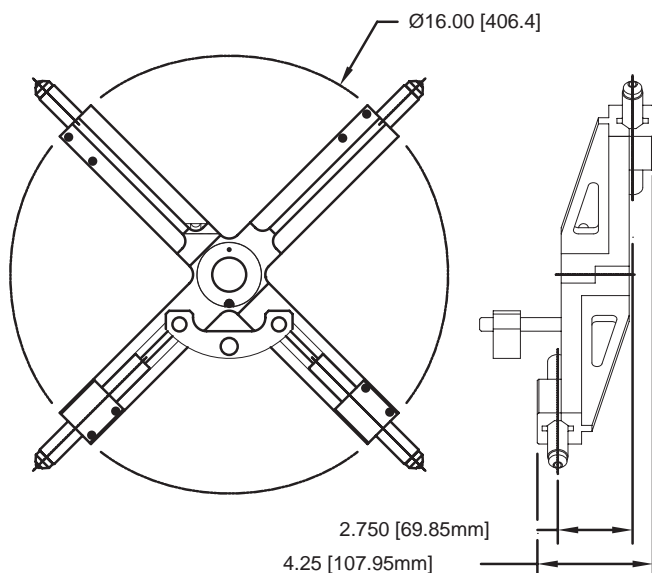
<b>A-512 Target</b>	Mounting Surface OD: 1.2498" (31.745 mm). Target sensor concentric to OD to within .0003" (0.008 mm). Mounting surface 303 SS.
<b>A-514A Small Bore Target Adapter</b>	For bore diameters from 3.75" (95 mm) to 6.75" (172 mm).
<b>A-514B Medium Bore Target Adapter</b>	For bore diameters from 6.50" (165 mm) to 17.5" (445 mm).
<b>A-514C Large Bore Target Adapter</b>	For bore diameters from 17" (431.8 mm) to 40" (1 M)
<b>A-514G Bore Gage</b>	Sets A-514 Adapters legs to correct bore diameter to .0002" (.005 mm). Use A-514GS for A-514A & B Adapters. Use A-514GL for A-514A, B & C Adapters.



A-514A Target Adapter



A-514B Target Adapter



A-514C Target Adapter

## L-706 Laser

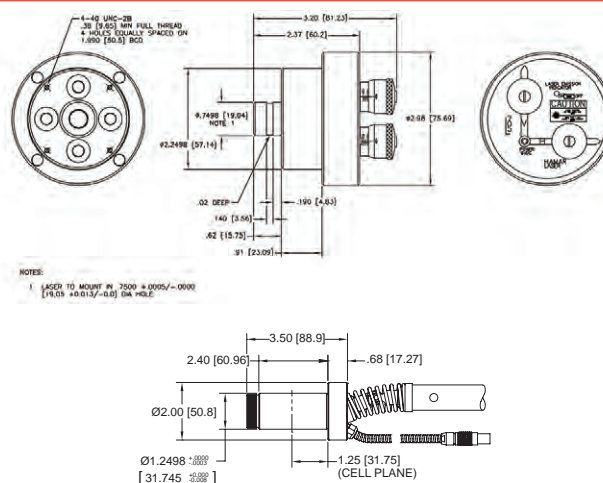
<b>Size</b>	(See line drawings)
<b>Weight</b>	1.2 lbs. (0.5 kilograms)
<b>Power</b>	9V external battery pack/AC adapter
<b>Center</b>	Laser aperture ground concentric within .0003" (0.005 mm). No adjustment
<b>Angle</b>	Controlled by two micrometers for Vertical and Horizontal Axes .0001" on micrometer = .001" tilt @ 100 ft. (0.0025 mm = 0.025 mm in 30 M)
<b>Angular Adj. Range</b>	$\pm 0.06^\circ \pm .0125"/ft.$ ( $\pm 1.04$ mm/M)
<b>Operating Distance</b>	up to 110 ft. (33.3 M) Recommended
<b>Laser Beam Straightness</b>	.00001"/ft. (.0008 mm/M)
<b>Laser Beam Stability</b>	.0001"/hr./°F (0.004 mm/hr./°C) .0001"/ft./hr./°F (0.01 mm/M/hr./°C)
<b>Laser Type</b>	Laser < .9 mW Cw, BRH Class II, 670 nanometers
<b>Materials</b>	Aluminum Flange. All mounting surfaces: 440 SS. Aperture: Hardened and ground in one setup (RC 54-60).

## L-111 Laser Stand

<b>Angular Adj. Range</b>	$\pm 0.06^\circ \pm .0125"/ft.$ ( $\pm 1.04$ mm/M)
<b>Vertical Translation Range</b>	8 in. (203 mm) on standard 12" (304 mm) posts
<b>Angular Range</b>	$\pm .36"/foot$ (30 mm/M) for Pitch (vertical) & Yaw (horizontal)
<b>Angular Resolution</b>	$\pm .0006"/foot$ (0.05 mm/M)
<b>Laser Mounting Plate</b>	Steel for L-705/L-706 with 0.7498" (19.045mm) mounting hole

## L-102 Beam Translator

<b>Center Adjustment Resolution</b>	$\pm .0001"$ (0.0025 mm) translation
<b>Center Adjustment Range</b>	$\pm .100"$ (2.5 mm) of translation range



A-512 2-Axis Target



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