

Application Note

Power Generation



System Recommendations

Turbines	L-706 Turbine Alignment System
Split-Joint Flatness	L-740 Leveling Laser System
Rotating Equipment	S-680 5-Axis Shaft Alignment System

In 1975, Hamar Laser built the first steam turbine laser alignment system for Westinghouse. Laser alignment saved the company significant time over traditional methods like tight wire, feeler gages (leads) or optics. With today's advanced laser systems, the timesaving benefit, as well as accuracy, has increased even more. According to the Tennessee Valley Authority, their allocated time for alignment dropped by 50 percent when using our L-705 Turbine Alignment System.

Hamar Laser's second generation of turbine alignment lasers are smaller, faster and even easier to set up than their predecessor, the L-711. There is virtually no warm up period and their smaller size has eliminated one of the reference targets, which has reduced setup time by over 1 hour.

Laser Better & Faster than Tight Wire

The most common method of turbine alignment is the tight wire. Although tight wire has produced good results for many years, it is increasingly becoming outdated. It takes too long to set up, is subject to vibration, which limits other work during alignment and is subject to catenary sag and other environmental influences. With power company consolidation and competitive power markets, shorter outages and more efficient turbines are critical to industry profitability.

The combination of the L-706 Turbine Alignment System, the L-740 Split-Joint Measuring System and the new S-680 5-Axis Shaft Alignment Systems create a powerful tool kit to significantly reduce turbine outages and increase efficiency.



Aligning Steam Turbine Diaphragms with L-706



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The L-705/L-706 Turbine Alignment System

High Accuracy and Long Range

The L-706 Steam Turbine Bore Alignment Laser is designed for turbine alignments up to 110 feet (33 m). Under good environmental conditions, the L-706 system has a bore centering accuracy of .004 in. (0.1 mm) over the whole range.

L-706 Virtually Significantly Technician Measurement Variability

A big problem with tight-wire-based turbine alignment systems is trying to get good repeatability from one technician to the next. This is because the tight wire technique strongly depends on the technician's interpretation and skill, which has a big impact on repeatability from one shift to the next. With lasers, that problem is significantly reduced because laser beams do not have sag or kinks and are not susceptible to wind. In addition, by using sophisticated electronics to detect the laser beam, human interpretation of the readings is eliminated, making them very repeatable from one technician/shift to the next. This means that the technician will no longer record what he *thinks* the reading is; he will record what the reading *actually is*. Reduced technician variability means faster alignments and higher confidence in the alignment accuracy from one shift to the next.



L-705 Bore Alignment Laser

Fast Alignment Can Save Days Off Outage

Sometimes days can be saved off an outage just from the fact that the L-706 laser system allows for other work to take place while the laser is being used. The tight wire, on the other hand, requires a lot of time to set up and settle down, and no other work can be performed while the wire is in use, as vibration will cause alignment errors. In addition, all the components (diaphragms, seals, etc) must be installed to do the alignment; otherwise the wire will have to be repeatedly broken down and set up again.



With L-705/706 Turbine Alignment System, components can be taken in and out of the shell while the laser is being used. Furthermore, the laser provides live data, which means that while the components are being moved, a large digital display shows a live display of the misalignment.

System Pays for Itself in Days

With higher accuracy and faster alignments, a steam turbine aligned with our L-705 will require less energy to generate a kilowatt of electricity and will come on line more quickly than when using other alignment methods. This reduction in cost is pure profit and can pay for the system in a matter of days.

Alignment System Features

- Set up in 30 minutes or less
- Accuracy down to +/- .0025 in. (0.13 mm) in 110 feet (33 m) in good environment
- Wireless data transmission eliminates need for long cables
- Simple, rugged fixturing
- Laser setup is very similar to tight wire methods, so it is easy to use and learn and reduces training costs
- Laser and bore sweep unit use same fixture to speed setup
- A-1511 Wand Bore Target speeds data taking and is very similar to inside-micrometer methods used in tight wire alignment
- Portable, battery operated
- Dynamic display of component misalignment
- Wireless transmission of reference target data, eliminating long cables.



R-1307 Readout

Recommended System Configuration

L-706 Bore Laser
R-1307B-2.4ZB Wireless Target Readout (2)
T-218T 2-Axis Turbine Target
A-501A Turbine Small Bore Sweep Unit
A-502A Turbine Reference Target Bracket
A-502L Laser Support Bracket
A-1511 Wand-Bore Fixture
A-1519-2.4ZB Wireless 2-Axis Target
R-1308 Single-Axis Readout
A-815 Steam Turbine Shipping Case

Optional Accessories

L-706 Long Distance Bore Laser
A-501 Turbine Large-Bore Sweep Unit
A-1356-2.4ZB Ruggedized Nomad PDA with Read15 Software

The L-740 Leveling Laser System



Measuring split or horizontal joints during an outage can take hours and hold up other critical work on a turbine. Traditionally split joints are measured with transits and usually require at a 2-man crew. The measurements rely on the human eye and are subject to interpretation by the operator, an inexact science.

The L-740 Ultra-Precision Leveling Laser was designed for high-accuracy leveling applications. It is accurate to $.00003"/ft.$ (0.0025 mm/M). It is an extremely portable and very affordable alternative to traditional leveling methods like theodolites or transits. Its automatically sweeping laser plane and large-range targets with 00002 in. (0.0005 mm) resolution create a powerful tool for quickly checking the flatness of the split joint.

High Accuracy Reduces Optics Guesswork

Hamar Laser's L-740 is accurate to $\pm.003 \text{ in.}$ (0.075 mm) in 100 feet (30.5 m) or $\pm.0003 \text{ in.}$ (0.0075 mm) in 10 feet (3 m) under good atmospheric conditions. This accuracy turns the alignment process from an art using optics to a science using lasers. Optics can be considered an art because each operator "sees" the readings differently and essentially has to make an educated guess as to the correct number. With the L-740, this guesswork

is eliminated because high resolution target electronics determine the alignment reading.

Reduce Alignment Work Crews

The L-740 only requires 1 operator, even on the very largest jobs. That frees up critical manpower to perform other tasks on the outage, helping to reduce the duration of the outage. In fact, the same technician can operate the L-740 Leveling System and the L-706 Bore Alignment Laser for turbine diaphragm and seal alignments.

Minimal Training Needed

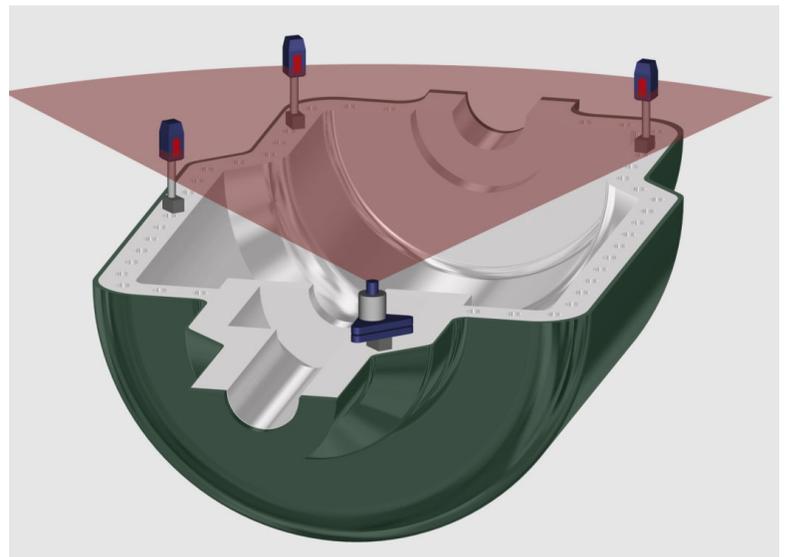
The L-740 is so easy to use that it usually only requires 1 day of training and if our Plane5 software is purchased then it only adds 1 day to the training. Compared with optics where training can last up to 2 weeks, the L-740 can significantly reduce the time critical technicians are out of action when being trained.

Reduce Alignment Time by 50%

The L-740 Leveling Laser System can use multiple targets, which really speeds the data-taking process for split (horizontal) joints. In fact, up to 4 targets can be used simultaneously. The combination of automatically rotating lasers and multiple targets can easily reduce split-joint measurement time by 50% or more.

Wireless Targets and Readouts

The L-740 Leveling Laser uses our wireless A-1519-2.4ZB Single-Axis Target, which eliminates long extension cords to reference targets. The targets have up to a $\pm.55 \text{ in.}$ ($\pm 14 \text{ mm}$) measuring range and can be used up to 100 feet (30.5 m) from the readout. Other features like electronic zeroing help to speed setup.



L-740 Leveling Laser checking flatness of split joint

Most Accurate Mechanical Levels Available

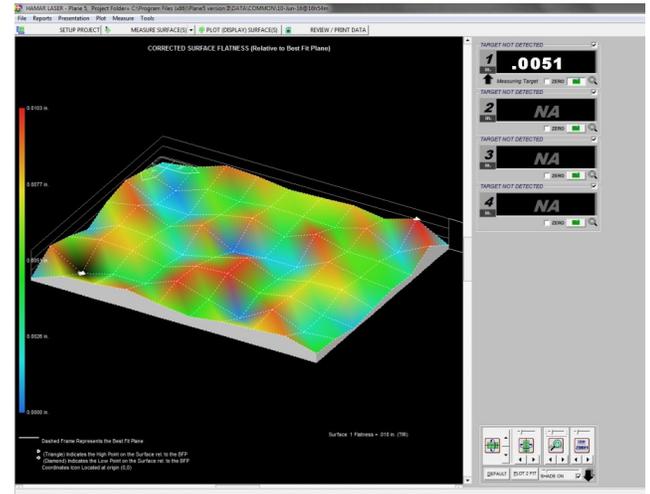
The L-740 Laser uses level vials that are accurate to 1 arc second (.00006 in./ft. or 0.005 mm/M). Only expensive, difficult-to-use, and fragile electronic levels are more accurate. The combination of accurate levels and automatically rotating laser planes creates an alignment tool that is hard to beat.

Plane Software

The L-740 can also be linked to our new Plane 5 flatness analyzing software. It is Windows-based software that can analyze almost any layout for flatness or straightness. Plane 5 will even analyze squareness if used with our squareness lasers (L-743, L-742, L-741, L-733, and L-732). Squares, rectangles, frames, circles, rings, and up to four sets of ways can all be easily analyzed with Plane 5. The alignment data is automatically downloaded by using our wireless data receiver, the A-910-2.4ZB.

Alignment System Features

- Continuously rotating laser with 100 ft. (30.5 m) radius operating range
- Setup in as little as 5 minutes
- Laser base includes coarse/fine pitch and roll adjustments
- Laser planes flat to .00003 in./ft. (0.0025mm/M)
- Precision level vials accurate to .00006 in./ft. (0.005 mm/M)
- A-1519-2.4ZB Single-Axis Wireless Target with .00002 in. (0.0005 mm) Resolution $\pm .55$ in. (± 14 mm) Measuring Range
- R-1356 PDA Receiver displays up to 5 targets with 150 ft. (45 m) wireless range
- Laser and target fit into a small, portable shipping case
- Uses A/C adapter or battery pack
- Plane5 software quickly records and analyzes flatness data



S-1388 Plane5 Software Results Flatness Graph

Recommended System Configuration

- L-740 Ultra-Series Leveling Laser
- L-106 Instrument Stand w/case
- A-1519-2.4ZB Single-Axis Wireless Target
- R-1356-2.4ZB PDA Readout w/Read15 Software
- A-909 Shipping Case
- Optional Accessories**
- A-1519-2.4ZB Single-Axis Wireless Target
- R-342 Notebook Computer
- R-1342 Toughbook Laptop Computer
- A-910-2.4ZB Wireless Data Receiver for Laptop
- S-1388 Plane5 Software

The S-680 5-Axis Coupling Alignment System



Hamar Laser developed the very first 5-axis live alignment system in the early 90's. It quickly became the standard by which other systems were judged. Our S-680 Wireless Coupling Alignment System sets a higher standard. With features like internal Bluetooth® wireless communication, super-linear PSD technology, a 5-axis target with automatic sweep function, sub-micron resolution, the largest cell range in the market and updated alignment software, the S-680 is rapidly becoming the first choice for coupling/shaft alignment applications.

S-680 Reduces Bearing/Seal Costs

Properly aligned motors and pumps will last longer, perform better and use less electricity. The S-680 is an extremely fast and highly accurate tool to align motors to pumps. Not only will you perform motor/pump alignment in record time, but you will also increase the life of your motor bearings and seals, saving you thousands of dollars annually in reduced maintenance costs. And depending on how many motors you have, the S-680 will probably pay for itself in the very first year.

Lasers Are Simply Faster

It is now an established fact that lasers are simply faster and more accurate than indicator-based methods. The bigger the motor, the more time saved during alignments. We had one customer tell us that they reduced the alignment time on one motor from 2 days to 4 hours! This

time saving can be especially helpful on critical machinery where downtime is very costly.

Real-Time Data in 4 Axes and Shim Values Really Speed Alignments

The S-680 shows both the horizontal and vertical misalignment for both angle and offset at the same time in real time. No longer will you have to guess how far your horizontal moves are going. Our *Couple6* Windows-based software now runs on a ruggedized 10" tablet. The software calculates shim values for you, saving additional time.

Indicator Methods Not Accurate Enough

With the advent of vibration analysis and thermal imaging, it is becoming clear that indicator-based methods are no longer good enough. To reduce vibrations and bearing-destroying heat, motors must be aligned very accurately. Indicator methods do a reasonable job of aligning the centers of the shafts but a poor job of making them parallel; large angular misalignments are common. By contrast, the S-680 provides the needed accuracy to reduce excess vibrations and heat so the motors last as long as the salesman says they should!

PM Programs More Efficient with S-680

If you have a preventative maintenance program, you will be glad you have the S-680. Whether you are changing a worn-out motor or simply performing a PM check, the S-680 can be set up and displaying misalignment data in about 10 minutes, allowing you to know instantly whether you must align a motor or not. And with our computer-based laser system, generating reports and saving alignment data has never been easier.

Automatic Sweep Function Saves Even More Time

The S-680 uses an accelerometer to provide rotation angle measurements, eliminating the "clock method" many other systems still use today. This rotation sensor automatically detects "start" and "stop" points and works with a sweep angle of as little as 60°, which is especially useful in cramped conditions.

Recommended System Configuration

- L-790 Laser w/Dual-Beam™ Technology
- T-1290 Bluetooth Wireless 5-Axis Shaft Alignment Target
- A-980A Upgraded Bracket Kit for 0.5" to 12" (25 mm to 300 mm) Shaft Diameters
- R-1342 Ruggedized Tablet Data Collector
- T-241 Backup Cable
- S-1396 Couple6 Software
- A-812 Shipping Case

Optional Accessories

- A-980B Small Shaft Adapter
- A-980C Extra Chain Set for 1" - 12" Shaft Diameter
- A-980-OF Offset Bracket
- A-980NRA-1 Non-rotating Shaft Bracket without chain
- A-980NRA-2 Non-rotating Shaft Bracket w/chain
- A-980NRB Non-rotating Large Shaft Bracket
- A-982 Magnetic Bracket Set

S-680 Even Works in Direct Sunlight

With our new internal light meter, the S-680 actually provides a display of how sunlight affects the readings. In most cases, with the use of our optional light shield, the S-680 will work in direct sunlight without having to put up tarps or other shade devices.

Universal Brackets Eliminate Bulky Accessories

One set of mounting brackets is all that is needed to align 95% of the motors out in the field. The brackets accommodate shafts from 1 in. to 12 in., (25 mm to 300 mm) without modification, and they can be easily expanded to fit larger shafts to 18 in.. They even have built-in magnets for extremely large shafts. About the only bracket accessories that are needed are offset brackets used for very short shafts.