Operations Manual

Turbine Alignment

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HAMAR LASER®
ALIGN WITH THE BEST

HAMAR LASER INSTRUMENTS, INC.
www.hamarlaser.com

Five Ye Olde Road, Danbury, CT 06810
Phone: (800) 826-6185 Fax: (203) 730-4611

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Turbine Alignment Hardware

The L-705 and L-706 Bore Alignment Lasers are perfectly designed to perform alignment of gas and steam turbine bores. The system uses a laser, reference target, measuring target, micrometer sweep device, and fixtures to hold the laser and targets. Since the laser beam is concentric to the OD of the L-705/706 housing to within .0005 in. (0.013 mm), it can serve as one reference target. This saves a lot of time during setup.

On most turbine alignments, the rotor bearing bores are used as the references. This means that fixtures that hold the laser and reference target must be placed precisely in these bores to the set points determined by the manufacturer of the turbine.

The fixtures are hung in the bores using angle iron and special magnetic bases. Depending upon the size of the bore, either the large (A-501) or the small sweep unit (A-501A) is used to position the fixture so that the center is exactly on the reference points provided. The sweep unit is essentially an inside micrometer that allows the fixture to be placed to any points desired (for example, .000 in. left, .009 in. right and -.010 in. bottom).

Once both fixtures are swept in, the laser (L-705 for distances up to 50 ft. (15 m) and the L-706 for distances from 50 to 110 ft. or 15 m to 33 m) is placed in one reference fixture and a target (T-218T) is placed in the opposite reference fixture. The L-705 laser is manufactured so that the laser beam is concentric (centered to) to the housing's OD to within .0005 in. (0.013 mm). With the fixture "swept in," the laser is inserted into the fixture and is thus centered to the reference points.

Recommended System Configuration

L-705 Bore Laser
R-1307-2.4ZB Target Readout
T-218T 2-Axis Turbine Target
A-501A Turbine Small Bore Sweep Unit
A-502A Turbine Reference Target Bracket
A-502L Laser Support Bracket
T-231A 25 ft. (7.62 m) Target Extension Cable
A-510 Self-Centering Small Bore Target Adapter for 2 – 5 in. Bores
A-814 Shipping Case

Optional Accessories

L-706 Long Distance Bore Laser
A-1511 Wand Bore Target
A-501A Turbine Bore Sweep Unit
A-1519-2.4ZB Single-Axis 2.4GHz Wireless Scan Target
R-1308 Single-Axis Readout
A-1356-2.4ZB Ruggedized Nomad PDA with Read15 Software

All that is needed now is to adjust the angle of the laser beam, using the two micrometers on the back of the L-705. These micrometers are adjusted until the reference target reads zero, both vertically and horizontally. The laser is now set up and ready for measurements.

For measuring an individual component, such as a diaphragm, there are two target choices. The first is the T-218T Turbine Target. The T-218T works much the same as the reference targets. The target fixture (A-502A) is swept into the center of the bore using the A-501(A) sweep unit, then the target is placed in the fixture and the reading is taken. A positive vertical reading means the diaphragm is higher than the reference bores. A positive horizontal reading means the diaphragm is to the right of the reference bores. Since the data is live, the diaphragm can be adjusted until the reading is zero (or to an offset determined by the engineers).

The second measuring target that can be used is the A-1511 Wand Bore Target. Instead of using a fixture to "hang" a target in the center of the bore, the A-1511 uses fixed-length legs that are approximately equal to the radius of the bore. Two legs are used, each 90 degrees from the other. One leg has a measuring tip on it and the other is used for support. The A-1511 has replaceable legs and can be used on bores with a radius of 10 to 96 in. (254 mm to 2.44 m).

Both the A-1511 and T-218T measuring targets are very repeatable. However, in our experience, the A-1511 is much faster at taking the measurements. To get the best repeatability, some mechanism should be employed to ensure that each point on the diaphragm or other component is marked and the measuring tip is placed exactly on the same point. Given that the surfaces inside a turbine are usually pitted and rough, a radius tip should be used. For new turbine installations, repeatability of .001 in. (0.025 mm) or better is easily achievable. However, for older turbines, it becomes increasing more difficult to hold .001 in. repeatability because of the high level of pitting and corrosion.

The L-705 Laser

The L-705 Laser has been designed with a .750 in. (19.05 mm) mounting stud and flat face with magnets to hold it flush to fixturing. Since the laser beam is concentric to the OD to within .0005 in. (0.01 mm), a simple flat face and .750 in. (19.05 mm) hole on center is all that is needed to hold the laser (the extruder package includes a self-centering chuck fixture). In fact, the laser replaces the first reference target that a typical borescope would need.

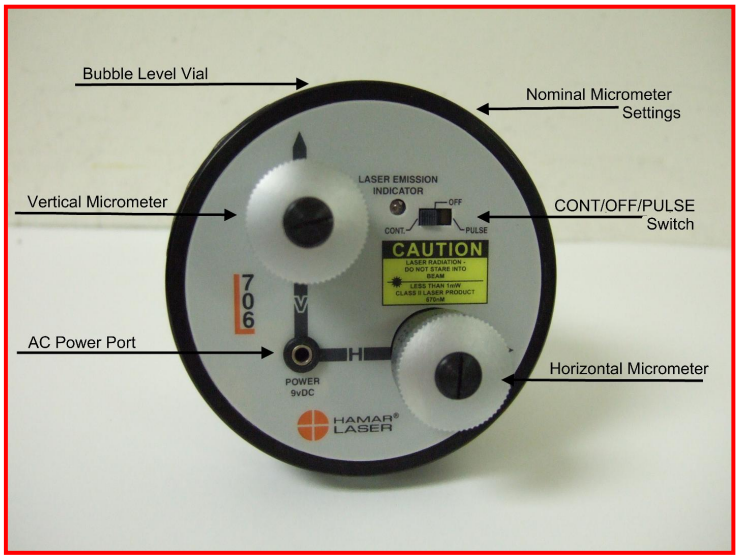


Figure 1 – *L-705 Laser*

L-705 Features and Setup

The L-705 has a range of 50 ft. (15 m), and under good environmental conditions, it is accurate to .001 in. (0.025 mm) over the whole range. By carefully following the NORMIN procedure described in Appendix A, accuracies of .0002 in. (0.005 mm) in 10 ft. (3 m) can also be achieved.

The L-705 has a range of 50 ft. (15 m), and under good environmental conditions, it is accurate to .001 in. (0.025 mm) over the whole range. By carefully following the NORMIN procedure described in Appendix A, accuracies of .0002 in. (.005 mm) in 10 ft. (3 m) can also be achieved.

The L-705 provides a straight reference line to which any bore or extruder barrel can be aligned and measured. The laser mounts in an adapter. The laser and adapter, in turn, are mounted in either in the bore or the counter bore of the gearbox spindle. The laser projects a beam through the adapter and down through the inside of a bore or barrel toward any of Hamar's bore targets, which are mounted in the opposite end of the bore or the free end of the extruder barrel. The laser beam is then adjusted (qualified) to project the actual axis of rotation of the gearbox.

The following describes the operational features of the L-705 Laser. These features include bubble level vial orientation, micrometer values and settings, ON/OFF switches and the external battery pack.

- **The ON/OFF slide switch** has a lighted LED to indicate that power is ON.
- **The Pulse/Continuous switch** selects the laser mode compatible with the readout/interface being used (see Page 6 for more information about Pulse/Continuous modes and the readouts used for each mode).
- **Battery Pack connector** accepts a slip-fit probe with a flexible cord.

- **Bubble level vials** on the laser mounting flange are used for rotational accuracy. When the bubbles in the level vial are centered horizontally, all micrometer adjustments (controlling laser beam angle) will shift the laser beam vertically or horizontally with reference to the bore/target axis. If the bubbles are not centered, any micrometer adjustment to one laser axis will change the laser beam position in both axes. The levels also provide fixture mounting repeatability (assuming the laser is hard-mounted to fixture).
- **Micrometer controls** are provided for the adjustment of the angle at which the laser beam emerges from the precision ground, mutually concentric steel laser housing. Each laser has a NOMINAL setting for both the V-Vertical and the H-Horizontal micrometer controls. The nominal settings are determined at the factory and correlate to values for the laser beam when it is perpendicular to both the 2 in. and 4 in. mounting faces. When the bubble in one of the level vials is centered, a nominal setting of each micrometer squares the laser beam to that specific axis. For example, if the nominal vertical setting is .120, then setting the micrometer to .120 sets the laser beam square to the vertical axis. When a laser is mounted in the gearbox or bore adapter, vertical and horizontal micrometers should be *set in the nominal positions* to facilitate the alignment and measurement process.

Adjusting the L-705 Laser

The L-705 Laser beam is factory adjusted to be concentric to the mounting diameters (2.25 in. or 57.15 mm and .75 in. or 19.05 mm) within ±.0005 in (0.0127 mm). With the adjusting micrometers set at the nominal position, (see the **Nominal Settings** label on the outer flange), the laser beam is perpendicular to the front mounting surface and parallel to the mounting diameters within ±.0003 in/ft.

In a typical bore measuring application, the L-705 Laser is mounted concentric to one end of the bore by means of a fixture ring or plate. Because fixtures are seldom perfect, the laser beam requires angular adjustment to make it concentric to the bore. This is accomplished by placing the Self-Centering measuring target at the other end of the bore and adjusting the micrometers on the laser until the laser beam is centered on the target.

The circular level vial on the laser mounting flange is used to reference the orientation of the vertical and horizontal axes of the L-705 Laser. When the bubble in the level vial is centered, all micrometer adjustments (controlling laser beam angle) will shift the laser beam vertically or horizontally with reference to the bore/target axis. If the circular level bubble is *not* centered, any micrometer adjustment to one laser axis *will make the laser beam position appear to change in both axes*. The level vial also provides fixture mounting repeatability (assuming the laser is hard mounted to the fixture). Only minor readjustments of the laser to the bore and fixture surfaces are required in situations where frequent alignment is expected.

Attaching the Battery Pack

The L-705 Laser battery pack is a stand-alone unit that attaches magnetically to an extruder gearbox. The battery pack has a detachable cord with a probe at each end. One probe attaches directly to a jack on the battery pack and the other probe is inserted in the control panel of the L-705 Laser.

1. **Turn off the man power switch.**
   The main power switch ***must*** be off before attaching the battery pack.
2. **Insert the probe into the battery power input jack.**
   The jack is located on the end panel of the battery pack. Insert the plug gently until it snaps into place.
3. **Insert the probe into the laser power input jack.**
   The jack is located on the micrometer control, at the apex of the V and H axis arrows. Insert the plug gently until it snaps into place.

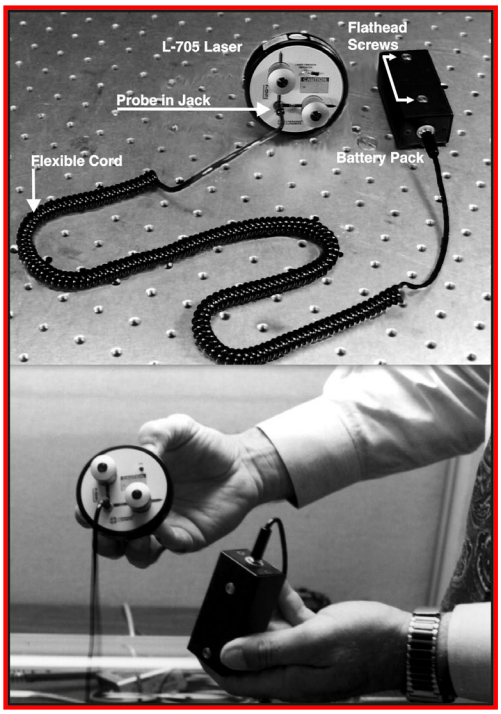


Figure 3 – *Attaching the Battery Pack*

Replacing the Batteries

The battery pack uses two 9-volt batteries. The batteries are housed in a two-part case which is held together by flathead screws. Hamar Laser recommends using alkaline or nickel-cadmium (NiCad) cells for best performance.

1. **Unplug the battery pack from the laser.**
   Pull the probe out of the laser control panel and gently set aside.
2. **Unscrew the cover of the pack.**
   Locate and loosen the two captive flathead screws, and remove the cover.
3. **Replace the two batteries.**
   Remove the old batteries and replace them with new 9-volt cells, being careful to orient them with the *negative terminal out (or up)*.
4. **Re-attach the cover.**
   Put the cover back on and secure it to the battery pack with the screws.

T-218T 2-Axis Turbine Target

The T-218T turbine target works much the same as reference targets. The target fixture (A-502A) is swept into the center of the bore using the A-501(A) sweep unit, then the target is placed in the fixture and the reading is taken. A positive vertical reading means the diaphragm is higher than the reference bores. A positive horizontal reading means the diaphragm is to the right of the reference bores. Since the data is live, the diaphragm can be adjusted until the reading is zero (or to an offset determined by the engineers).

Figure 4 – *T-218 Target*

A-1511 Wand Bore Fixture

The A-1511 Wand Bore Fixture speeds data taking for steam turbine bores with diameters from 10 in. to 96 in. (254 mm to 2.44 m) and provides high levels of repeatability for faster measurement-taking to help reduce overhaul alignment times by up to 50 percent. The fixture uses two fixed-length legs approximately equal to the radius of the bore, one leg with a measuring tip and one for support.

Figure 5 – *A-1511 Wand Bore Fixture*

The Model R-1307-2.4ZB Readout

The Model R-1307 Readout supports both wireless Unitargets, such as the A-1519-2.4ZB, or local (cabled) targets. It is available with a radio frequency 2.4 GHz ISM band. The R-1307 can be used as the primary readout or as an additional readout to copy position data captured by another R-1307.

Figure 6 – *R-1307 Readout*

The Model R-1308 Single-Axis Readout

The R-1308 Single-Axis Readout is a small, lightweight readout that attaches to the base post of Hamar Laser's A-1519-2.4ZB Wireless Targets and connects directly to the target via the auxiliary port. The readout includes a user-selectable display that allows the target position to be viewed in either inches or millimeters and shows readings in either Relative (Zero) or Absolute mode. The numeric LED display has a resolution of four decimal places (0.0000) for easy viewing of target reading.

Figure 7 – *The R-1308 Single-Axis Readout*

Performing a Turbine Alignment

Preparing for an Alignment

There are several preparations that need to be made before beginning a measurement or alignment process. Ensure that accurate records are kept for all procedures.

Hardware Preparation

- Determine what hardware is necessary to perform the alignment, including the laser, target, mounting fixtures, readouts or interface, cables, etc. Make a note of the target model number so that the information can be entered into the program setup.
- If a test or measurement is expected to take more than 3-4 hours, be sure to connect portable computers, interfaces, and other battery-operated devices to their external power supplies.
- Observe safety precautions when setting up hardware. Lock out machines for stationary procedures. If a machine is running, set up barriers and/or warning signs and route all cables away from moving parts. Clean and check all equipment, fixtures, and mounting surfaces before beginning any alignment process.

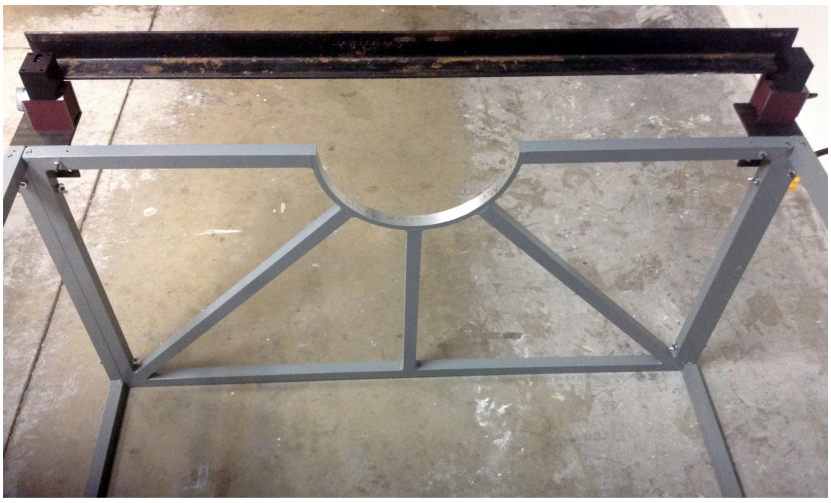
Turbine alignment is usually measured by referencing one bore on each end of the turbine shell and aligning the internal components to that centerline. In many cases the oil seal housing is measured to the rotor shaft during disassembly and the alignment is performed based on the oil seal housing by setting the reference to the offset from the rotor shaft.

Installing the "Pac Man" Magnets

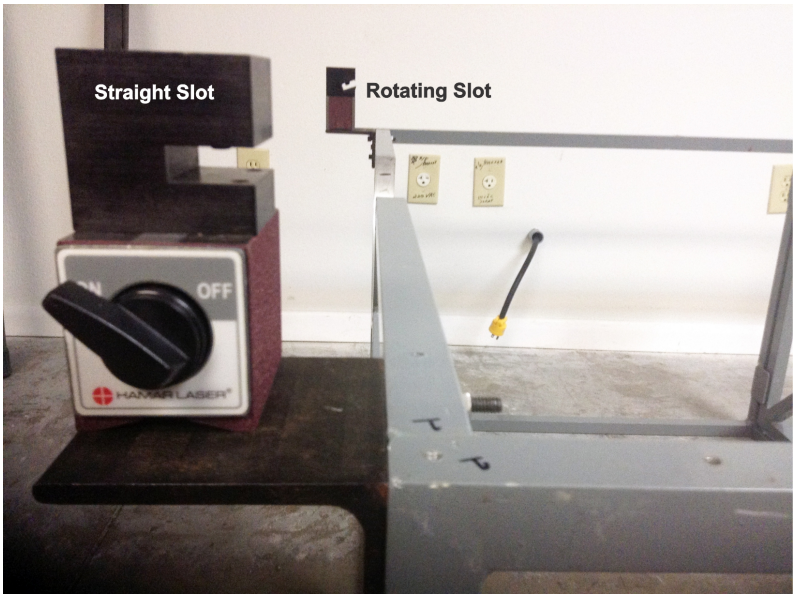
Begin by placing one of each type of magnetic mount (one straight slot and one rotating slot) on the turbine shell beside the bearing reference bore, approximately 3 in. (76.2 mm) behind the reference bore with the slots facing the opposite reference bore. Turn the handle to lock the magnets.

Cut lengths of angle iron to span the top of the turbine shell or reference bore.

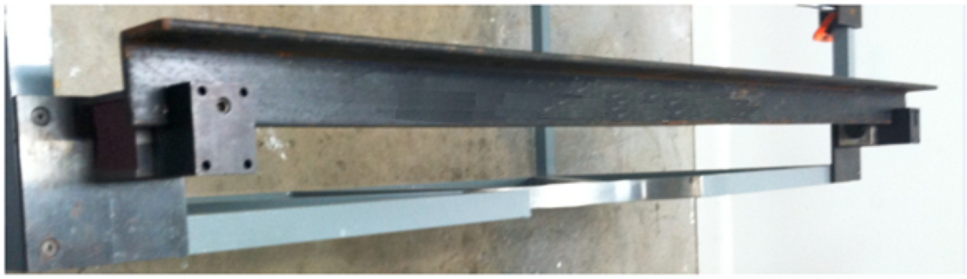
- The A-502L requires 2 pieces of 2 in. x 2 in. (50.8 mm x 50.8mm) angle iron
- The A-502A requires 1 piece of 2 in. x 2 in. (50.8 mm x 50.8mm) angle iron



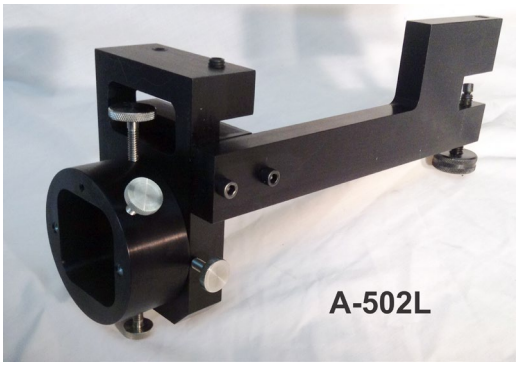
Insert one piece of 2 in. x 2 in. (50.8 mm x 50.8 mm) angle iron into the magnetic mounts. Tighten the set screw in the straight slotted magnetic mount against the angle iron first. The rotating slot rotates in order to absorb any angularity that may occur when tightening the set screws against the angle iron. Tighten the set screw in the rotating slot magnetic mount against the angle iron.



Place one of each of the magnetic mounts (one straight slot and one rotating slot) approximately 5 in. (127 mm) behind the existing magnetic mounts holding the angle iron. Turn the handle to lock the magnets. Place a second 2 in. x 2 in. (50.8 mm x 50.8 mm) length of angle iron into the slots and tighten the set screw onto the angle iron, tightening the straight slotted magnetic mount first. Tighten the set screw in the rotating slot magnetic mount against the angle iron.

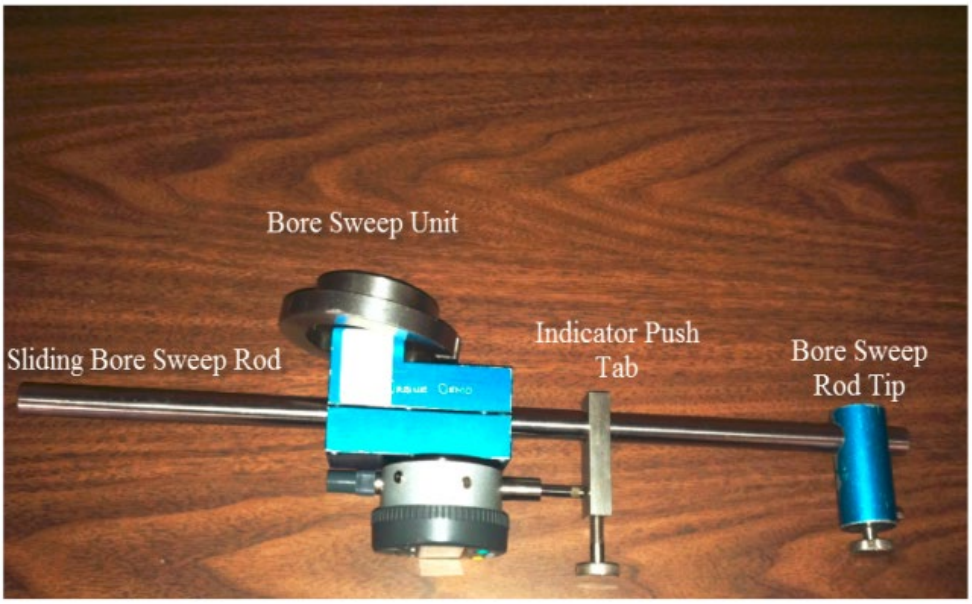


Mount the A-502L onto the first length of angle iron with the support arm underneath the angle iron and onto the second length of angle iron.

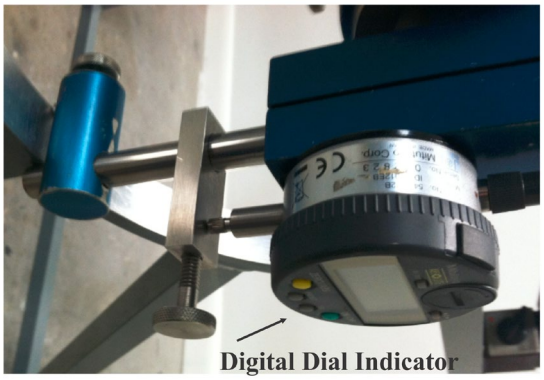


Use a measuring tape to center the A-502L with the bore from side to side. The magnetic mounts are designed so that the A-502L will be very near to the center when mounted onto the angle iron. Tighten the set screws in the A-502L against the angle iron.

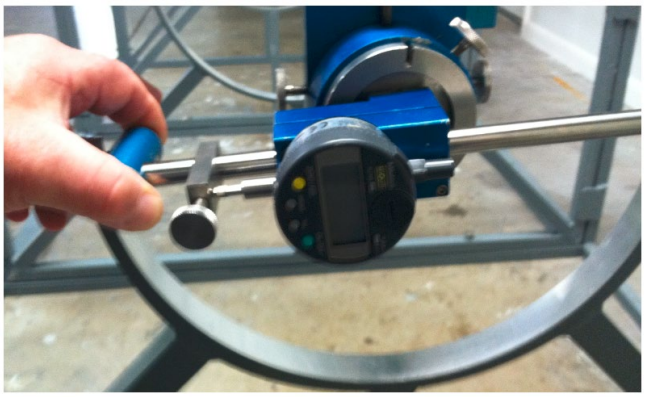
Place the A-501 Bore Sweep Unit into the A-502L and secure it with the thumb screw. Slide the Sliding Bore Sweep Rod into the A-501 Bore Sweep Unit. Slide the indicator push tab onto the rod but do not tighten the set screw. Slide the Bore Sweep Rod tip onto the rod so the rounded tip is down and toward the reference bore. Place the tip onto the bore surface so it will hold the rod from falling out. The Bore Sweep Unit has a linear bearing slide so the rod cannot rotate when it is inserted into the unit. Slide the indicator push tab up onto the rod until it compresses the indicator rod approximately half way and then tighten the set screw against the rod.

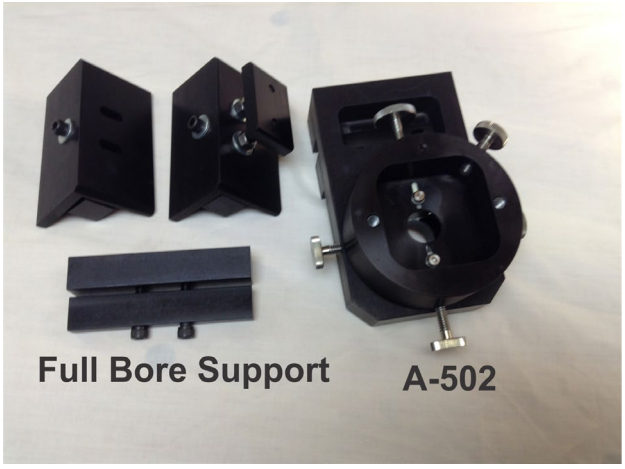


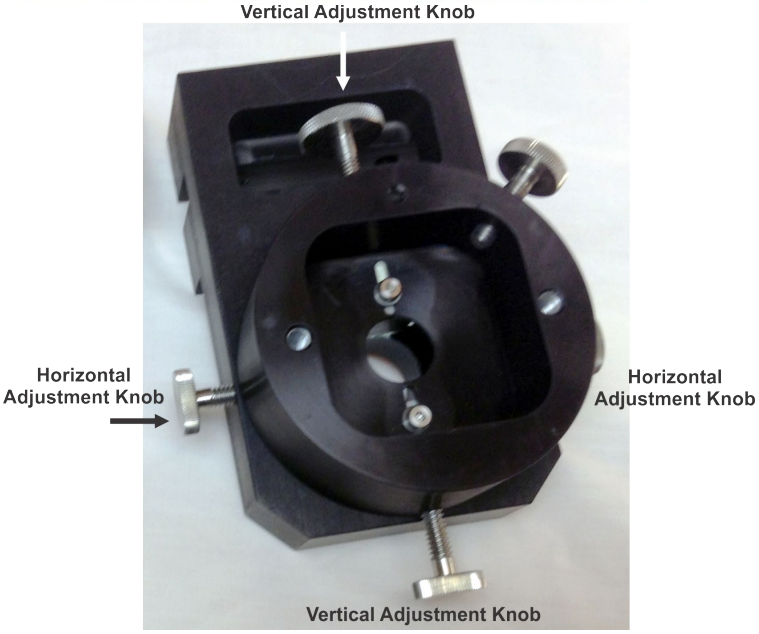
Place the Bore Sweep Rod tip on one side near the top of the reference bore and zero the Digital Dial Indicator by pressing the yellow **Zero** button.



Move the Bore Sweep Rod tip to the other side of the bore.



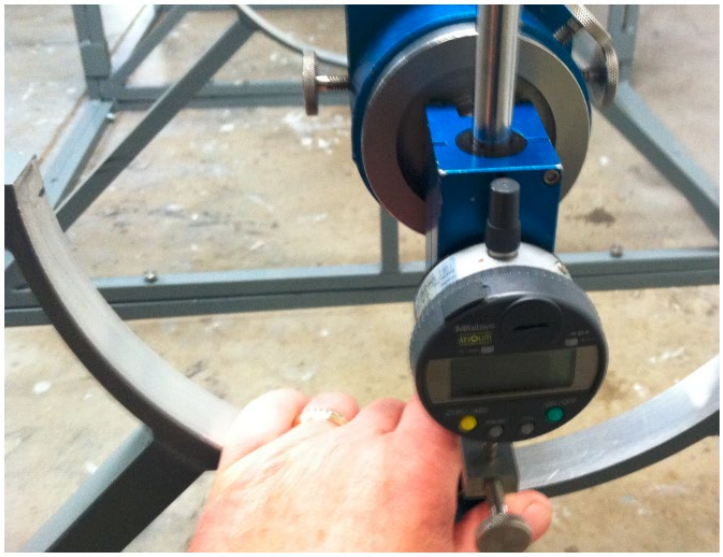




Using the horizontal adjustment knobs, center the A-502 in the bore according to the desired offsets determined by the shaft centerline.
Note: *The adjustment knobs are only push adjustments. One knob must be loosened and the opposite knob tightened to move the A-502.*

Move the bore sweep rod tip back to the zero point and **Zero** the Digital Dial Indicator.

Move the bore sweep rod tip back to the opposite side of the bore and readjust to the desired set point if necessary. If any adjustment is made, the Digital Dial Indicator must be e re-zeroed at the original set point. Move the Bore Sweep Rod tip to the bottom of the bore.



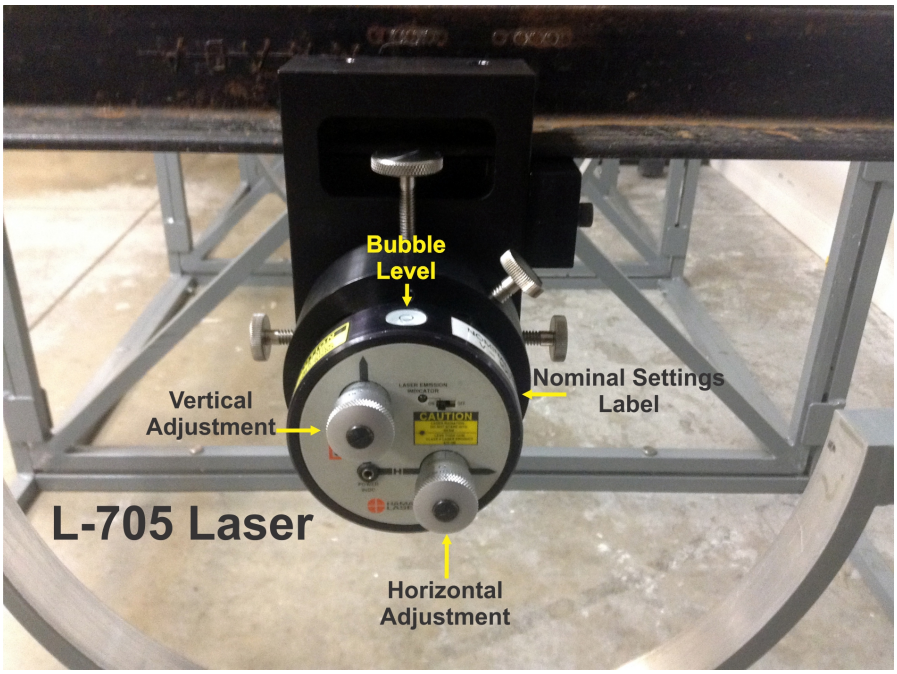
Position the A-502 vertically in the bore to the desired set point by adjusting the vertical adjustment knobs.

Position one each of the magnetic mounts (one straight slot and one rotating slot) beside and approximately 3 in. (76.2 mm) behind the other reference bore with the slots facing toward the end of the turbine housing. Turn the handle to lock the magnets.

Place a length of 2 in. x 2 in. (50.8 mm x 50.8mm angle iron into the slots and tighten the set screw against the angle iron in the straight slot magnetic mount. Tighten the set screw in the rotating slot magnetic mount.

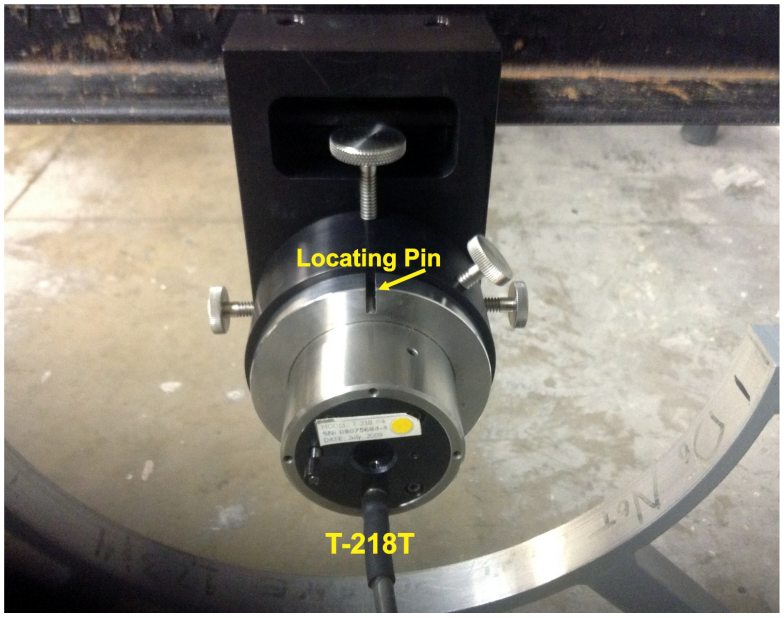
Using a measuring tape, position the A-502 onto the angle iron horizontally near the center of the bore. Tighten the set screws against the angle iron.

Place the A-501 Sweep Unit in the A-502 and adjust it to the desired set points as defined previously. Place the L-705 Laser in the A-502L so the bubble level is level from side to side and secure it with the thumb screw. Plug the battery pack in and move the switch on the L-705 to the "Pulse" position.

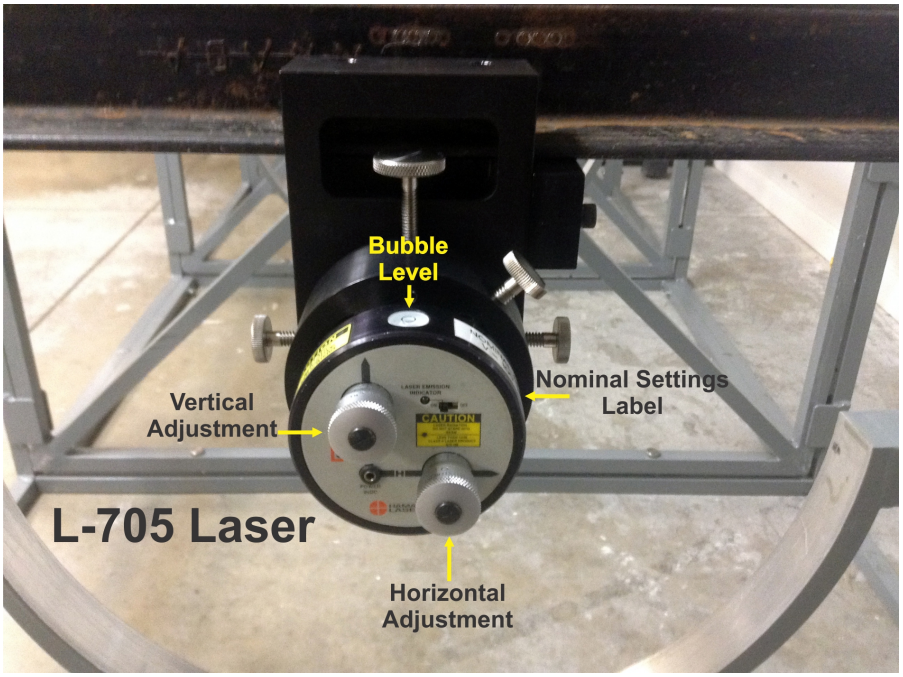


Using the T-218T 2-Axis Turbine Target

Place the T-218T 2-Axis Turbine Target into the A-502 so the cable is on the bottom and extends out the front and the locating pin fits into the slot. Connect the target cable to the R-1307 and power on the R-1307.



If the laser beam is going into the front opening of the T-218T 2-Axis Turbine Target and numbers display on the R-1307, adjust the laser beam until the readout reads .000 vertically and horizontally by turning the vertical and horizontal adjustments on the front of the L-705 laser.

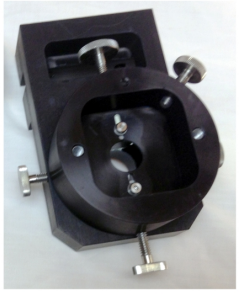


If the laser beam is *not* going into the front opening of the T-218T 2-Axis Turbine Target, it may be necessary to loosen the magnetic mounts and adjust the angle of the laser from side to side. A vertical adjustment can be made by the adjusting screws on the top and bottom of the A-502L Support Arm. If any adjustments are made, it will be necessary to reposition the A-502 by inserting the Bore Sweep Unit again and readjusting to the desired set point.

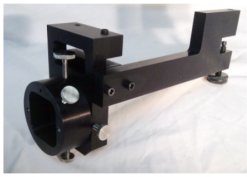
On the following page is a graphic representation of the setup using the T-218T 2-Axis Turbine Target.

Half-Bore Alignment Setup

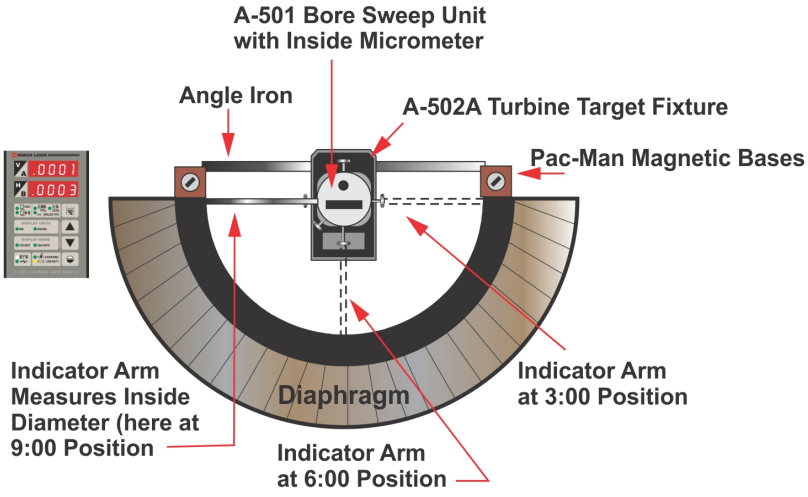
A-501A Turbine Bore Sweep Indicator Unit

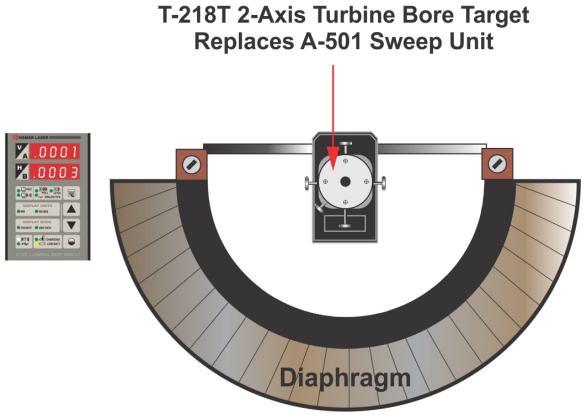


A-502A Turbine Target Fixture

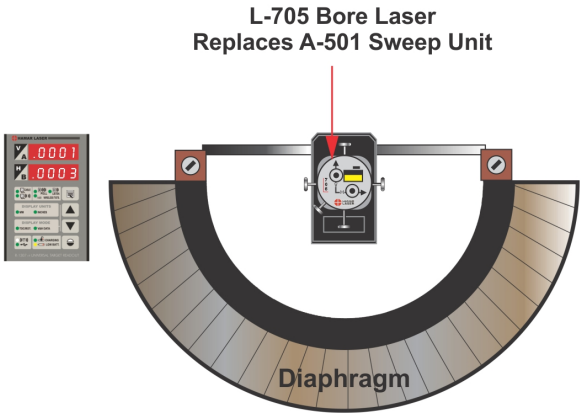


A-502L Turbine Laser Fixture





After the A-502 Fixture has been set to correct bore center, the T-218 2-Axis Turbine Bore Target replaces the A-501 Sweep Unit (both units have the same OD - 2.250 inches) in the second reference bore.



After the A-502 Fixture has been set to correct bore center, the L-705 Bore Laser replaces the A-501 Sweep Unit (both units have the same OD - 2.250 inches) in the first reference bore.

Measuring Bores Using the A-1511 Wand Bore Target/R-1308 Readout

There are two methods of obtaining readings when using the A-1511 Wand Bore Fixture. The first method is by attaching the R-1308 Readout to the target. The second method is by using the R-1307 Readout for wireless communication. To configure the R-1307 Readout for dual-axis mode, see Appendix B, beginning on Page 24.

Using a measuring tape, measure the diameter of the bore. Select the appropriate legs and/or extensions that can be adjusted to the radius of the bore, less 3.750 in. (95.25 mm).
Attach these legs to the A-1511 Wand Bore Fixture.

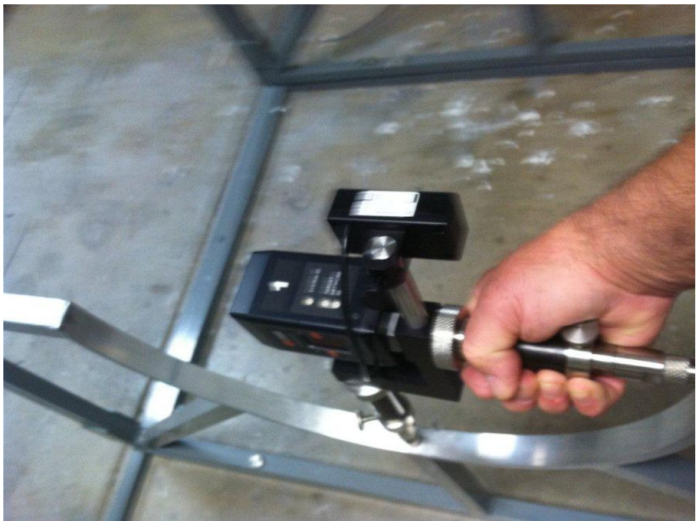
Use a measuring tape to coarse-adjust the legs. The measurement of the legs to the center of the target should be approximately the same as the radius of the bore. Final adjustments are made while measuring the bore.

Attach the R-1308 Single-Axis Readout to the A-1511 Wand Bore Fixture and plug it into the readout port on the side of the A-1519-2.4ZB Target.

Place the measuring tip against the side of the bore so it is resting on the support leg. Press the **Display Mode** button on the readout to change the display to horizontal bars. Adjust the support leg until there are fewer than three bars showing.

Press the **Display Mode** Button again to change the display to vertical numbers. Adjust the measuring leg until the readings are near .000. Slowly sweep the target in and out until you get the highest number reading on the readout. When you have the highest number reading on the readout, press the **ABS/REL** Button on the front of the R-1308 Readout to zero the reading.

Rotate the target 180 degrees on the fixture. Place the measuring leg against the opposite side of the bore so it is resting on the support leg. Press the **Display Mode** button on the readout to display the horizontal bars.



Adjust the support leg until fewer than three bars are showing. Press the **Display Mode** button again to display the vertical numbers. Slowly sweep the target in and out until you get the highest number reading on the readout. Record that number on a sheet of paper.

Place the measuring leg on the bottom of the bore so the support leg rest against the side of the bore.

Press the **Display Mode** button on the readout to display the horizontal bars. Adjust the support leg until fewer than three bars are showing. Press the **Display Mode** button again to display the vertical reading. Slowly sweep the target in and out until you get the highest number reading on the readout. Record that number on the sheet of paper.

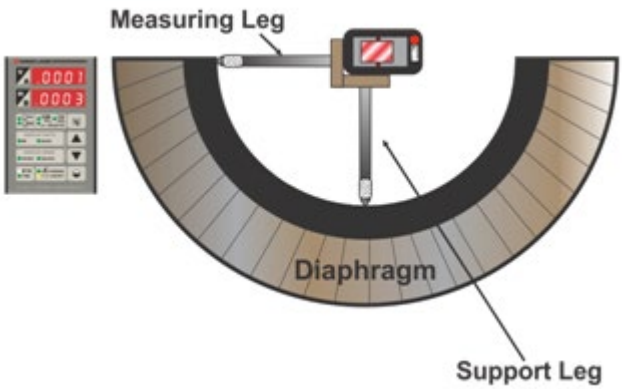
Calculating the Bore Misalignment

Left side of bore target reading = .000
Right side of bore target reading = +.026
The bore is misaligned by half of the reading (.013 – measured from the right side, looking into the target)
Bottom of bore target reading = -.045.
The bore is misaligned by -.045 minus .013 or -.032 (Low)

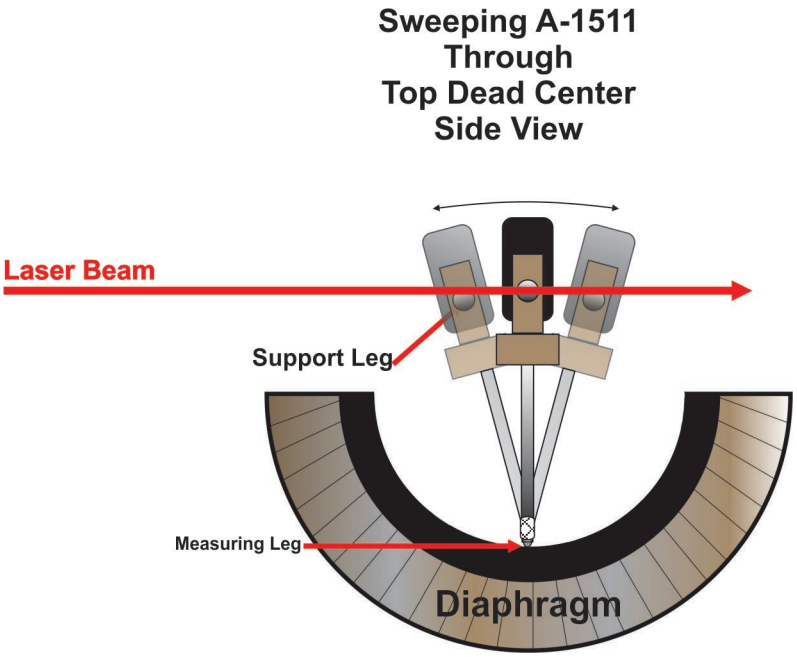
Measuring Bores Using the A-1511 Wand Bore Target/R-1307 Readout

Ensure that the R-1307 Readout is configured correctly for the A-1519-2.4ZB Wireless Target. See Appendix B beginning on Page 24 for configuration instructions.

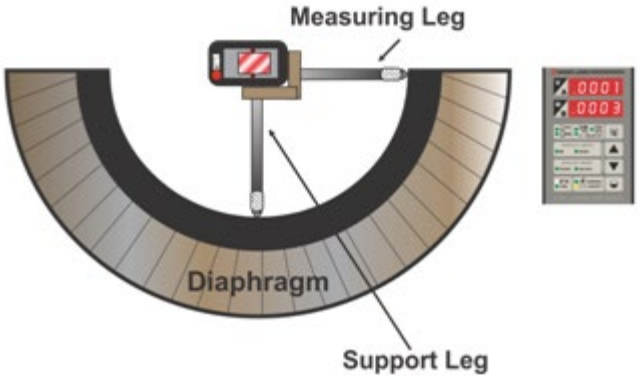
Place the measuring tip on the side of the bore so it is resting on the support leg. Adjust the *support* leg until the horizontal reading on the R-1307 readout is less than .030 in. (0.77mm). Adjust the *measuring* leg until the vertical reading is near .000.



Slowly sweep the target in and out until the highest number displays on the R-1307 Readout. Press the **Zero Button** on the side of the target for approximately 3 seconds to zero the readout.

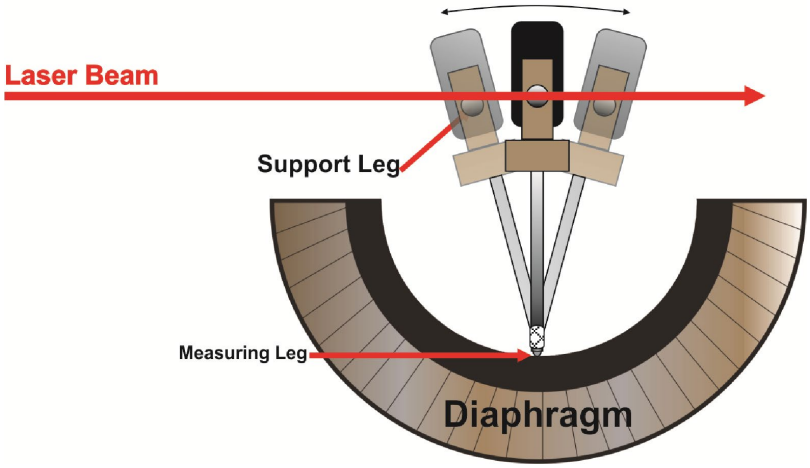


Rotate the target 180 degrees on the fixture. Place the measuring leg against the opposite side of the bore so it is resting on the support leg. Adjust the support leg until the horizontal numbers are less than .030 in. (0.77mm).

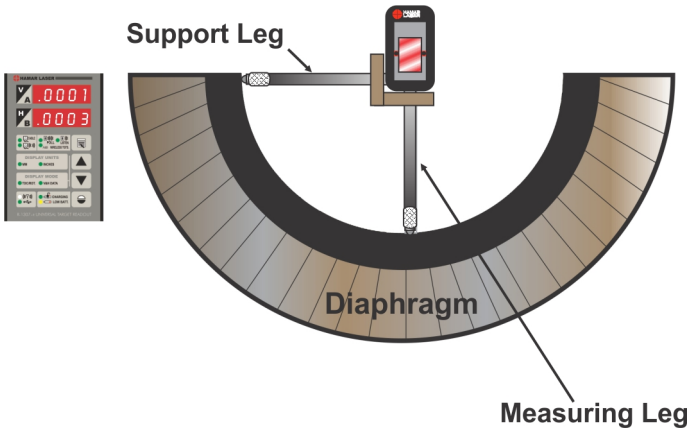


Slowly sweep the target in and out until the highest number displays on the R-1307 Readout. Record that number on a sheet of paper.

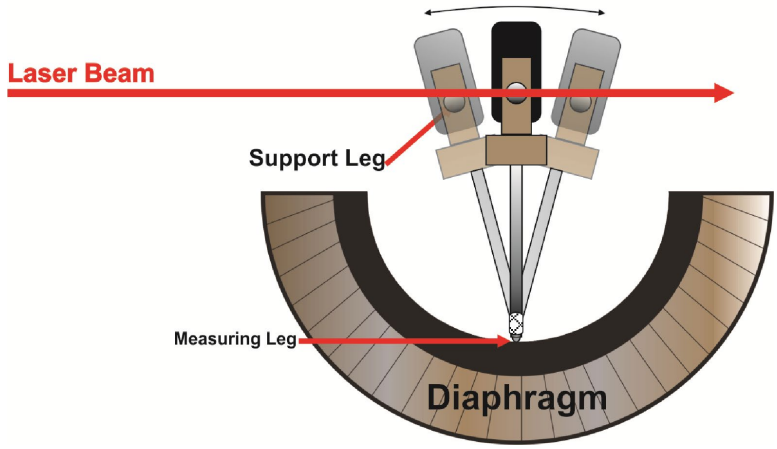
Note: *Be sure to note whether the number is positive* (+) *or negative* (-).



Place the measuring leg on the bottom of the bore so the support leg rest against the side of the bore. Adjust the support leg until the horizontal numbers are less than .030 in. (0.77mm).



Slowly sweep the target in and out until the highest number displays on the R-1307 Readout. Record that number on a sheet of paper.
Note: *Be sure to note whether the number is positive* (+) *or negative* (-).



Repeat this procedure in each of the components to be measured.

Calculating the Bore Misalignment

Left side of bore target reading = .000
Right side of bore target reading = +.026
The bore is misaligned by half of the reading (.013 – measured from the right side, looking into the target)
Bottom of bore target reading = -.045.
The bore is misaligned by -.045 minus .013 or -.032 (low)

Appendix A – The NORMIN Method (Bore and Spindle)

The NORMIN method was developed by Hamar Laser Instruments as a way of compensating for laser or target mounting errors in bore or spindle work. The word is a contraction of "NORMal-INverted," which briefly describes the method. It is quite similar to the four clock readings taken with dial indicators, but uses a laser and a target instead. The NORMIN method is used in conjunction with simple fixtures and targets that allow inexpensive, precision measurement. The target/fixture is set in the bore or spindle in the NORMal position (cable down) and the readings are recorded. Then the target/fixture is rotated 180 degrees to the INverted (cable up) position, and a second set of readings is obtained. The two sets of readings cancel out centering errors and provide a very accurate result.

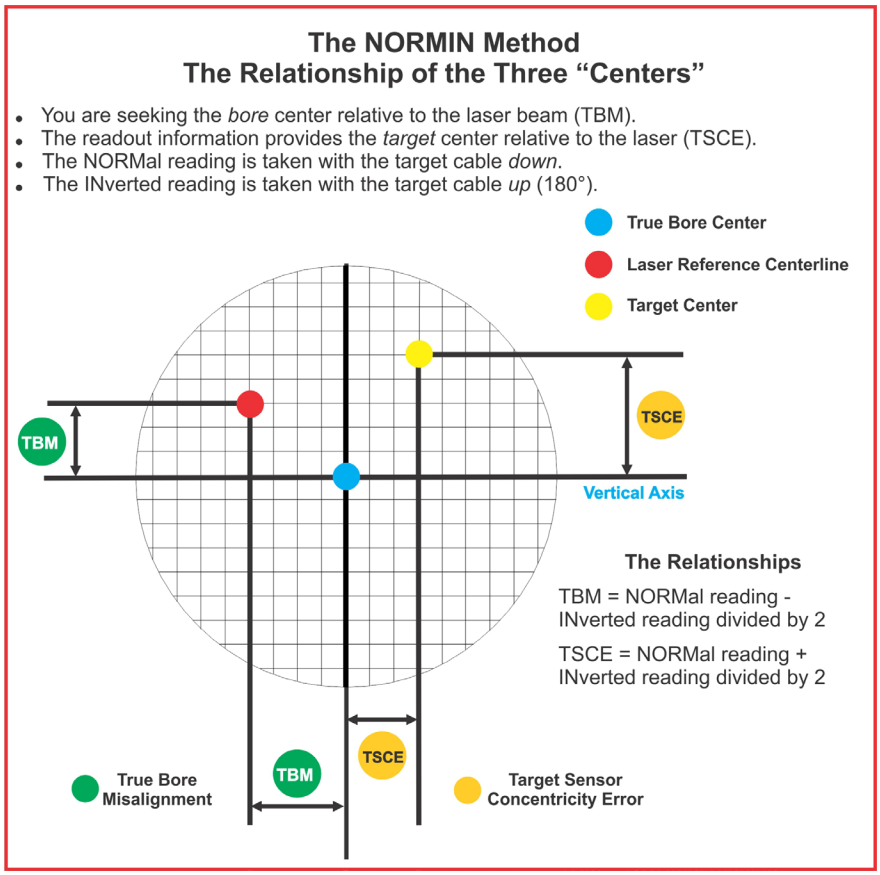


Figure 8 -- *Three centers of bore alignment*

There are three centers involved in bore alignments: the True Bore Center, the Target Center, and the Laser Reference Centerline. If mounting fixtures were perfect, the Target Center would be located at the True Bore Center, and if perfectly aligned, the True Bore Center would be located at the laser beam center. In reality, however, they seldom line up. An example of the three centers with respect to one another is shown in Figure 8.

Two relationships can be calculated from these three centers and two sets of NORMIN readings: the Target Sensor Concentricity Error (TSCE) and the True Bore Misalignment (TBM). The True Bore Misalignment (TBM) is used when it is desirable to know the true bore centerline position relative to the laser beam center without fixture errors. Usually, the laser beam center is where a bore center *should* be located, and the TBM shows its *actual* location. The Target Sensor Concentricity Error (TSCE) is used if the operator wants to place the laser beam center exactly in the middle of a bore.

The general rule is: buck in to the TSCE and measure the TBM.

The readout always shows the displacement between the Target Center and the Laser Beam Center. When the Target Center is not on the True Bore Center, the numbers and the signs on the readout will change when the target is rotated because the Target Center is moved to a different location in relationship to the laser beam.

Figure 9 represents the target in the NORMal position, with the cable *down*. If each square represents .001 in., the Target Center is .002 in. higher than the Laser Beam Center (+.002 in.) and is .007 in. to the right of the Laser Beam Center (+.007 in.).

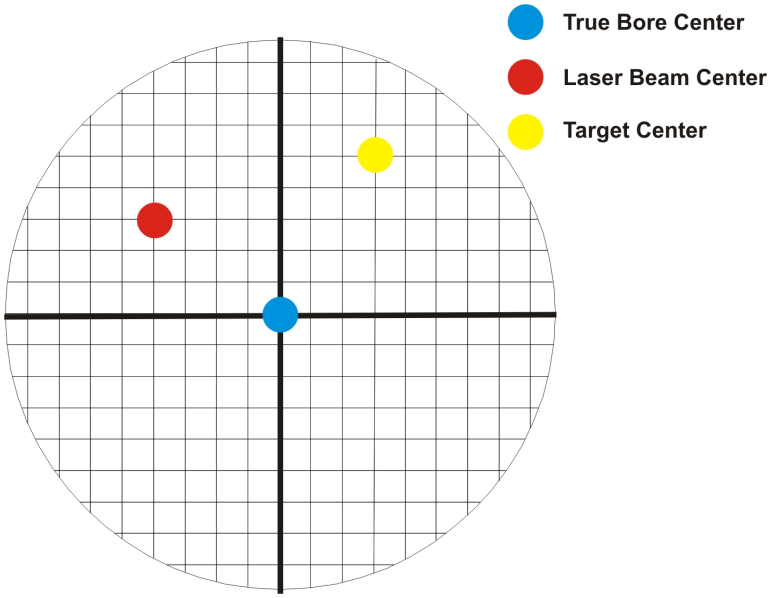


Figure 9 – *Target in the NORMal position*

Figure 10 represents the target in the INverted position, with the cable *up*. When the target is rotated, the *signs* on the readout are also rotated. Therefore, although the Target Center appears to be to the right of and lower than the Laser Beam Center in Figure 10, the vertical readings are positive, and the horizontal readings are negative. When the vertical TCE is calculated, (NORMal+INverted divided by 2) the Target Center is .004 in. higher and .003 in. to the right of the True Bore Center in the NORMal position.

The table below shows the calculation of the vertical and horizontal TSCE values.

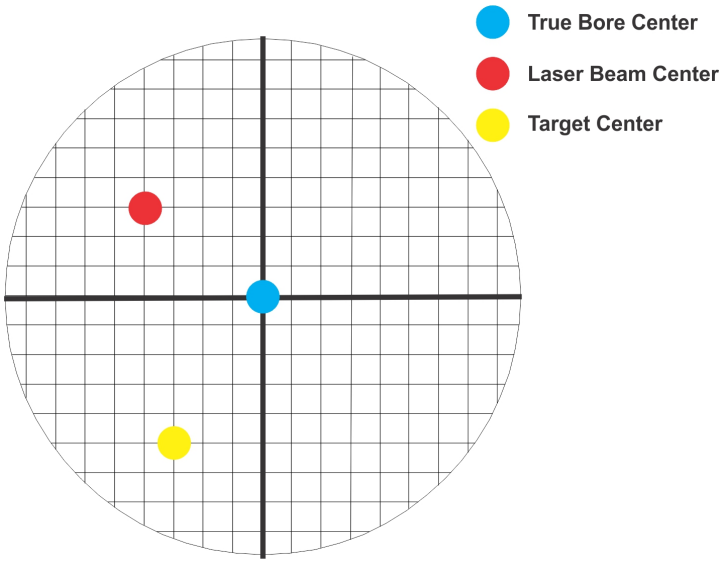


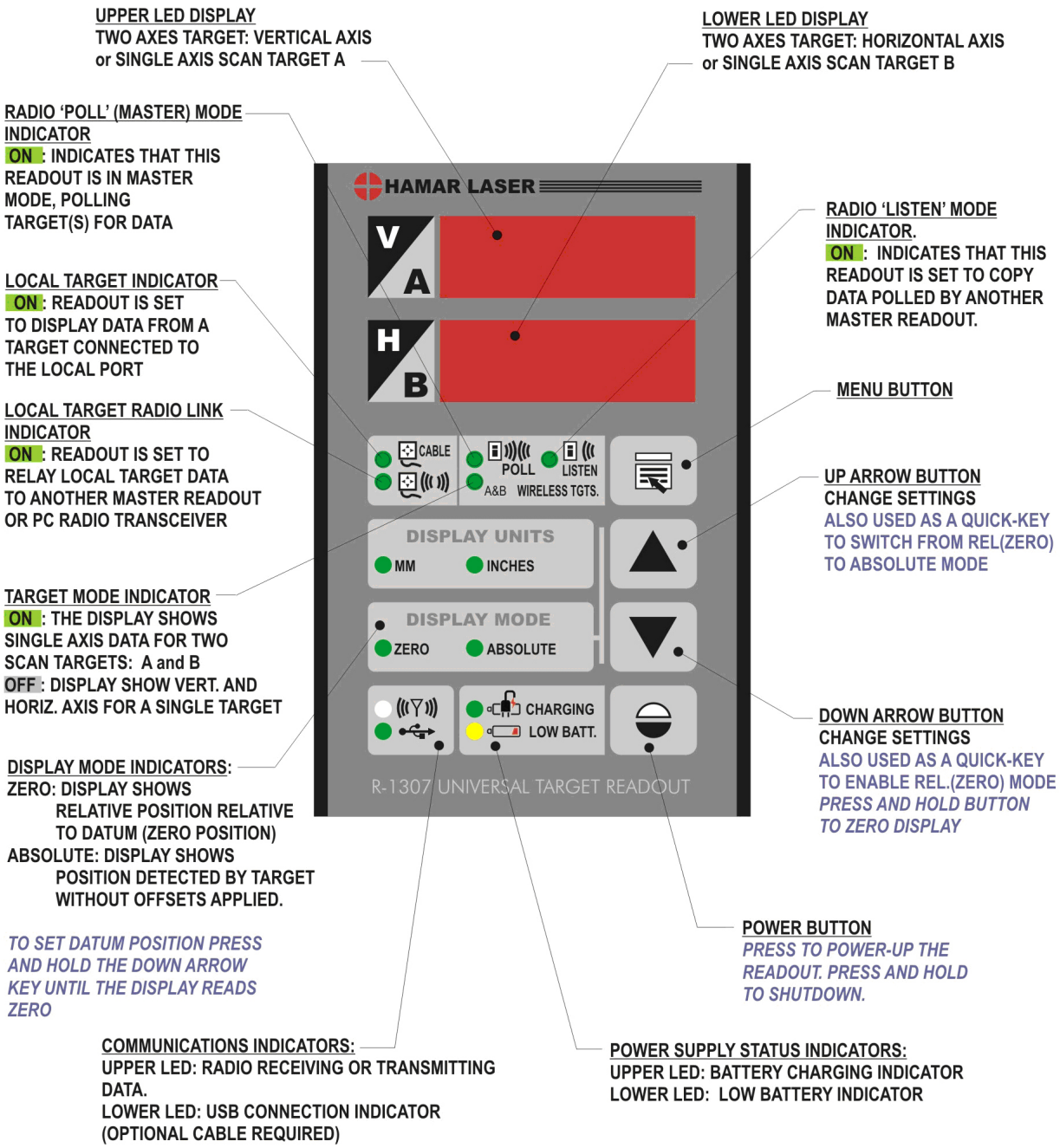
Figure 10 – *Target in the INverted position*

NORMal Vertical Reading	+.002 in.		NORMal Horizontal Reading	+.007 in.
INverted Vertical Reading	+.008 in.		INverted Horizontal Reading	-.001 in.
Total	+.010 in.		Total	+.006 in.
Divide by 2 = **Vertical TSCE**	**+.005** in.		Divide by 2 = **Horizontal TSCE**	**+.003** in.

If you place the Laser Beam Center exactly on the True Bore Center with the target in the NORMal position, the readings will show Vertical +.005 in. and Horizontal +.003 in.

Appendix B – Configuring the R-1307-2.4ZB Readout

Model R-1307 Readouts – Control Panel



Configuring the R-1307 Readout for a Cabled (Local) Target

Note: *Shut off power to the readout before connecting or disconnecting a target from the local port.*

1. **Connect the cabled target to the local port of the readout**
2. **Press and hold the MENU button for approximately 2 seconds to enter configuration mode.**
3. **Set the Measurement Units**
   Press the MENU button until the upper display shows unitS _ Use the UP and DOWN arrow keys to select either inch for inches or mm for millimeters.
4. **Set the Dampening Level**
   Press the MENU button until the upper display shows AuErAGE. Use the UP and DOWN arrow keys to set the number of averages. Adjust this value as required to suit the application. The default for this application is 8. For long distance shots, use 16 or 32.
5. **Set the Readout Function to Local Target**
   Press the MENU button until the upper display shows FunctS. Use the UP and DOWN arrow keys to select FunctS LOCAL.
6. **Select the PSD descriptor applicable to your target**
   Press the MENU button until the upper display shows tGtS nn, where nn designates the target calibration factor number. There is one calibration record for each target purchased. The R-1307 can store up to 9 records. Each calibration record in the R-1307 has the following target types:
   - TGT=0 (for HLI use only. Do not use)
   - TGT = nn, P.10.10 (10x10 mm sensor- pulsed beam mode)
   - TGT = nn, F.10.10 (10x10 mm sensor- fixed beam mode)
   - TGT = nn, P.4.4 (4x4 mm sensor- pulsed beam mode)
   - TGT = nn, F.4.4 (4x4 mm sensor- fixed beam mode)
   - TGT = nn, P.20.20 (20x20 mm sensor- pulsed beam mode)
   - TGT = nn, F.20.20 (20x20 mm sensor- fixed beam mode)
   - TGT = nn, P.40.40 (40x40 mm sensor- pulsed beam mode)
   - TGT = nn, F.40.40 (40x40 mm sensor- fixed beam mode)
     nn= R-1037 Readout number and matching target number

Press the UP or DOWN arrow to select the correct target number, which will change the second window. For example, tGtS02 F_ 10_ 10 or tGtS02 P_ 10_ 10 for R-1307 #2. The PSD sensor size and type is fixed to the target calibration record.

Warning: Targets are matched to specific calibration records in the R-1307 Readouts. For example, Target #1 must be connected to Calibration Record #1 in the R-1307 or the calibration is void. However, each R-1307 can have up to 9 target records, so up to 9 different target calibration records can be stored in each R-1307. When there are multiple calibration records, the record ID must match the target ID, so if you have Target #1, you should select TGT=01 to select the matching calibration factors.

7. **To exit configuration mode, press and hold the MENU button for approximately three seconds until the display returns to normal mode.**
   The R-1307 will also return to normal mode automatically after approximately four seconds of inactivity.

Configuring the R-1307 Readout for the A-1519-2.4ZB Wireless Target in Dual-Axis Mode

1. Press and hold the **Menu** button until the menu displays.
2. Press and release the **Menu** button until **ID** displays in both the V and H Display windows.
3. Use the up or down arrow keys to set the **Vertical ID** to 01.
4. Press the **Menu** button again and use the up or down arrow keys to set the **Horizontal ID** to 01.
5. Press the **Menu** button again and use the up or down arrow keys to set the **Channel** to ch-= 1
6. **Note:** *Ensure that the Target System ID dial on the side of the target is set to 1.*

7. Press the **Menu** button until FUnct displays in the Vertical Display window. Use the up or down arrow keys until Poll displays in the Horizontal Display window. After a few seconds the R-1307 readout will start polling for the target. When the laser beam is on the target, readings display in the Vertical and Horizontal Display windows.
8. Press and hold the **Up** arrow key to zero the readout.
9. Take measurements in each bore as described in *Measuring Bores with the A-1511 Wand Bore Target and the R-1307 Readout* beginning on Page 19.
   Note: *When using the Wand Bore Fixture with the R-1307 Readout, adjust the support leg until the horizontal readings are less than .030 in. (.73 mm).*

Appendix C – Care and Cleaning of Target Optics

The proper care and cleaning of optical windows and/or lenses of Hamar Laser's position-sensing devices (targets) assures optimum performance. Contaminants on an optical surface increase scatter, absorb laser energy, and eventually degrade the accuracy of the position-sensing devices. Because cleaning any precision optic risks damaging the surface, optics should only be cleaned when absolutely necessary. When cleaning is required, we recommend the following supplies and procedures.

Required Supplies

- **Optics Cleaning Tissue:** Soft, absorbent, lint-free lens tissue
- **Swabs:** Cotton swabs with wooden handles or polyester swabs with polypropylene handles
- **Dust Blower:** Filtered dry nitrogen blown through an antistatic nozzle is best. Canned dusters, such as Dust-Off, will also work.
- **Mild Soap solution:** Neutral soap, 1 percent in distilled water. Avoid scented, alkali, or colored soap such as liquid dishwashing detergents or hand soap. Ten drops of green soap (available at a pharmacies and optical cleaning suppliers) per 100 cc of distilled water is an acceptable alternative.
- **Isopropyl Alcohol:** Spectroscopic grade. Over-the-counter alcohol contains too much water and may have impurities.
- **Acetone:** Spectroscopic grade. Do not use over-the-counter Acetone, such as the type intended for nail polish removal.

NOTE: *When cleaning precision optics, even with the best quality optical cleaning tissue, use gentle pressure to avoid scratching the surface or damaging the optical coating(s). Always wipe using a figure-eight motion in one direction (begin at the top and work toward the bottom in a figure-eight motion).*
Use only moistened (not soaked) optical cleaning tissue, swabs and Spectroscopic grade Acetone and Isopropyl Alcohol. ***Never spray any type of liquid directly on the device or submerge any part of the device.***

Removing Dust

Dust can bind to optics by static electricity. Blowing only removes some of the dirt. The remainder can be collected by using wet alcohol and Acetone swabs wrapped with optical lens tissue. Acetone dries rapidly and helps to eliminate streaks.

1. Blow off dust.
2. If any dust remains, twist lens tissue around a cotton swab moistened in alcohol and repeat as necessary.
3. Repeat using Acetone.

Cleaning Heavy Contamination

Fingerprints, oil, or water spots should be cleaned immediately. Skin acids attack coatings and glass and can leave permanent stains. Cleaning with solvents alone tends to redistribute grime.

1. Blow off dust.
2. Using a soap-saturated lens tissue around a swab, wipe the optic gently. Repeat as necessary.
3. Repeat using a distilled water-saturated lens tissue wrapped around a swab.
4. Repeat using an alcohol-saturated lens tissue wrapped around a swab.
5. Repeat using an acetone-saturated lens tissue wrapped around a swab.