

Extruder Alignment

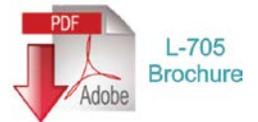
System Recommendations

L-705 Laser Borescope for Extruders
L-700 Twin Barrel Extruder
Alignment System



The L-705 Laser Borescope is unparalleled for ease of use and fast extruder alignments. It is also highly accurate, which can help to triple the life of extruder barrels and screws. With barrels costing up to \$5,000 and screws even higher, the L-705 Laser Borescope alignment system can pay for itself very quickly. It can further save money by reducing the electrical consumption of the motor. We've had one customer use a forklift to pull out the screw from one extruder and after laser alignment, slide it back in by hand!

Any bore from 1.5" (38 mm) to 14" (356 mm) can easily be measured with our L-705 Laser Borescope. The heart of the system is our patented A-510 2-Axis Self-Centering Target that automatically finds the center of the bore with no moving parts. This allows nearly instantaneous bore measurements for alignment or straightness.



The L-705 Laser Borescope Alignment System

In most cases, an extruder can be completely aligned in less than 1½ hours, including setup! With simplified fixturing and self-centering targets, the alignment system can be set up and misalignment data taken in as little as 10 minutes. And in most cases, bore straightness data can be taken and analyzed in 15 minutes or less using our Bore9 software. Compared with optics that can take 2 hours just to set up, the L-705 can bring your extruders back on line, producing parts in record time.

Simple Fixturing for Fast Setup

The L-705 Laser has been designed with a .750" (19 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" (0.01 mm), a simple flat face and .750" (19 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.

Long Range and High Accuracy

The L-705 Laser Borescope has a range of 100 feet (30 M), and under good environmental conditions, it is accurate to .003" (0.08 mm) over the whole range. By carefully following the NORMIN procedure described below, accuracies of .0002" (.005) in 10 feet (3 M) can also be achieved.



L-705 Laser Bore
Alignment Laser



R-1307 2.4ZB Target
Readout



5 Ye Olde Road, Danbury, CT 06810 • Phone: (800) 826-6185 • Fax: (203) 730-4611
E-mail: sales@hamarlaser.com • Internet: <http://www.hamarlaser.com>

Replaceable Adapter Legs for Each Barrel ID

Give us each extruder barrel ID and we make a set of legs customized to that ID. The legs insert into the A-510STA or A510LTA Bore Adapter Hubs to self-center the target in the barrel.

Patented, Self-Centering Target Bore Adapters

Hamar Laser has developed the world's first self-centering target (A-510) and bore adapter (A-510STA/A-510LTA) that uses no moving parts. It takes just seconds to position the target in the barrel for an accurate measurement down to .0005" (0.01 mm). See *How the Alignment System Works* for more information.



A-510 2-Axis Bore Target

A-510LTA/STA Adapter Hubs with M-705CL Legs

Barrel Wear Measurements

The A-510STA (or LTA) Bore Adapter can be placed on the A-510 Target in two ways. With the adapter placed on the target in Self-Centering Mode, it will center itself into the barrel. By inserting the A-510STA (or LTA) in Measuring Mode, the adapter will measure diameter changes in the bore. To measure barrel wear/diameter changes, a measurement is taken with an inside micrometer of a reference bore, usually at the free end of the barrel. The target and adapter in Measuring Mode are inserted into the reference bore. A measurement is taken with the target in the NORMAL position and in the INverted position. The two readings are averaged and the result is the starting measurement for the laser. At each subsequent measuring point, two sets of readings, NORMAL and INverted, are taken and averaged. Subtract the result from the reference measurement to produce the diameter change.

L-705 System Features

- 10-15 minute setup time
- Built-in horizontal and vertical angular adjustments for quick referencing
- Target uses lightweight, customized bore adapters
- Self-centering target, accurate to .0002" (0.005 mm), vastly simplifies measurement process
- Easily accommodates bores as small as 1.5" (38 mm)
- Wireless transmission of alignment data to Bore9 software
- Hand-held LED readouts show alignment data in 2 axes
- Portable enough to fit into small carrying case. Entire system weighs less than 15 lbs. (6.8 kg)
- Large digital 2-axis display with wireless output to software
- Laser beam straight to .0001" (.0025 mm) accuracy in 10' (3 M) or .001" (.025mm) accuracy in 100' (30 M)
- Battery operated

Recommended System Configuration

L-705 Bore Laser
A-510 2-Axis, Self-centering Target
A-510STA Extruder Target Adapter Hub (2"-5" bores)
M-705CL Customized Set Legs for each ID for Bore Adapter Hub
A-705 Chuck-style Gearbox Adapter
R-1307BC 2-Axis Readout w/0.001 mm resolution
A-510E Pole Extension
T-231A 25' Target Extension Cable
A-650 Shipping Case
A-909B Pole Case

Optional Accessories

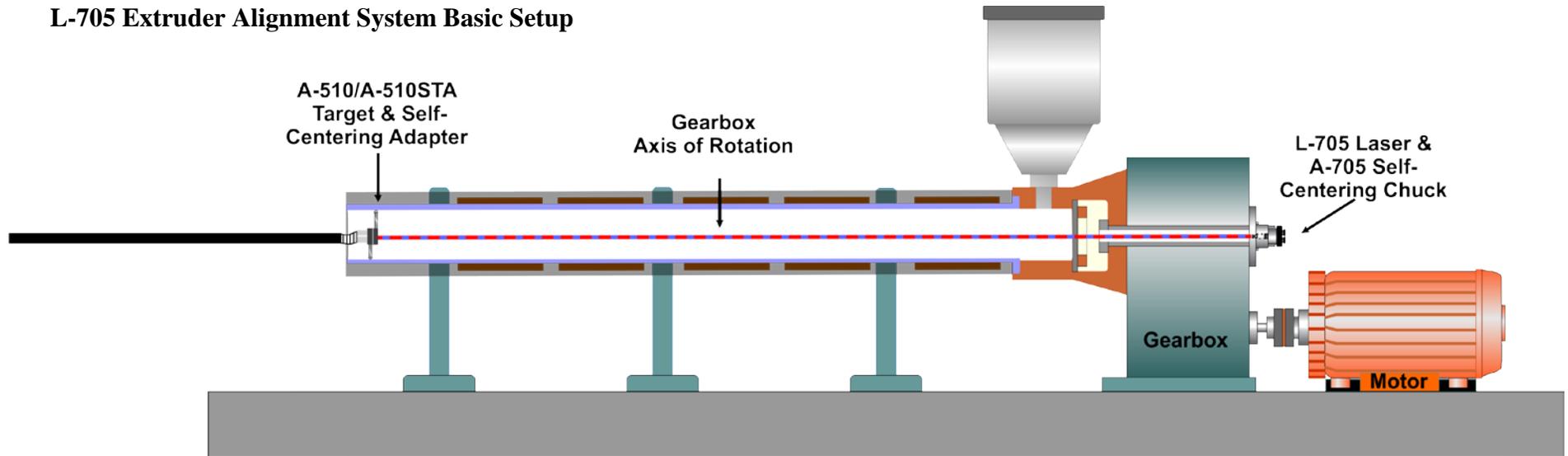
S-1403 Bore9 Software
A-910-2.4ZB Wireless Computer Interface
A-705L Large Chuck-style Gearbox Adapter
A-510LTA Large Bore Adapter Hub (5" to 16")
R-1307C 2-Axis Cabled Readout

More Information Online



How the Alignment System Works

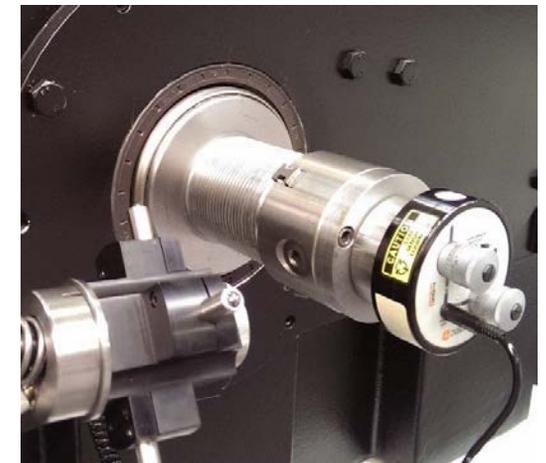
L-705 Extruder Alignment System Basic Setup



The L-705 Laser is mounted into the gearbox through-hole (counter bore) by using our A-705 self-centering chuck, which has a specially adapted plate with a .750" (19 mm) hole that is centered to the feet to within .0005" (0.01 mm). The laser projects the axis of rotation of the extruder gearbox using a method we call the NORMIN (NORMAL and INverted) procedure.

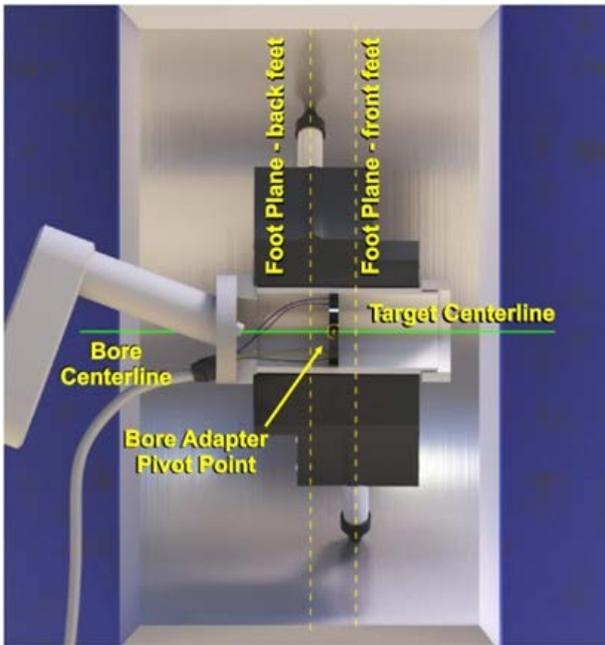
The A-510 and A-510STA (or LTA) are designed so that the PSD (Position Sensing Detector) is centered axially between the four feet of the adapter, two of which are offset axially from the other two. This, in effect, puts the PSD on the pivot point of the adapter and allows the angle of incidence to the laser beam to vary by up to 45°. To insert the target into the barrel, a spring-loaded pole is attached to the target and the target cord is pulled. This tips the target forward, allowing it to easily slide into the bore. When the cord is released, the target and adapter "jam" into the bore, finding the center automatically. The weight of the pole keeps the target seated in the bore.

The target and bore adapter are specially designed to find the center of the bore, without any moving parts, to a tolerance of .0005" or 0.01 mm (with care, tolerances of .0002" or .005 mm can be achieved). The bore adapters are customized for each barrel diameter, but can handle a small range of diameter variance.

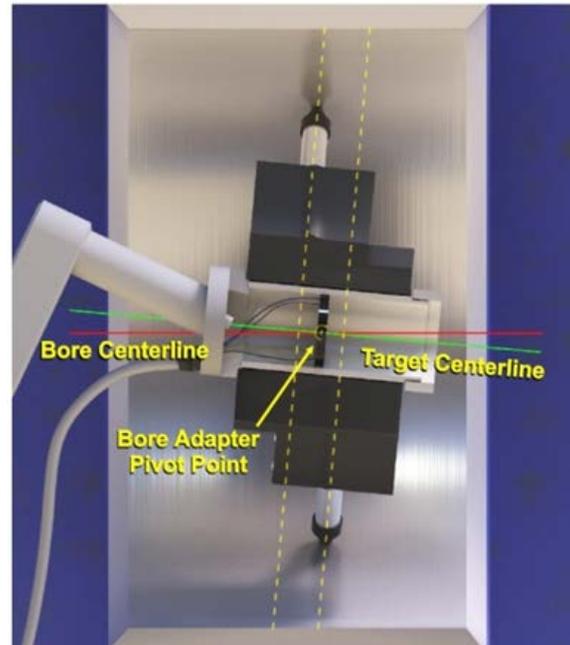


L-705 Bore Laser with A-705 Self-Centering Chuck in an extruder counterbore

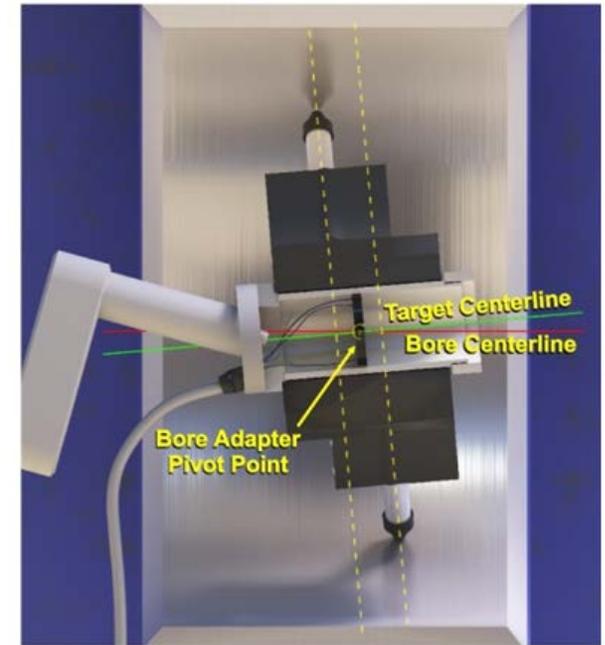
How the A-510 and A-510STA Self-Centering Adapters Work



**A-510/A-510STA Target & Adapter
Adapter OD = Nominal Bore ID**



**Bore ID > Nominal ID
Target Tilts Forward
PSD Is Still Centered**



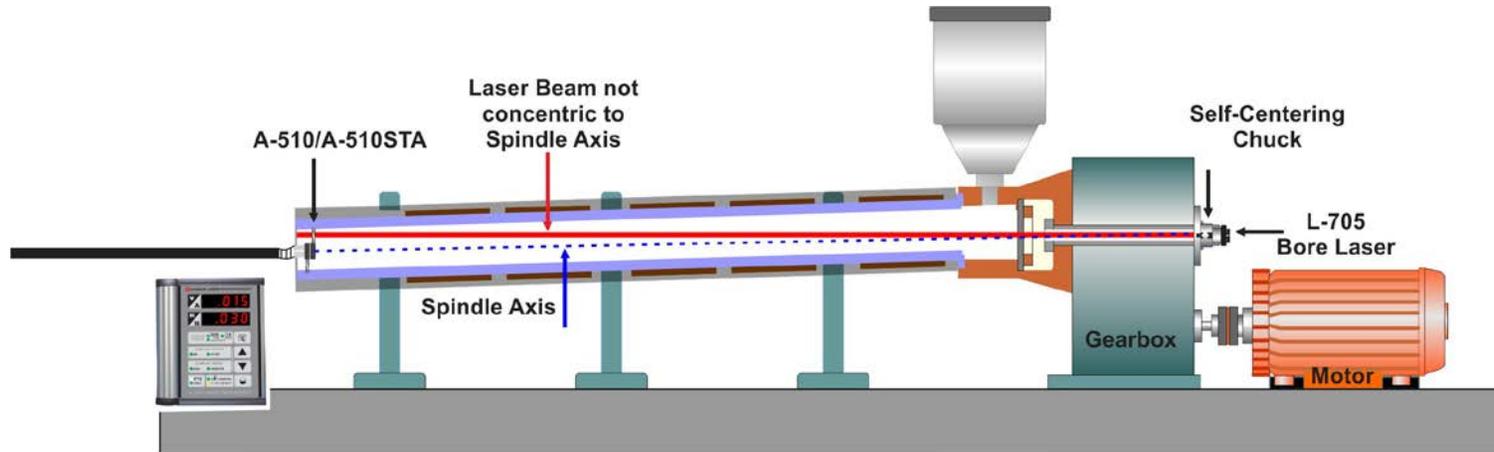
**Bore ID < Nominal ID
Target Tilts Back
PSD Is Still Centered**

The L-705 Extruder Alignment Procedure

To perform an alignment, Hamar Laser's NORMIN procedure is used to put the laser beam on the axis of rotation of the gearbox, which is then projected down the barrel to the target.

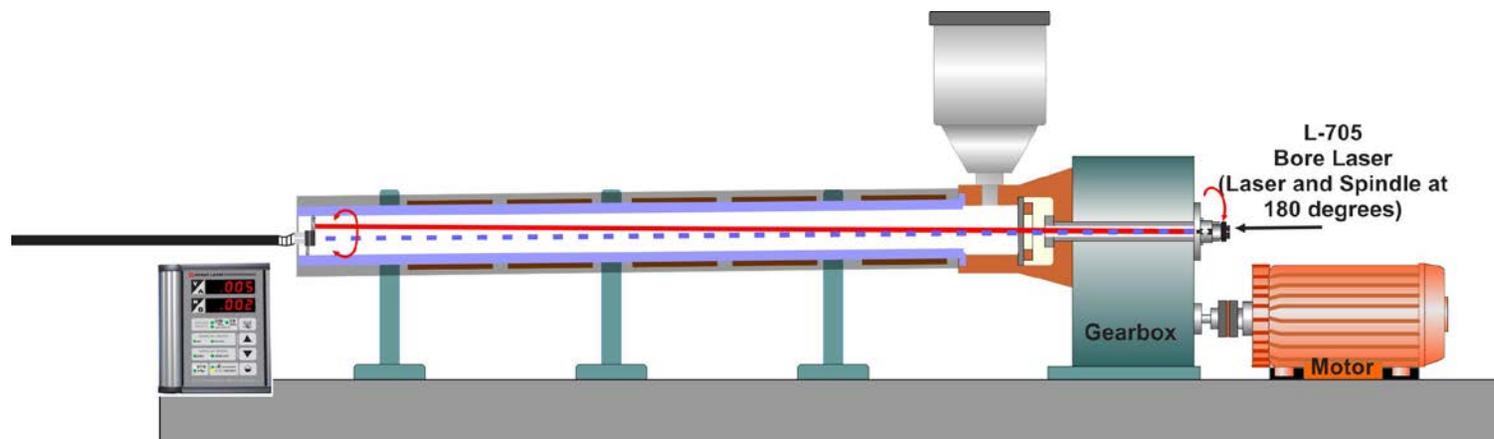
Step 1: L-705 Laser in Normal Position

Insert the laser and the self-centering laser fixture into the gearbox counter bore and the A-510 Target and A-510LST Bore Adapter into the free end of the barrel. Write down the H (horizontal) and V (vertical) readings.



Step 2: L-705 Laser in Inverted Position

Rotate the gearbox by hand until the laser is inverted, using the built-in levels to determine the inverted position. Write down the second set of readings.



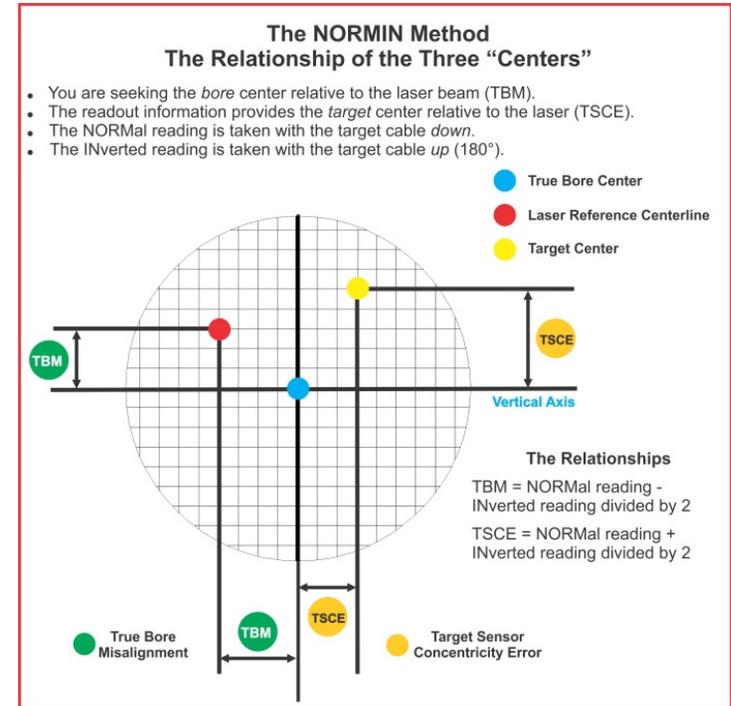
Step 3: Calculate Set Points

Average the horizontal values for NORMal and INverted, and then average the vertical values. The results determine the set points for the horizontal and vertical axes (see example below).

| | |
|---|---------------|
| Laser at 0 degrees (12 o'clock) | |
| V Reading | +.015" |
| H Reading | -.030" |
| Laser at 180 degrees (6 o'clock) | |
| V Reading | +.005" |
| H Reading | +.002" |

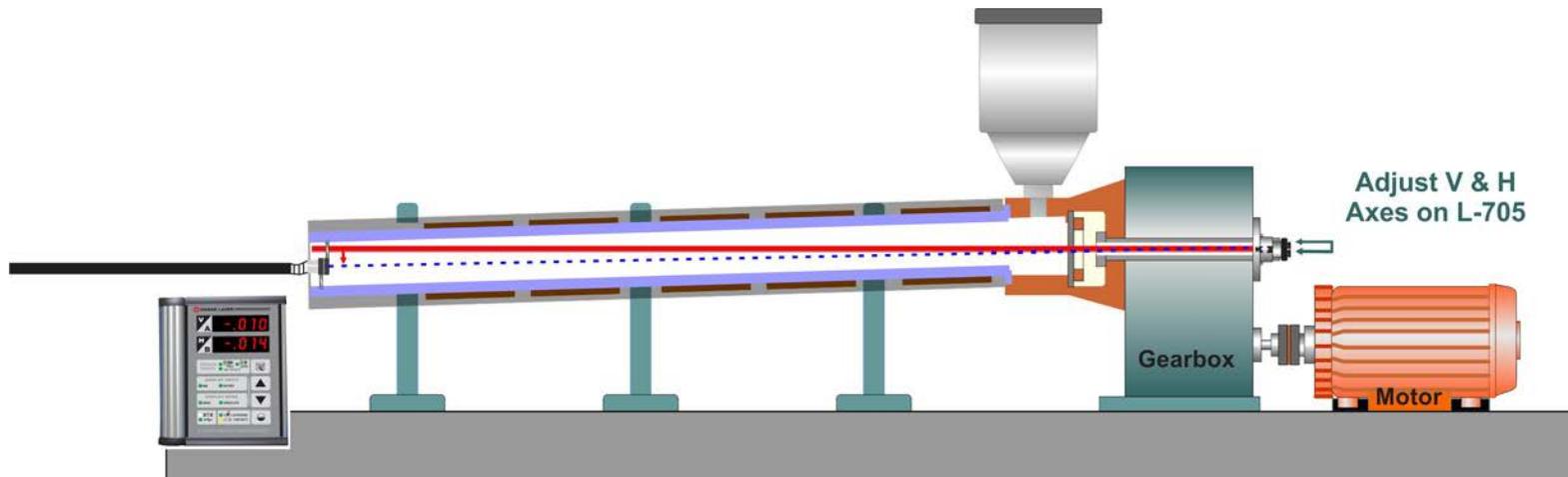
$$\text{Setpoint} = \frac{V_N + V_I}{2} = \frac{.015 + .005}{2} = +.010''$$

$$\frac{H_N + H_I}{2} = \frac{-.030 + .002}{2} = -.014''$$



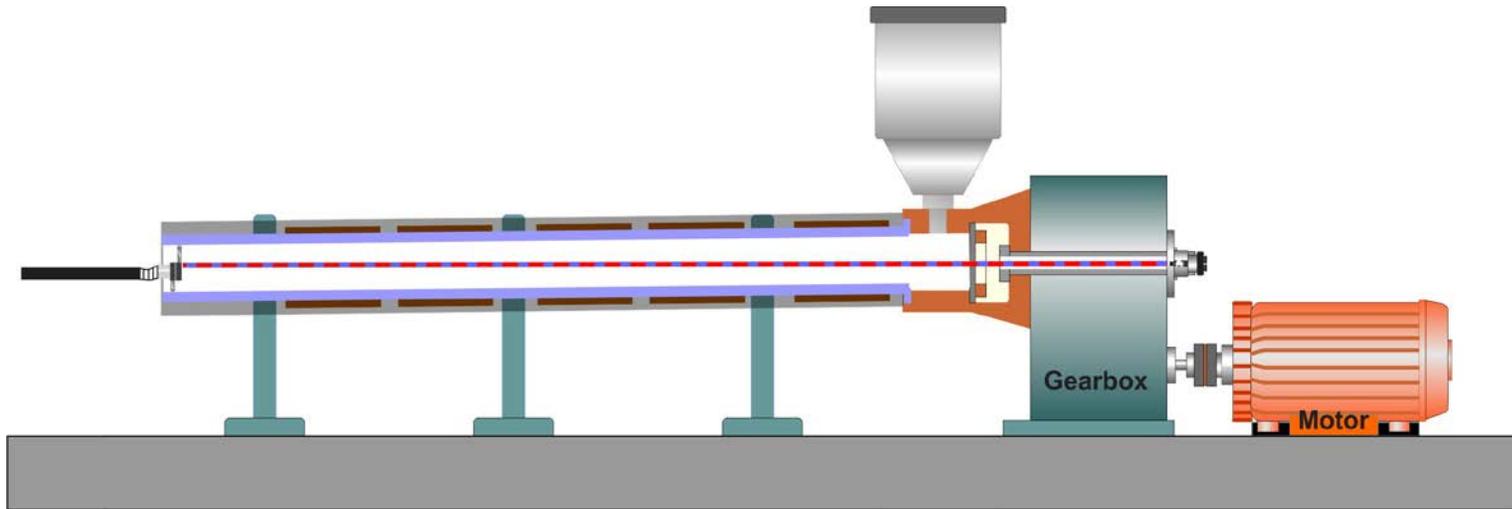
Step 4: Adjust Laser V & H Micrometers Until Readout Displays the Set Points

Turn the angular adjustment micrometers until the readout V and H display values equal the Set Points.



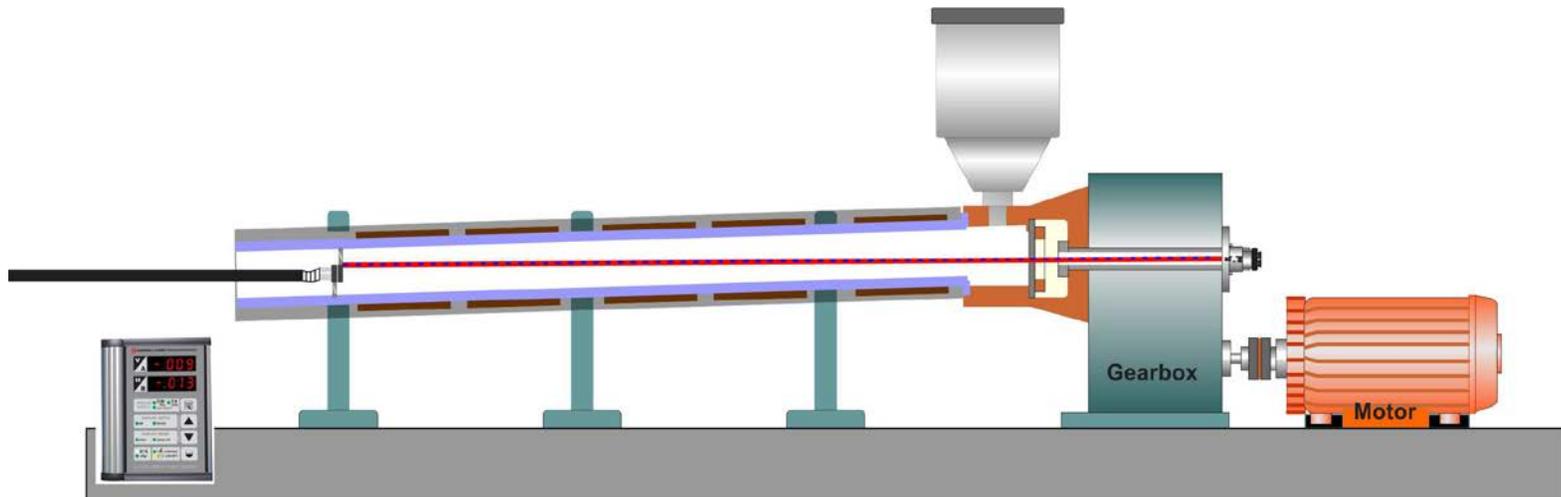
Step 5: Laser Beam Concentric to Axis of Rotation

The reading produced after completing the NORMIN procedure is then a measure of the misalignment of the free end of the barrel to the gearbox axis of rotation. To align the barrel, it is best to move the target into the barrel just above the first support. Now the barrel can then be shimmed or moved until the readout displays .000" in both axes. If there are no other supports, then the barrel is aligned!



Step 6: A-510 Target Inserted to First Adjustment Point

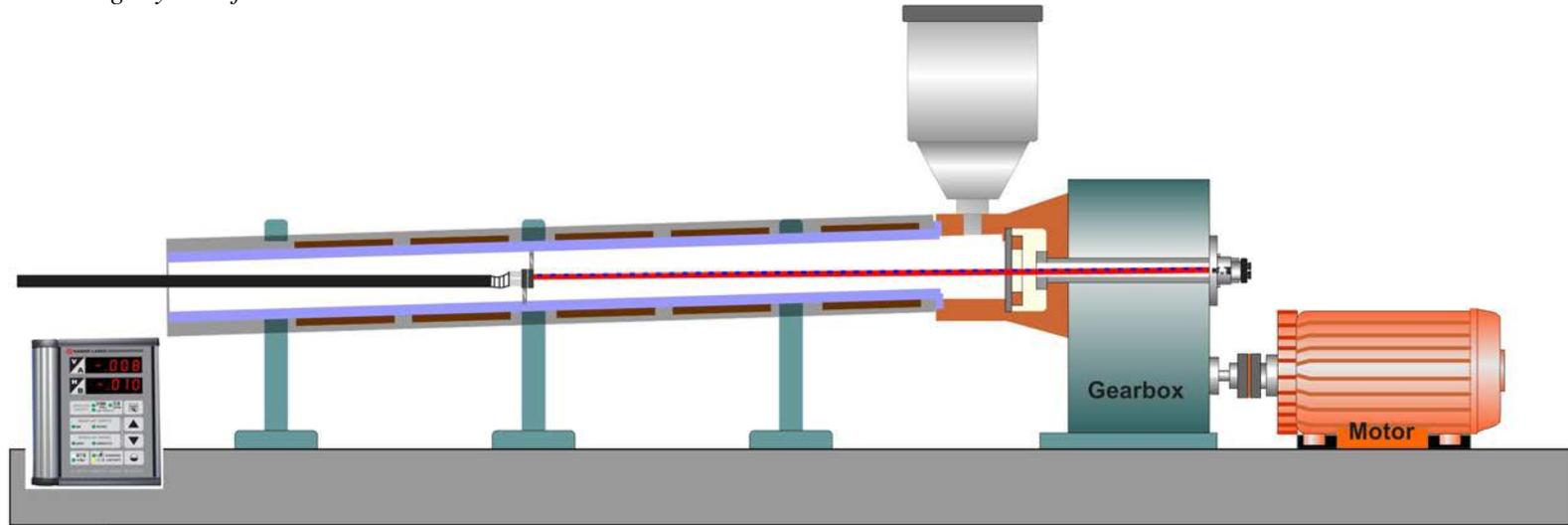
Pull on the cord to release the A-510 Target and move the target into the barrel to just above the first adjustment point. Adjust the V and H axes of the barrel until the R-1307 Readout shows zero or is within the alignment tolerance. The data is live, so the R-1307 readout will update as the barrel is adjusted.



Step 6: A-510 Target Inserted to Second Adjustment Point

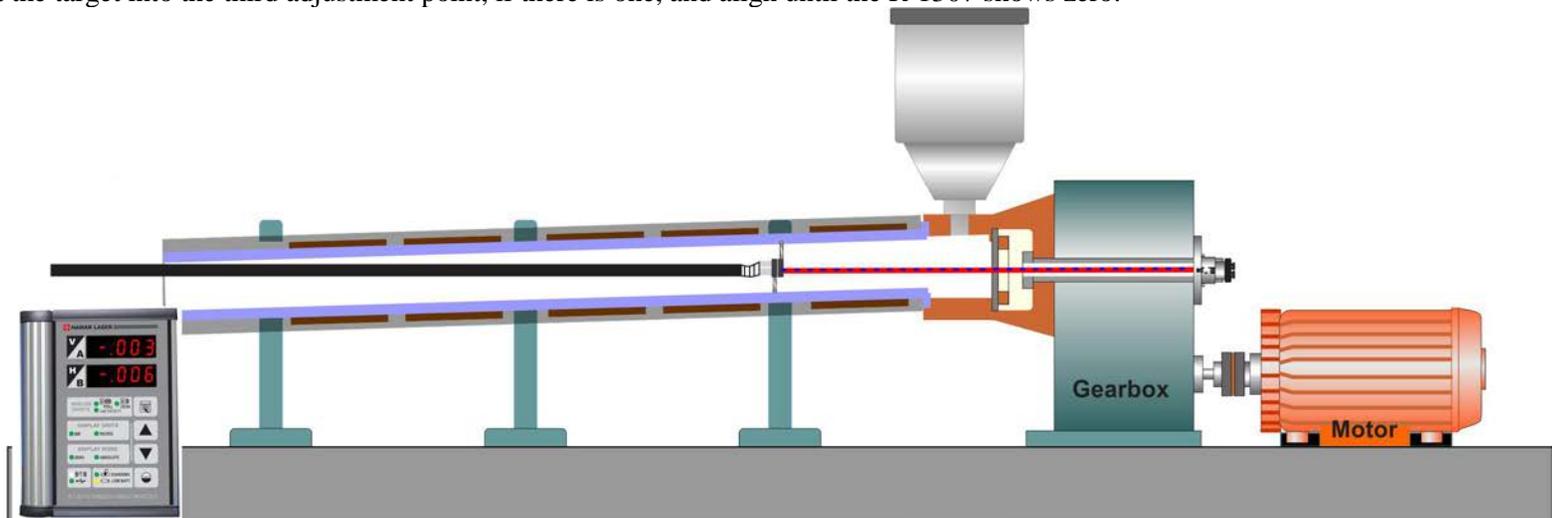
If there is more than one adjustment point for the barrel, then the target can be inserted into the barrel at the point just above the second support, and again the barrel can be shimmed or moved until the readout reads zero or is within tolerance.

Note: *It is always advisable to move the target back to the first support point and check to see if adjusting the barrel at the second point caused the alignment at the first support to be slightly out of tolerance.*



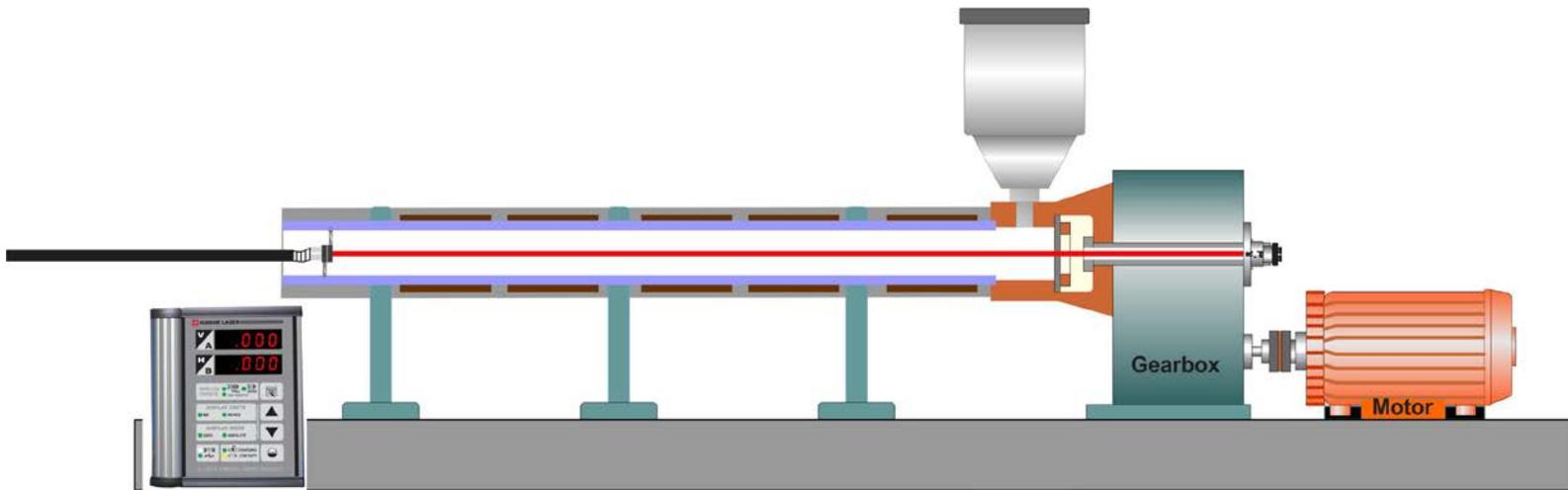
Step 6: A-510 Target Inserted to Third Adjustment Point

As before, insert the target into the third adjustment point, if there is one, and align until the R-1307 shows zero.



Step 7: L-705 Extruder Alignment System –Barrel Aligned to Gearbox

Double check to make sure the first and second adjustment points are still aligned. If so, then, the barrel is now aligned!



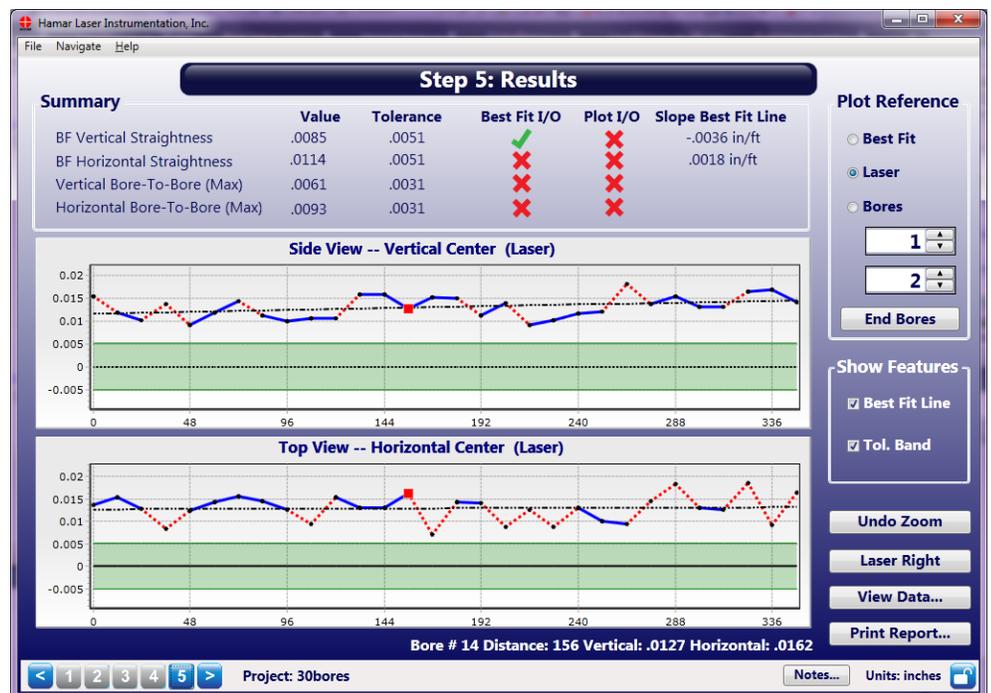
Using Bore9 Software

Hamar Laser's Bore9 software supports all of Hamar's past and present bore alignment equipment to create a powerful tool for measuring and aligning up to 50 bores. This comprehensive and easy-to-use program measures bore straightness (axis centering) and diameter change when using our targets in measuring mode. Applications include engine blocks, extruder barrels, hydraulic cylinders, large-bore gun barrels, printing press bearings, rotary compressors and turbines.



Bore9 features an easy 5-step process (described briefly below) that guides the user through the alignment process from setup to results. These results can be plotted, saved, and exported to an Excel spreadsheet.

- **Step 1 – Bore Setup.** The user enters setup information for the alignment check such as number of bores, distance between bore, bore diameters and bore straightness tolerances.
- **Step 2 - Target Mounting Error.** An optional step in the extruder alignment process for high accuracy applications to remove target adapter mounting errors, using the NORMIN method. The word NORMIN is a contraction of **NORMAL-INverted**, which briefly describes the method.
- **Step 3 – Laser Setup.** On-screen instructions guide the user through setting up the laser and making it parallel to reference points.
- **Step 4 – Record Data.** Bore straightness data is recorded. There are several different sets of data that can be taken in this step.
- **Step 5 –Results.** Results of the recorded data are plotted on a graph and a least-squares, best-fit data algorithm is applied to generate the straightness results and to determine if they are in or out of tolerance. Plot data can be changed to reflect the position of the centerline of the bores relative to the end bores, selected bore numbers, the laser beam or a “Best Fit” line. The data for each point is recalculated automatically based upon which references are chosen. Reports are also generated in this step and can be customized to the four different bore references. Comments may be added and the report can be printed with a summary, a graph of the vertical and horizontal straightness, comments and a table showing the recorded data.



The L-700 Alignment System for Twin-Barrel Extruders



Using components from several different systems, Hamar Laser has developed a package to align twin-barrel extruders as quickly and accurately as possible. Our L-700 Spindle Laser and A-510 2-Axis Self-Centering Bore Target create a powerful package to align twin-barrel extruders up to 70% faster than conventional or optical borescope methods. With an accuracy of $\pm .0002$ " (.005 mm) and our optional alignment software, the L-700 is the perfect extruder alignment tool.

The alignment of the twin-barrel extruders has never been easy. Traditional methods, such as using indicators to line up the outside of each barrel section, are subject to large stack-up errors and make the assumption that the outside of the barrel is parallel to the center line of the bore. Given the long length of the barrel, a slight error of

.001" (.025 mm) to .002" (.05 mm) for each section can add up to .015" (.38 mm) or more misalignment at the free end of the barrel.

The L-700 laser virtually eliminates indicator stack-up errors by projecting the axis of rotation of the gearbox drive shaft out to 100 feet (30 M). This provides a single reference from which each section of the barrel can then be aligned. A target accuracy of .0002" (.005 mm) means very accurate alignment of each section of the extruder can be achieved.

Since the target can simultaneously show a live display of both horizontal and vertical readings, you can start aligning each section of the extruder without changing the setup or moving the laser. When the readout reads zero in the front and back (if desired) of the bore of an extruder section, it is aligned.



L-700 System Features

- Simple fixturing to mount the laser onto the drive shaft projecting its axis of rotation to 100 (30' M)
- Vertical and horizontal controls for both angle and center for adjustment of laser to shaft's precise axis of rotation
- Self-centering target comes with pole for insertion into long bores
- .0002" (.005 mm) target accuracy with live measurement data in two axes (vertical and horizontal center)
- Visible light beam
- Hand-held LED readouts show alignment data in 2 axes
- Laser runs for up to 8 hours on a standard, replaceable 9-volt battery
- Windows-based software with large, color graphics
- Compact and rugged (4" L x 2.9" H x 1.75" W or 101 mm x 73 mm x 44 mm)

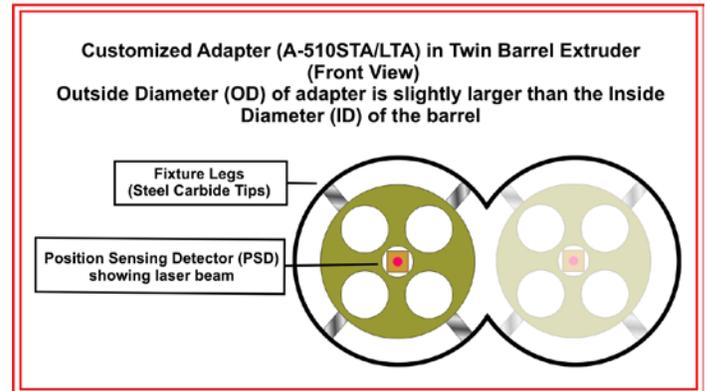
How the Alignment System Works

The L-700 Laser is affixed to the gearbox output shaft using a self-centering chuck with a specially designed plate that has a .500" (12 mm) hole (matches stud on back of laser) that has been aligned to the feet. The laser is attached to the chuck and it is placed over the output shaft. A 2-axis target and the NORMIN procedure are used to position the laser beam on the axis of rotation of the gearbox shaft. When removed, the laser will project the gearbox shaft centerline out to 100 feet (30 M).

A customized adapter (A-510STA/LTA) and pole are attached to the A-510 Target and the assembly is inserted into the free end of the barrel. The target automatically centers itself and immediately provides a horizontal and vertical measurement of alignment. If the twin-barrel is under construction, the system can be used to align each section of the barrel. This is a much better alignment method than using indicators on the outside of the barrel or relying on pins and manufacturing to perform the alignment, both of which are subject to significant stack up errors.

If the extruder to be aligned is already installed, the A-510 target can be inserted into the barrel and positioned over adjustment points. The digital readout displays the misalignment numbers dynamically. Simply adjust the barrel until the readout reads zero and that section is aligned. If there is radial adjustment in each individual barrel section, then the same procedure can be followed for the other bore.

Aligning Twin Barrel Extruders



Recommended System Configuration

L-700 Spindle Alignment Laser
A-510 2-Axis, Self-centering Target
A-510STA Extruder Target Adapter Hub (2"-5" bores)
R-1307-2.4ZB Target Readout
A-650 Shipping Case

Optional Accessories

S-1380 Read8 Software
A-910-2.4ZB Wireless Computer Interface
R-342 Laptop Computer or R-1342 Shop-hardened Laptop Computer
R-307V 2-Axis Large Number Readout
A-510E Target Pole Extension
T-231A 25' Target Extension Cable