Operations Manual

Bore9

Alignment Software for the R-1307 Readout

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Revision L

HAMAR LASER
ALIGN WITH THE BEST

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Bore9 Alignment Software for the R-1307 Readout

Bore9 Alignment Software measures and displays the alignment of multiple bores. It measures bore straightness (axis centering) and size (diameter) using one of the bores as a reference. Applications include turbines, engine blocks, rotary compressors, extruder barrels, gun barrels, hydraulic cylinders and printing press bearings.

Compensating for Mounting Errors

Target and laser mounting errors must be compensated for in order to achieve accurate results in bore and spindle work. Bore9 uses the NORMIN method developed by Hamar Laser. The NORMIN method is a quick and precise way of canceling out these errors and eliminates the need for complicated, expensive fixtures. The word NORMIN is a contraction of **NORM**al-**IN**verted, which briefly describes the method.

One unit (target or laser) is set in the NORMal (cable down) position, and the other rotated 180 degrees to the INverted (cable up) position. A set of INverted readings is taken. Then the laser and target are both set in the NORMal (cable down) position and the readings are recorded. In some cases, three readings are taken: target NORMal and laser INverted, laser NORMal and target INverted, and both units NORMal. The readings are then averaged to cancel out both centering and angular mounting errors and provide a very accurate result. A detailed description of the NORMIN procedure can be found in Appendix A, beginning on Page .

Bore9 Features

- **Live display**
  The plot displays move with each adjustment, allowing the user to see the misalignment and correct it easily.

- **Offsets**
  Bore9 allows the user to develop or enter various offsets or error corrections. The offsets can be toggled on and off as required and include the following capabilities:
  - Zero
  - Buckin
  - Manual Offset
  - Align Target

- **Save, print and analyze recorded data**

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.

Connecting to a Computer Interface

Hamar Laser's computer interfaces couple with a portable computer to act as a readout and allow the use of the Bore9 program to perform calculations, display live laser beam-to-target position information, and plot results.

Figure 1 – *A-910-2.4ZB Interface*

- The **R-358 Interface** attaches to the computer with an RS-232 cable and is powered by a lithium ion battery or an AC adapter. The R-358 is available in both standard (.0001 in.) and high-resolution (.00001 in.) versions.

- The wireless **A-910 Interface** for Hamar Laser's Type II Universal Wireless Targets incorporates a built in radio transceiver available in 900 MHz or 2.4 GHz. Operating through the A-910 Radio Transceiver/Hub, up to 99 Type II Targets may be connected as a Target System Group, and up to ten Target System Groups consisting of 99 targets per group may be used at one time. The 900MHz model has an indoor range of 300 feet (91 meters) and the 2.4 GHz model has an indoor range of 600 ft. (1.83 m). Data transmission is 4 mW and 50 mW respectively. See Appendix B on Page **56** for configuration instructions.

    Warning: You must install the A-910 Driver before inserting it into the USB port!!!

- The **A-910-2.4ZB Interface** is used for up to 99 targets. The A-910ZB is a very small, USB-powered 2.4GHz radio transceiver that can read up to four targets simultaneously. If you are using the A-910-2.4ZN Interface, see Appendix E on Page **60** for configuration instructions.

Connecting to the R-358 Computer Interface

Note: *Before using the R-358 Computer Interface, ensure that the battery is fully charged or that the AC charger/adapter is plugged in. Make all connections with computer powered off.*

1. **Connect the target(s) to the INPUT connector on the front of the R-358 Interface.**
    The interface can support one 4-axis target. It can also support two 2-axis targets with the use of an optional splitter cable.
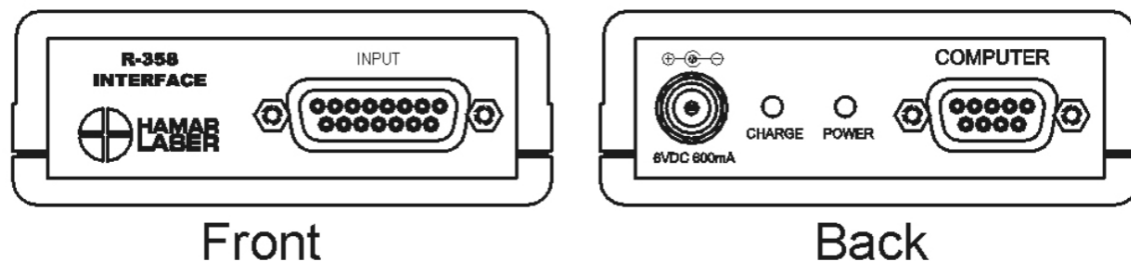
Figure 2 – *R-358 Computer Interface Connections*

2. **Connect the R-358 Interface to the computer.**
    Connect the interface to the computer serial port using the standard RS-232 cable provided. The connector for the cable is located on the back of the unit and is labeled COMPUTER.
3. **Turn on the computer.**

Pulse/Continuous Modes (L-705 and L-706 Lasers)

The L-705 and L-706 Lasers are now equipped with a PULSE/CONTinuous switch, which manually switches the laser beam between *Pulsed* and *Fixed Beam Modes*. *Pulse Mode* automatically removes the effects of excess (ambient) background light for the R-1307 readouts, providing a more accurate reading. The R-1307 Readout is capable of supporting both Pulse Mode and Continuous Mode as well as storing up to nine different target calibration factors for multiple target users. These capabilities must be specified when ordering a system.

The chart below indicates the operational modes for Readouts/Computer Interfaces that operate with the L-705/L-706 Lasers:

Mode	Readouts	Computer Interfaces
Pulse	R-1307B-2.4ZB, R-1307BC, R-1307C, R-1307-900/2.4, R-1307-2.4ZB, R-1307+R	A-910-900/2.4 (when used with R-1307-900 or R-1307-2.4) A-910-2.4ZB
CONTinuous	R-307, R-307V	R-358

Notes:
1. *The T-261A and T-266 Targets do not support the Pulsed-Beam Mode and the system purchased is factory-configured to operate in CONTinuous mode when using these targets.*
2. *When using the L-700 Laser with the R-1307 and a 2-Axis Target, the system is factory-configured to operate in CONTinuous mode.*

The Model R-1307 Readout

The Model R-1307 Readout supports both wireless Unitargets, such as the A-1519, or local (cabled) targets. It is available with a radio frequency of either 900 MHz or 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 3 – *R-1307Readout*

Configuring the R-1307C, R-1307-900/2.4 or R-1307-2.4ZB 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 two seconds to enter configuration mode.**
3. **Set the Measurement Units**
   Press the MENU button until the upper display shows ᴜn ɪᵗᴢ ˍ Use the UP and DOWN arrow keys to select either ɪnᴄʰ for inches or ͞�͞ for millimeters.
4. **Set the Dampening Level**
   Press the MENU button until the upper display shows ᴀᴜᴇ┌ᴀ9ᴇ. 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 ᴅᴜnᴄᵗᴢ. Use the UP and DOWN arrow keys to select ᴅᴜnᴄᵗᴢ ʟᴏᴄᴀʟ.
6. **Select the PSD descriptor applicable to your target**
   Press the MENU button until the upper display shows   ᵗᴮᵗᴢ 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, ᵗᴮᵗᴢ02 ᴅˍ ꓲ0ˍ ꓲ0 or ᵗᴮᵗᴢ02 ᴘˍ ꓲ0ˍ ꓲ0 for R-1307 #2. The PSD sensor size and type are 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.

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, select TGT=01 to select the matching calibration factors.

The R-1307B version of the readouts can only save one target calibration record, so each R-1307B readout must be matched up the target the calibration factors were generated with.

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.

R-1307 WITH A LOCAL TARGET

APPLICABLE TO ALL TWO AXES
CABLED TARGETS, INCLUDING:

T-212
T-214
T-218
A-517

A SECOND READOUT CAN BE USED TO COPY THE TARGET READING DISPLAYED BY THE READOUT CONNECTED TO THE TARGET.

THIS CAPABILITY IS NOT SUPPORTED BY MODEL#R-1307C

OPTIONAL SECOND READOUT MODEL# R-1307 OR R-1307W ONLY

CONFIGURE THIS READOUT AS FOLLOWS:

R-1307 AND R-1307W REQUIRED
- SET 'FUNCT' TO POLL
- SET 'ID' OF UPPER AND LOWER DISPLAY TO THE SAME VALUES AS THE READOUT THAT IS CONNECTED TO THE TARGET.
- SET 'CH' TO THE SAME VALUE AS THE READOUT THAT IS CONNECTED TO THE TARGET

ANTENNA NOT PRESENT IN MODEL# R-1307C

READOUT, MODEL# R-1307 AND R-1307C

CONFIGURE READOUT AS FOLLOWS:

R-1307C:
- SET 'FUNCT' TO LOCAL 'ID' AND 'CH' NOT USED

R-1307:
- SET 'FUNCT' TO LOCAL
- SET 'ID' OF UPPER AND LOWER DISPLAY TO THE SAME VALUE (DEFAULT=1)
- SET 'CH' TO A VALUE NOT USED BY ANOTHER READOUT WITHIN RADIO RANGE (DEFAULT=1)

(BOTTOM VIEW)

MODEL #T-212 TWO AXIS TARGET (TYPE 2)

MODEL #T-212 TWO AXIS TARGET (TYPE 1)

HORIZONTAL (X) AXIS

VERTICAL (Y) AXIS

TARGET SENSING ORIENTATION (CABLE DOWN)

LOCAL PORT

ADAPTER CABLE REQUIRED FOR TYPE 1 TARGETS WITH CPC CONNECTOR

CPC CONNECTOR

DISPLAY UNITS
DISPLAY MODE
ZERO

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Hardware Configurations

Pre-installing the Common USB Port Driver (A-910-2.4ZB)

This driver is required for the A-910-2.4ZB Transceiver in order to communicate with targets via the computer's USB port. The driver creates a virtual COM Port that is recognized by the applications as a standard serial port.

Note: *You must pre-install this driver prior to connecting the A-910-2.4ZB Receiver (s) to the computer through the USB port.*

Installing the Driver

1. Insert the USB Flash Drive into an available USB Port.
2. Select **My Computer**, locate the Removable Disk (Flash Drive) icon and click to open it.
3. Select the USB Common Drivers folder.
4. Locate the **CP210x_VCP** icon and click to initiate the installation process. The **Install Driver** dialog box displays.
5. Select the Windows operating system installed on your computer and open the folder.
6. Click **Browse** to select an installation folder different from the default folder (optional).
7. Click **Install**. Once the installation is complete, the **Installation Successful** message displays (see **Figure 4**).
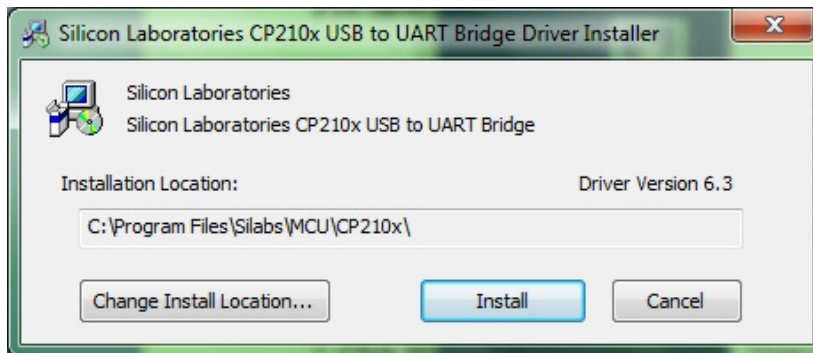

Figure 4 – *USB Common Driver Installed*

Configuring the Hardware and Utility Settings

Insert the A-910 ZB dongle into any unused USB Port. The computer should automatically assign a COM port number to the dongle.

1. Start the A-910 Utility Software. The software should display the COM port assigned to the Zigbee Dongle (see **Figure 6**). If the utility does not automatically detect the COM port, it must be manually selected (see Appendix E - *Manually Selecting a COM Port* on Page **60**). The Target System ID or R-1307 CH (channel) is the number associated with the A-1519/1520 targets or R-1307 Readout. If using both the A-1519/1520 targets and an R-1307 Readout, both need to be set to the same system ID and channel (see **Figure 7**).
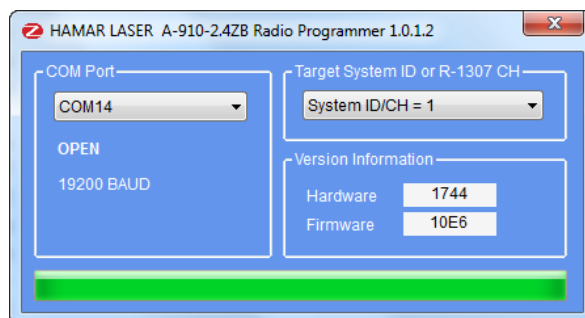

Figure 5 – *A-910 Zigbee Dongle*

Figure 6 – *A-910 Utility showing the COM Port, System ID and Channel Settings*
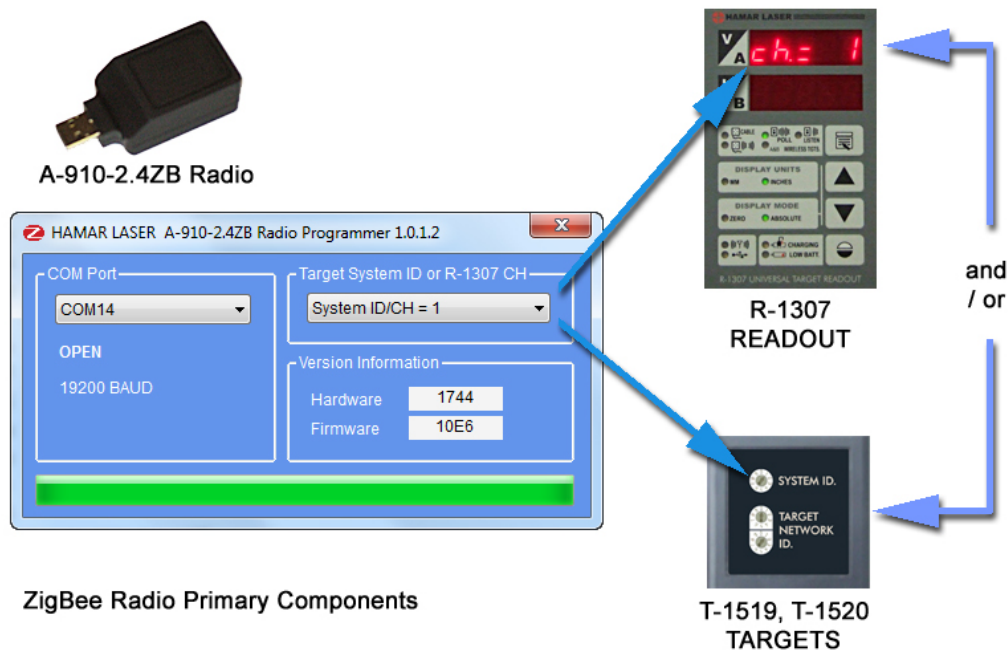

Figure 7 – *Setting the Targets/Readout to the same System ID and Channel*

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Installing the Bore9 Alignment Software

System Requirements
1Ghz minimum, 1G RAM minimum (2G RAM recommended), 1.1G free disk space, Screen Resolution 1024x768 minimum.

Installing the Bore9 Alignment Software

The following Microsoft Windows® operating systems have been tested with Bore9:

The following Microsoft Windows® operating systems have been tested with Bore9:
Windows XP Professional 2002 SP3, Microsoft Vista Business SP1, Windows 7 Ultimate x64, Windows 7 Home Premium SP1, Windows 7 Professional, Windows 8 Pro and Windows 10 Pro.

Note: *In addition, software for reading .pdf files, such as Adobe Acrobat, is necessary in order to access the program documentation and read alignment files saved in this format.*

Note:
Before installing the Bore9 software, ensure that your computer has the latest Windows Service Pack and critical updates. To find security updates, visit **www.windowupdates.com**. If you are installing on Windows XP 64 bit you might need to install the Windows Imaging Component.

The Windows Imaging Component 32-bit can be found at:
http://www.microsoft.com/en-us/download/details.aspx?id=32.
The Windows Imaging Component 64-bit can be found at:
**http://www.microsoft.com/en-us/download/details.aspx?id-1385.**

## Installing Microsoft .NET Framework 4

You must have Microsoft .NET Framework installed before installing the Bore9 software. If you are unsure about whether you have Microsoft .NET Framework 4 installed on your computer, open the Control Panel. For Windows XP users, select **Add/Remove Programs**; for Window 7 users, select **Programs and Features**. Scroll down the list of installed software to locate Microsoft .NET Framework 4. If the program is not installed, follow the instructions for installation on Page **10**.
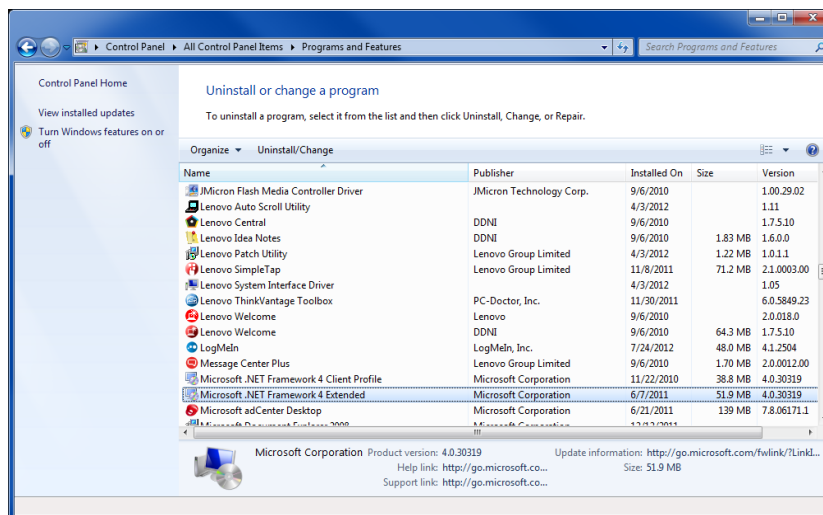
1. To install Microsoft .NET Framework 4, locate the folder **MS_Framework_4_X86_X64** on the Bore9 installation CD. Open the folder and double-click **DOTNETFX40_FULL_X86_X64** to begin the installation. Follow the on-screen prompts to complete.
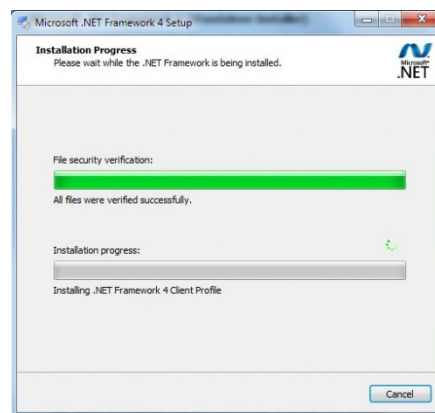
2. When the installation is complete, click **Finish** to close the installation program.
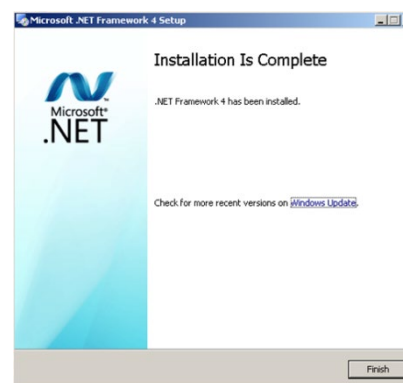
Installing Microsoft Access Database Engine

The Microsoft Access Database Engine must be installed on your computer before installing the Bore9 software. This file is usually on your computer if you have a full version of Microsoft Office installed.

If you do not have MS Office installed, then do the following:

1. Open the folder on the Bore9 installation CD called **MSAccessDatabaseEngine**. Double-click the file **AccessDatabaseEngine** to begin the installation.

2. When prompted, check the box to accept the terms in the License Agreement and select **Next** to continue.

3. Choose the location to install Microsoft Office Access Database. The default location is automatically selected. To change the installation location, select **Browse** and specify a folder. Select **Install** to continue.

4. When installation is complete, click **Finish**.
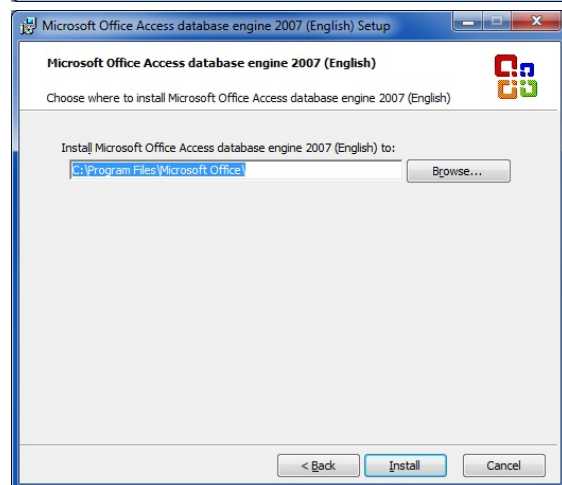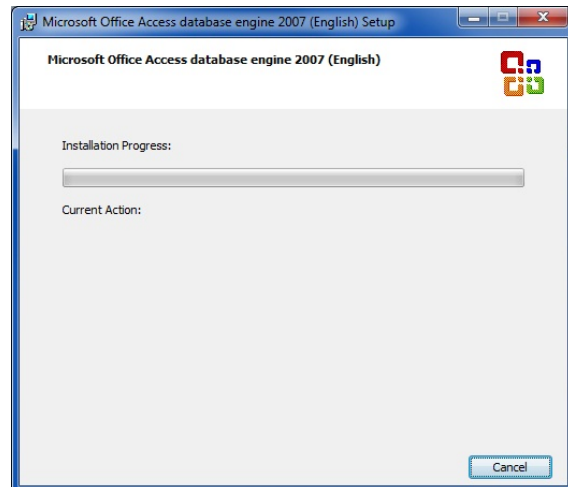
Installing Bore9

1. Insert the USB flash drive provided into the USB port on the laptop or tablet PC.
2. If your system is configured to do so, the AutoPlay window displays. Click **Open folder to view files**.
3. If the AutoPlay window does not display, click **Start>Run**. Click **Browse>My Computer** and select the USB flash drive.
4. Double-click the MS_Framework4_x86_64 folder and click **dotNetFx40_Full_x86_64.exe** to begin installation.
5. When finished, return to the main folder and double-click the MSAccessDatabaseEngine folder. Click **AccessDatabaseEngine.exe** to install. Return to the main folder.
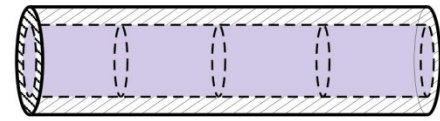6. Click **setup.exe** to begin the Bore9 installation.
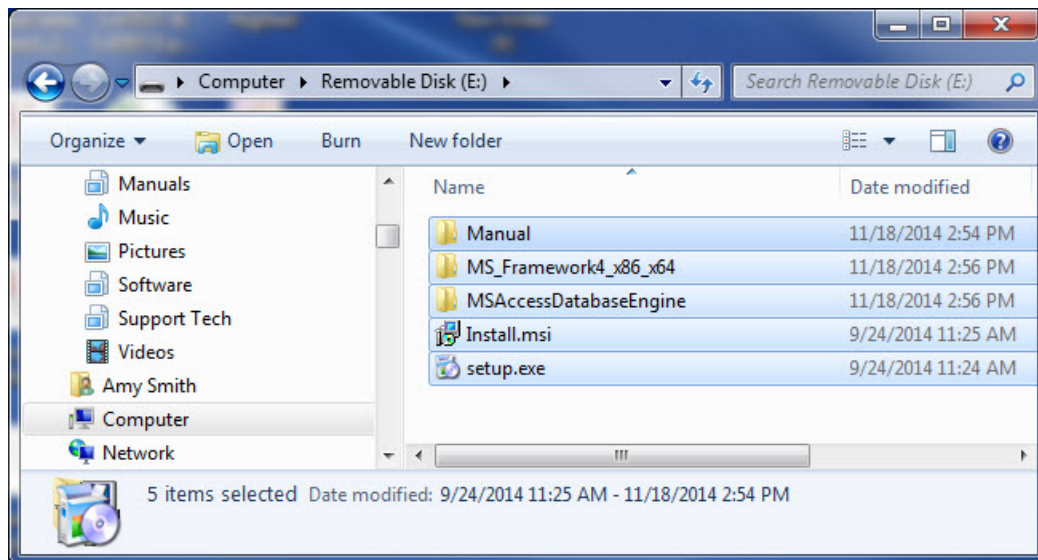
What is Bore Plot?

Bore Plot measures and displays the alignment of multiple bores. It measures bore straightness (axis centering) and size (diameter) using one of the bores as a reference. Applications include turbines, engine blocks, rotary compressors, extruder barrels, gun barrels, hydraulic cylinders and printing press bearings.

Continuous vs. Individual Bores

Continuous bores, such as rifle barrels, are single bores whose lengths are comparatively greater than their diameters. Measurements are taken by selecting points along the length of the continuous bore and taking readings at these cross sections.

Continuous Bore

Individual bores, such as bearing mounts in an engine block, are separate from one another and usually have lengths which are comparatively shorter than their diameters. One reading is taken at the center of each bore. If the bore is very narrow, the target may need to be mounted to a face and centered.
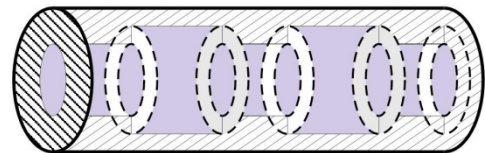
Individual Bores

Error Correction: The NORMIN Procedure

In order to get accurate results, target mounting, and other errors must be compensated for in some fashion. The NORMIN Procedure was developed as a way of canceling out these errors. It is used in conjunction with simple fixtures and targets which allow inexpensive, precision measurement. For an in-depth discussion of the NORMIN Procedure, see Appendix A beginning on Page 54.

Measuring Alignment and Size

- To measure alignment of several bores, the laser should be bucked into (made parallel to) the two end bores. The target is then moved from bore to bore, and the deviation from the end bores is the measure of the misalignment of the bore. For the most accurate results, the same target should be used for all of the bores.

  Note: *The NORMIN procedure is necessary when performing bore **measurement** with any target. The NORMIN procedure is necessary for performing bore **alignment** with all bore targets **except** the A-510, A-512 and A-516 Self-Centering Targets.*

- To measure the sizes of several bores with respect to a reference bore, a reference bore with a known size is selected. The same target is moved from bore to bore (taking care to square up the target as closely as possible), taking error correction readings. The program calculates and displays the actual diameters of the individual bores.

The following are the steps common to the different types of bore measurement:

Hardware Setup
There are two ways of setting up Hamar Laser's bore alignment lasers:
1. **External Mount** - This method uses the L-111 Laser Stand and the L-102 Beam Translator to mount the laser outside the end bores. A target is moved from the near to far bores and the Buckin procedure is used to align the laser to the end bores.
2. **Internal Mount** - This method uses the L-708 Laser with the A-514 Self-Centering Bore Adapters to mount the laser in first end bore. The A-512 Target and a second A-514 Self-Centering Adapter is mounted in the second end bore. The laser is then tilted (steered) until the readout shows zero.

Bucking In
The Buckin procedure is needed to align the laser to bore reference points (or a spindle axis of rotation) so the alignment of other bores can be checked. The laser is positioned by adjusting the laser beam (using a beam translator) to center on the near target, and then adjusting the laser itself to point the beam on the target in the far position. This is repeated until the target gives the same reading in both positions.

Bore Setup
The user enters information In the Bore9 Setup Screen, such as the number of and distance between bores, the diameter of the reference bore, and the spacing between points to be measured.

Recording Data
The user moves the target from bore to bore, taking data. Data may be taken in any order desired, but the simplest way is to measure bores in numerical order). When taking NORMIN readings to cancel out errors, both the NORMal and INverted readings can be taken for one bore before moving to the next or the NORMal readings can be taken for each bore in one pass, and the INverted readings in the next.

Plotting Results
The resulting data is displayed on the screen as a two-view graph.

Saving, Printing, and Reviewing Results
Data may be saved and customized for review and for generating a printed report.

Getting Started with Bore9

Hamar Product Registration

In order to protect against software pirating, we have implemented a simple product registration procedure. After a Hamar product is installed and when the program is run for the first time, the user is prompted to enter the Product Registration Code (see Figure 8). To obtain the Product Registration Code, send the PC ID Code (automatically generated) displayed on the screen to Hamar Laser Support (Support@hamarlaser.com). A Hamar representative will issue a Product Registration Code via email to complete the registration process. Enter the Product Registration Code and click **Register Product** (see Figure 9). The product is now registered.
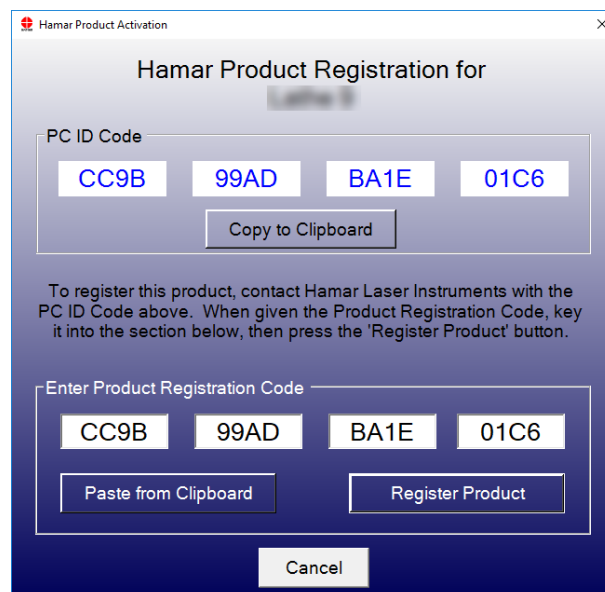

Figure 8 —*Product Registration Screen*

**Figure 9** – *Enter Product Registration Code*

To begin using Bore9, double-click the Bore9 icon or select the program from the Windows Start Menu. The initialization screen displays, providing the number of the current software version.

Creating a New Project File or Opening an Existing Project File

When the Bore9 software opens, the **Project Selection** screen displays. Here you can either open a saved project or create a new project. This screen can also be accessed by clicking **Open Project** from the **File** menu.
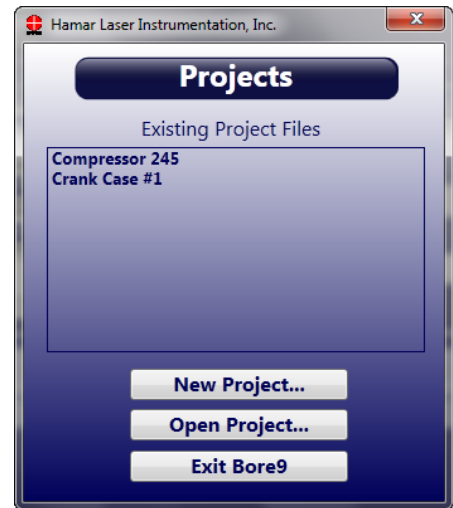
To create a new project, click **New Project** and enter a project name.
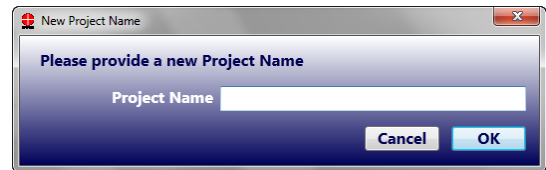
To open a saved project file, click **Open Project** from the **File** menu. Double-click on the project folder and then click on the ***.prj** file to open the project.
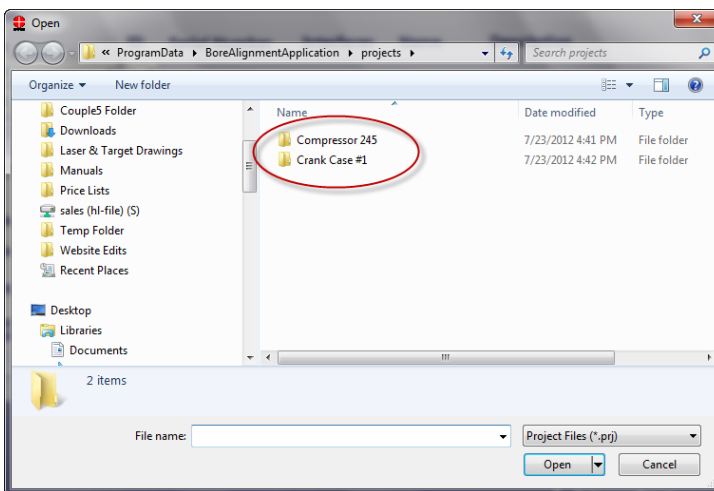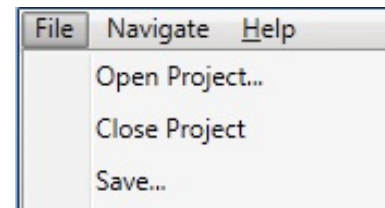
Figure 10 – *The File Menu*

Standard Features of the Bore9 Screens

Bore9 is structured to guide the user through the setup and data taking process. There are 5 steps to collecting bore straightness data:

Step 1 – Bore Setup (beginning on Page 26) – enter 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 (beginning on Page 30) - an easy procedure is followed to remove the mounting errors of the target if desired.

Step 3 – Laser Setup (beginning on Page 31) –on-screen instructions guide the user through setting up the laser and making it parallel to reference points.

Step 4 – Record Data (beginning on Page 41) – bore straightness data is recorded. There are several different sets of data that can be taken here.

Step 5 –Results (beginning on Page 46) –results of the 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. Reports are also generated in this step.

The Menu Bar

The Menu Bar in the Bore9 program is located at the top of the screen under the program banner. The options are File, Navigate, and Help (Alt-H). Click with the mouse on one of these options to view the associated drop-down menu.


Figure 11 – *Bore9 Menu Bar*

Once a Menu Bar dropdown menu opens, you can access any item on the menu by clicking it once with the mouse.

The File Menu

|	
Open Project	Opens folder for user to select project to open.
Close Project	Closes currently open project.
Save Project	Saves current project.
Preferences	Contains tabs for user to enter Company information, Units, Data Grid Displays, Decimal Displays, Target Setup and Record Mode.
View Comm Port…	Click here to see if data packets are coming in to Bore9.
Exit Bore9	Stores all current settings, prompts the user to save any unsaved data, and exits the Bore9 program.
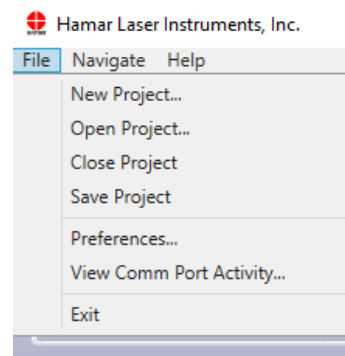
The Navigate Menu

Bore Setup	Displays the Bore Setup screen (Step 1 on Page **26**).
Mounting Error	Displays the Target Mounting Error screen (Step 2 on Page **30**).
Buckin	Displays the Laser Buckin screen (Step 3 on Page **31**).
Record Data	Displays the Record Data screen (Step 4 on Page **41**).
Results	Displays the Results screen (Step 5 on Page **46**).
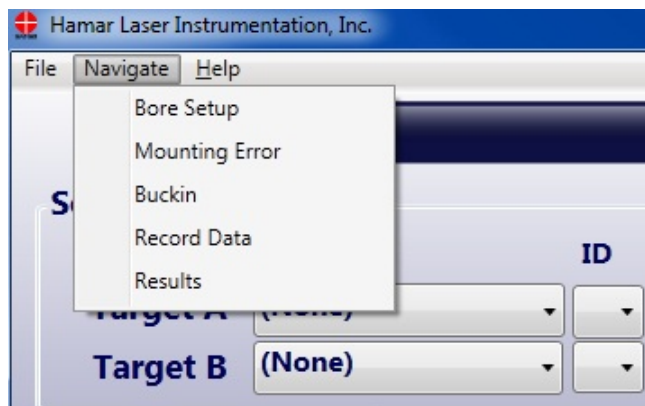
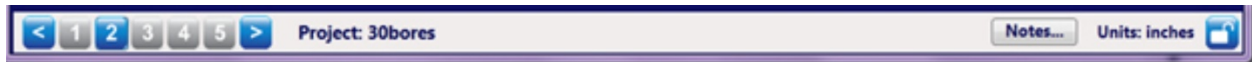## The Help Menu

User Guide	Displays the User's Guide.
About	Displays the software information.
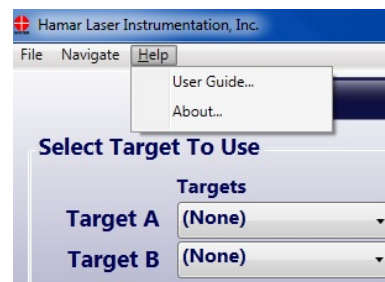
Navigating in Bore9 with the Status Bar

Software Steps

Click any number on the Status Bar to navigate to that step in the software. The right arrow and left arrow advances to the next screen.

Notes

Click **Notes** in the Status Bar to open a place to enter notes for the alignment. This information is printed in the report.

Units

Displays the measurement units selected in **Preferences-Units** (see Page **25**).

Target Setup

When you buy a new system from HLI, your target setup should already be pre-configured into Bore9. If so, then please go to **Step 1—Setup** on Page **26** to select the target.

If the target setup data has not been entered, click **File>Preferences>Target Setup**. Click **New Target** to specify and set up a computer interface and to select a target that reflects the type of work being performed.
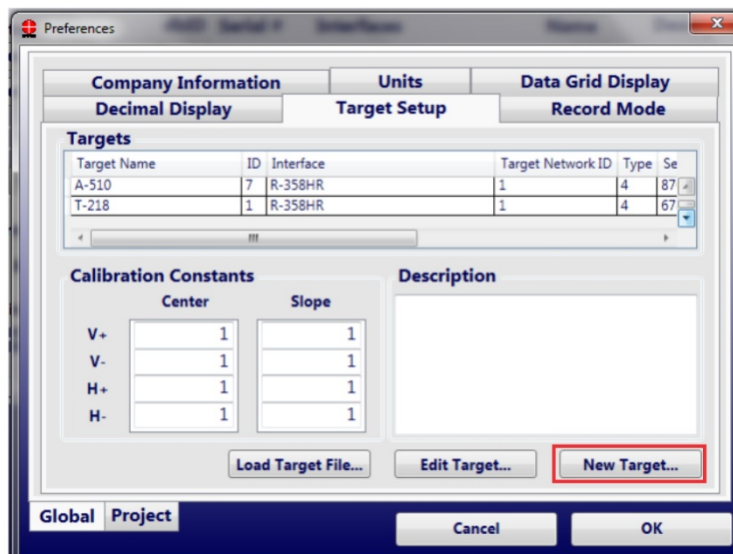
1. Select the type of Computer Interface you are using and click **Next**.
   Note: *If you are using an R-1307-2.4ZB Wireless Readout, select A-910-2.4ZB. If you are using the R-358 Computer Interface, select R-358HR. The R-358SR is for legacy customers who still have the discontinued R-355D.*


2. Select the target you are using and click **Next**. Hover the mouse cursor over a picture of a device to enlarge the picture.
   Note: *It is VERY important to match up the target part number to the target you are using. The most important factor is the size of the PSD. Therefore, if your target has a 10x10 mm PSD, do not select any targets that have either a 20x20 mm PSD or 45x45 mm PSD. If you do not match the target PSD's correctly, errors display in the data.*

3. A popup displays asking you if you want to load calibration factors. If you have a disc with your Target File, you may load it now. Click **Yes** to load your configuration files. Select **No** to continue if you do not have a Target Files.
Note: *This is only needed for the R-358 Computer Interface.*
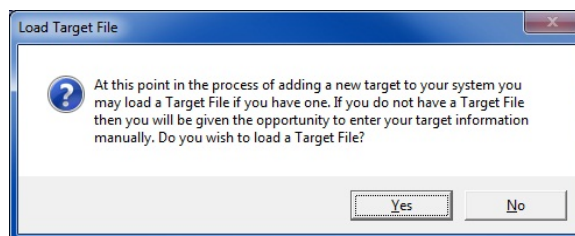
4. If you clicked **No, e**nter the required information: Target Name, Calibration Date, Target Network ID, (see *Setting the Target System ID and Target Network ID* on Page **60**) and depending on your target, the Calibration Constants. The Serial Number, Focal Length and Description are optional. Note that the **Name** field can contain *any* name that will readily identify the target.

When using cabled targets, the Target Network ID field is replaced with DC Plane.

Calibration Constants

If using the R-1307-2.43ZB/A-910-2.4ZB, you do not need to load any calibration constants. It is only for the R-358 that calibration constants are required.

To load calibration constants, click **Load Target File**… to load the calibration constants for the target specified in the Target Setup. These files are found either on the CD that is sent with a target or in a folder where they've been copied to your hard drive.

You can also enter calibration constants from your calibration report. To enter the factors, click on one of the four Center Entry Boxes. You will get a message asking if you really want to make changes. Click **Yes**.

Notes:

- *When entering the calibration constants from a printed list, click on each field and enter the value manually.*

- *Be very careful entering the Calibration Constants, since they can have a big influence on the values and entering a wrong value will cause big errors in the data. The standard range for calibration constants is 0.9 to 1.1. Any numbers outside of this range should be viewed with caution and it is recommended to contact Hamar Laser to confirm they are ok to enter.*
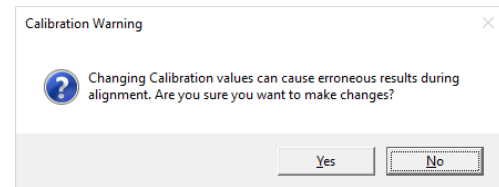
5. Click **OK** to save the settings. In **Step 1: Setup** the target will display in the drop-down menu in *Select Targets to Use* shown on Page **26**.

## Setting R-1307 Target Network ID to Match the Settings in Bore9 Target Setup

Setting System ID (Radio Channel) for the R-1307

Press **MENU** until the upper display shows ⊂h ⊇ nn, with the current System ID (nn) blinking. Use the UP and DOWN arrow keys to set the System ID.

NOTE: nn *must be set to the same number as the channel switch setting of the A-910 Zigbee Dongle or A-910 Radio Transceiver (see Appendix B beginning on Page 56.*

MENU provides access to the operational functions of the R-1307, such as display mode, measurement units, dampening, display resolution and display brightness. In addition, communication parameters between the target and readout are set through **MENU**.

1. To use **MENU**, *press and hold* the key for two seconds to enter C*onfiguration Mode*, and then press **MENU** to cycle through the selections. Press the UP arrow key (↑) or the DOWN arrow key (↓) to change the settings for a selection.

2. Press **MENU** until the upper display shows ıd⊇ nn with the current Target ID (nn) blinking. Use the UP and DOWN arrow keys to set the Target ID to match the setting of the upper display ID.

3. Press **MENU** until the lower display shows ıd⊇ nn with the current Target ID (nn) blinking. Use the UP and DOWN arrow keys to set the Target ID to match the setting of the lower display ID.
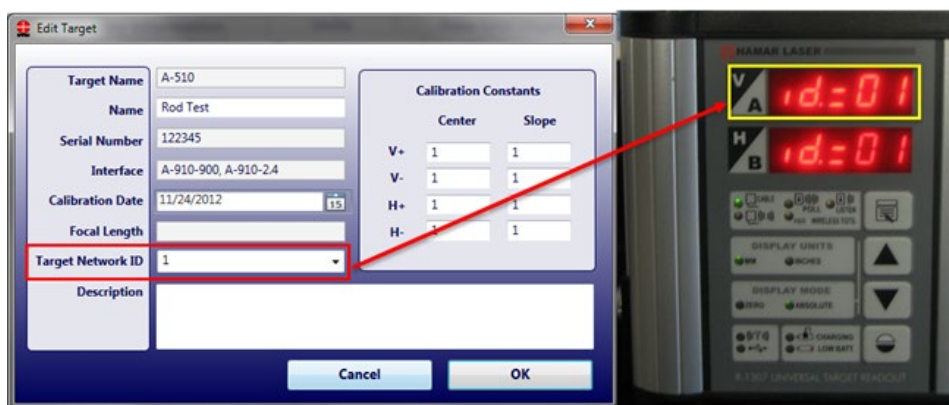
| ıd⊇ | Upper Display ıd⊇0 ı | ID of first wireless scanning target |
| | Lower Display ıd⊇02 | ID of second wireless scanning target |
| | | **Note:** *For fixed beam wireless target or local target, set both upper and lower ID to the same number* |

NOTE: *The TNID (Target Network ID) allows the hardware and software to communicate. If the TNID is not set correctly, the user receives no communication. Each Step in Bore9 requires the user to select the correct TNID, however once the TNID is selected in Step 2, it should remain selected through the following steps.*
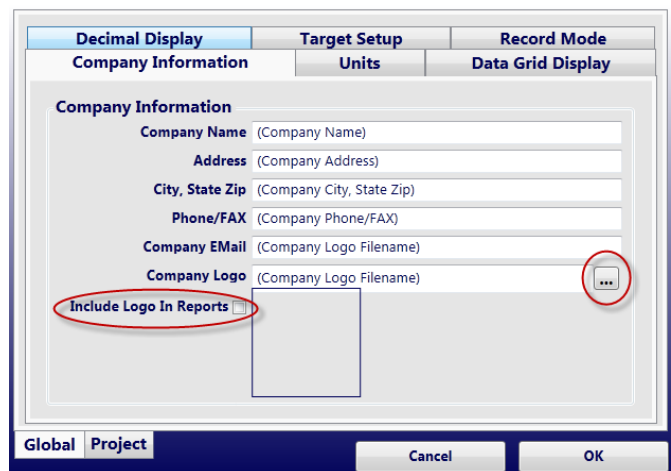
Preferences

Decimal Display

Select the desired number of decimal points to be used for alignment data displays.
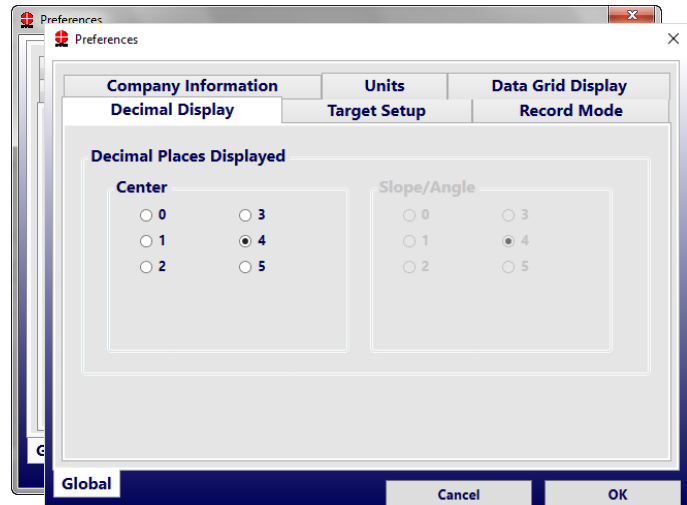
Company Information

Enter company contact information for the reports here. If you click **Include Logo in Reports** and then click **Browse**, you can import a company logo to display on the report.

Data Grid Display

This tab includes several options that control how Bore9 takes data and what analysis data is displayed in **Step 4–Record Data (**beginning on Page 41).

For most standard bore straightness applications using HLI's self-centering targets, click **Normal Target Readings – Center.** .

When using non-self-centering bore targets or using the self-centing targets in Measure Mode, select **Inverted Target Reading – Center.** If diameter change calculations are needed, then select **Diameter** to calculate bore diameter changes. In this case, you are required take a NORMal and INverted reading at each bore location. This allows the software to remove any mounting errors (TSCE) in the fixturing and also calculate the bore diameter change (if a reference bore diameter was entered in **Step 1: Setup** on Page 26).
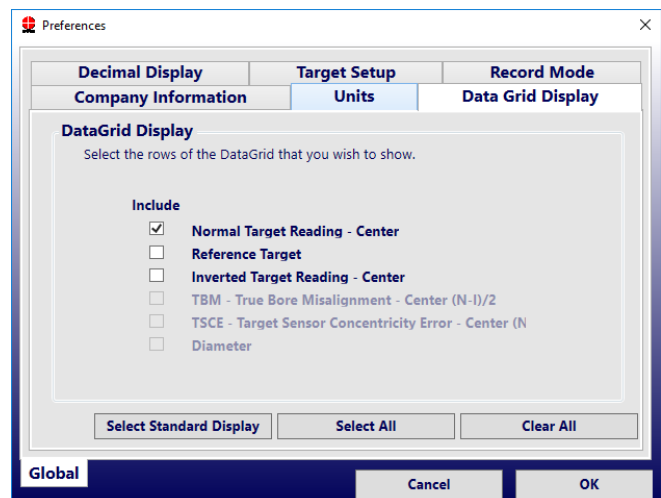
Units

Select Imperial (inches) or Metric (mm) and units for any slope calculations. The Slope/Angular units are used only in the Results Summary in **Step 5: Results** and in Bore9 Report where Bore9 shows the results of the slope of the Least-Squares, Best Fit line. The angular format is in/ft for Imperial and mm/m for Metric.

Record Mode

Select the number of data samples for each value in the data displays, as well as a date and time stamp and comment for each data point.   For the two-target configuration, you may set the averaging differently for each target.

Setting up a Bore Alignment Project

Step 1 - Setup

Enter the setup information for the bore alignment project, such as number of bores, distance between bores, targets being used, tolerances, etc.

Figure 12 – *Initial Bore Plot screen with Bore Setup*

Select Target to Use

Select the target(s) to be used in the alignment setup. If the target you are using is not in the dropdown list, go to **Preferences>Target Setup** to add your target (see **Target Setup** on Page **20**).

Number of Targets

For most bore applications, you will use only <u>one</u> target. Select a specific target by clicking the dropdown list for **Target A**.

To add a second target, for 2-target bore applications, click on the **Target B** dropdown list and select the target and dbID. When using 2 targets, **Target A** is used in the Near Bore and **Target B** is used in the Far Bore. The procedure for using two targets is explained in **Taking Data in Step 4 (Two Targets)** beginning on Page **42**.

Note: *Two targets can only be used with wireless technology. It is not possible to use two targets with an R-358 interface. You cannot select the same specific target for the A and B targets.*

Interpreting Target Data Signs (+, -)

Top View - H Axis Center

Side View - V Axis Center
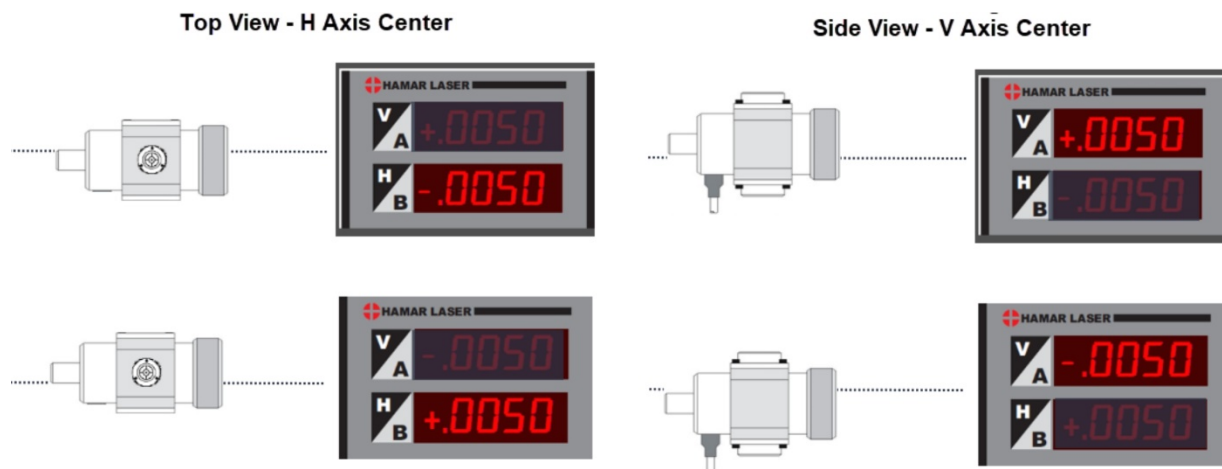
Number of Bores

Enter the number of points to be measured, either by typing in the number or using the up/down arrows. A minimum of three and a maximum of 50 points can be specified.

Bore Spacing

Specify whether the bores to be measured are evenly or unevenly spaced. If they are *evenly* spaced, enter the common distance (spacing) between points and press **Apply**.

If they are *unevenly* spaced, select the **Set Uneven Spacing** button to enter the distance between individual points in the grid.

To enter a value, click in the up/down arrows to select the starting and ending bores, then enter the value in the *Distance* box. Click **Apply** to save. To close the entry window, hit **OK**. You can also enter values directly into grid box in the table.

Note: *The words Even or Uneven display to indicate which spacing method was chosen.*
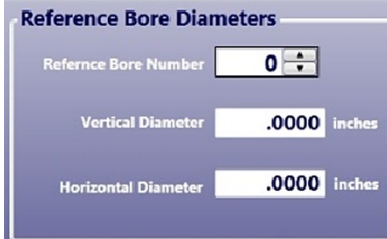
Reference Bore Diameters

If measuring several bores with respect to a reference bore, select the number of the bore to designate as a reference and supply its actual vertical and horizontal diameter.

Laser Position

Click on the graphic to select direction the laser is facing (left or right).
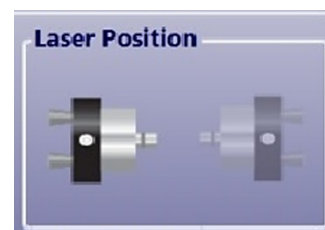
Tolerance Bands
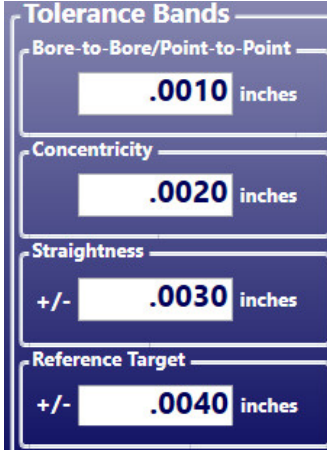
When the Tolerance Bands feature is ON in **Step 5: Results** and a tolerance number is assigned, the graphs in **Step 5** (see Page **46**) indicate whether the overall straightness (the acceptable straightness misalignment tolerance over the whole range of data points) and bore-to-bore straightness data is within the values specified.

Bore-to-Bore

This tolerance is the acceptable deviation tolerance from one bore to the next bore. This applies to either *Concentricity* or *Straightness* formats in **Step 5.**

Concentricity

This is the tolerance for the maximum allowable concentricity change from the lowest to highest value.

Straightness

The overall TIR straightness tolerance for the data. All the data points need to fall within the ± tolerance band to be *in tolerance*.

Reference Target

Enter a tolerance for the reference target when taking data in **Step 4** using two targets, where one target (reference) is used to monitor laser drift. If the display values exceed the tolerance entered here, the Reference Target display turns red.

Graphing

When viewing the alignment graphs in **Step 5**, a green tolerance band indicates the overall bore straightness tolerance. If a data point falls outside of this area, it is out of overall tolerance. For bore-to-bore tolerance, a red dotted line between measurement points indicates an out-of-tolerance bore-to-bore condition between those two points.

Step 2 – Target Mounting Error

The Target Mounting Error uses NORMIN readings to determine mounting and other errors in a fixture-mounted target and adjusts the display to remove the error from the readings. The user is required to take two data points: 1) with the target in the NORMal position; and 2) with the target in the INverted position. The software calculates the mounting error and then applies it to the displayed and recorded data to remove the mounting error from all data points. This is a *global* target offset and is applied to all data unless it is turned off.

Note: *When using A-510 or A-512 Self Centering Targets with the L-111 Laser Stand, you can skip this step since any centering errors are identical for the reference points and the measurement points. Since Bore9 uses the Least-Squares, Best-Fit data analysis, the centering errors are not important when measuring straightness or alignment for bores when using the end bores as a reference.*

1.   **Coarse-align the laser and target on the numerical display.**
   Ensure that that laser and target are in position and the numerical display is showing readings.

2.   **Select TNID (Target Network ID)**.
       Using the drop-down arrow, select the TNID for the target you are using to perform the mounting error. This number should match the one in the R-1307-2.4ZB readout (see Page **23**). Normally this is not changed.
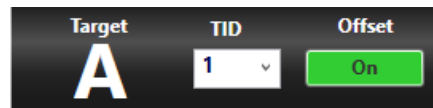
3.   The graphic showing the target with an **I** displays the proper orientation of the laser and target for taking the first reading. This means to invert the target, so the cable is at 12:00.
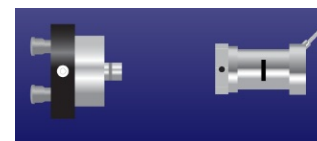
4.   **Click Record to take a reading**.
       Ensure the target and fixture or bore adapter have been rotate to the INverted position. Click **Record** or press the spacebar to take a reading at the current position of the target and laser. The cursor moves automatically to the next field in the table and the graphic showing the laser and target orientation changes.

5.   **Return the target to the NORMal position.**
       Rotate the target to NORMal position and level. (The target graphic now shows the letter **N**).

6.   **Click Record to take a reading.**
       Press **Record** or press the spacebar to take a reading at the current position of the target and laser. Wait until the program takes all of its samples and displays the readings before performing the next step. Bore9 automatically calculates the mounting error offsets and applies them to the displayed reading. You will see the Offsets button show **ON**, indicating there are offsets being applied.

       The plot screen now reads the laser beam position (less fixture mounting errors). The **Offset** button and **Status Bar** indicate that Target Mounting Error offsets are **ON**. Any further readings display with this value subtracted.

       To turn off the Mounting Error Offset, click the **ON** button. The display offset is removed.

Step 3 – Buckin (Laser Setup)

Buckin (laser setup) calculates set points for making a laser parallel to two reference points, usually the end bores. Use the **Step 3: Buckin Wizard** to guide you through the Buckin process.

While performing **Step 3: Buckin**, the following options are available:

Restart – click to restart the Laser Buckin procedure.
Record – click when instructed to record data for laser setup.
Previous – click to return to the previous steps of the procedure.
Next – click to proceed to the next set of steps in the procedure.
Finished – **Next** becomes **Finished** when the last steps of the procedure display. Click **Finished** to proceed to **Step 4: Record Data**.

Laser Mounting Options

There are three ways to set up the laser:
1. **Extruder Mount** - Select **Extruder Mount** if using the L-705 to align an extruder barrel to the gearbox.
2. **Internal Mount** - Use **Internal Mount** if using the L-708 Laser with the A-514 Self-Centering Adapters or if using any bore laser mounted directly in a spindle.
3. **External Mount** - Select **External Mount** if using the L-705/L-706/L-708 with the L-111 Laser Stand and L-102 Beam Translator.
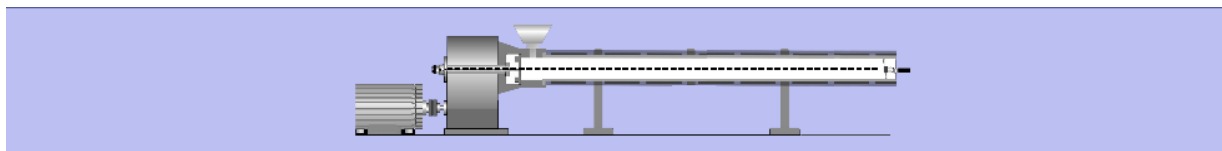

Figure 13 – *Bore Setup Display showing Extruder Mount*
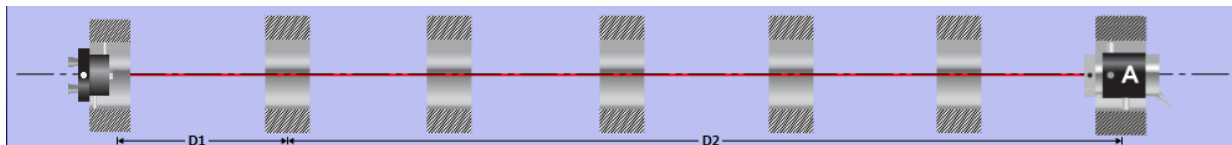
Figure 14 – *Bore Setup Display showing Internal Mount*
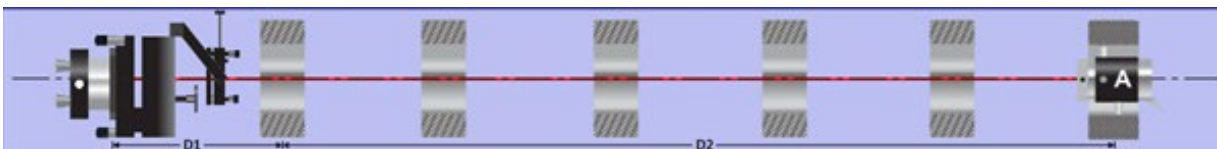
Figure 15 – *Bore Setup Display showing External Mount*

Step 3 -- Extruder Mount
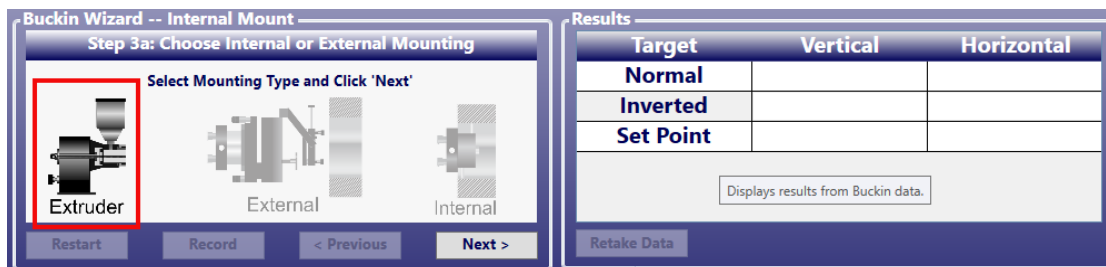
1.　　Select the laser mounting by clicking the **Extruder Mount** graphic. Click **Next**.

2.　　Place the A-705 Chuck Fixture into the counter bore in the gearbox and tighten in place. Place the L-705 into the A-705 and rotate it so the top level is centered in the circle (Appendix H beginning on Page **70** or L-705 Extruder Manual for more details).

3.　　Perform a Rough Buck-in of the laser to gearbox AOR to get the laser roughly aligned to the AOR.

4.　　To perform the Fine Buck-in, rotate the gearbox spindle (with the A-705/L-705) 180 degrees to the *INverted* position, making sure to center the bubble in the circle. Click **Record**.

5.　　Rotate the gearbox spindle (with the A-705/L-705) 180 degrees to the *NORMal* position, making sure to center the bubble in the circle. Click Record.

6.　　Bore9 calculates a *Set Point*, which is the average of the two sets of readings.

7.　　Turn the Vertical micrometer on the L-705 until the V display equals the *Vertical Set Point*, and then turn the Horizontal micrometer until the H display equals the *Horizontal Set Point.*

8.　　The laser is now bucked-in to the gearbox axis of rotation (AOR).

9.　　Repeat Steps 1-6 to verify the laser is bucked-in.

10.　　Go to **Step 4: Take Data**.
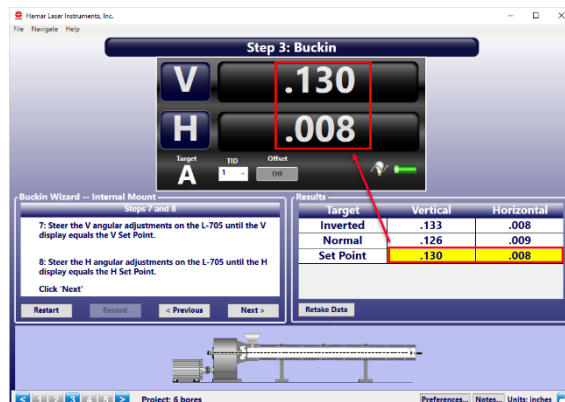
Step 3 -- Internal Mount Laser – L-708 Bore Laser

1.   Select the laser mounting by clicking the **Internal Mount** graphic. Click **Next**.
2.   Select the target to use for the laser setup. If using one target, select Target A for the laser setup. If you have two targets, select Target A or Target B for the laser setup. Click **Next**.

Note: *For internal mount, you cannot choose A+B.*
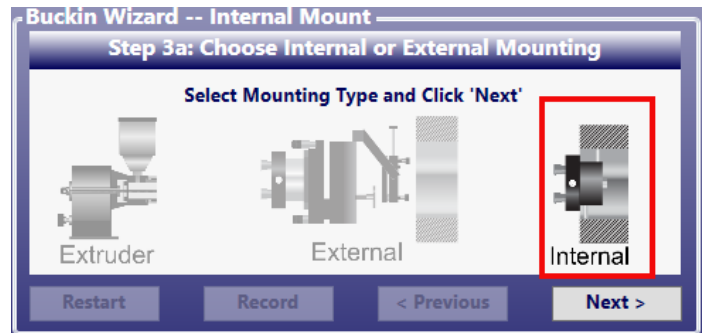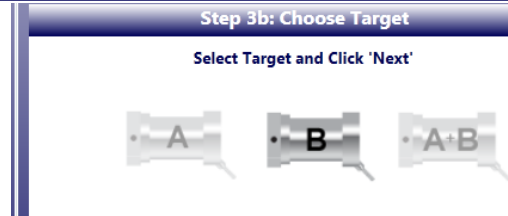
Target A Selected   **Target B Selected**

3.   Follow the on-screen instructions to perform the laser setup.
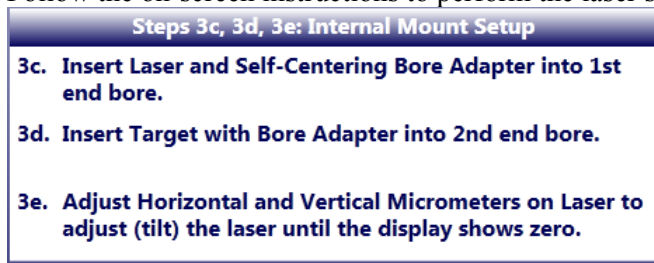
4.   Click **Finish** to go to **Step 4: Record Data** on Page 41.

Step 3 -- External Mount Laser Procedure – L-706/L-708 Bore Lasers + L-111 Laser Stand + L-102 Beam Translator

1. Select the laser mounting by clicking the **External Mount** graphic. Click **Next**.
2. Select the target to use for the laser setup. If using one target, select Target A for the laser setup. If you have two targets, select Target A or Target B for the laser setup. Click **Next**.
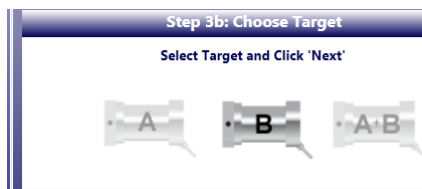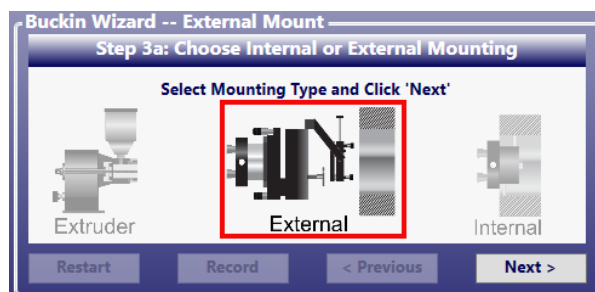
3. Enter **D1** distance from the L-111 Pivot Point to the Target in the Near bore and the **D2** distance from the near bore to the far bore, as shown in the graphic on the screen (also see **L-705/L-706 General Bore Alignment** manual for more details).
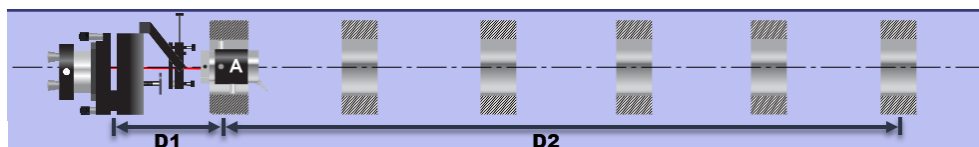
For example:
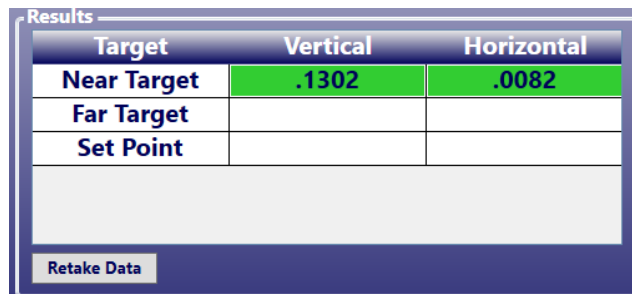
Distance from Laser Pivot to Near Target D1 = 4.46
Distance from Near Target to Far Target D2 = 12.67

4. Follow the on-screen instructions to record data for **Near Point** and click **Next**.

4.
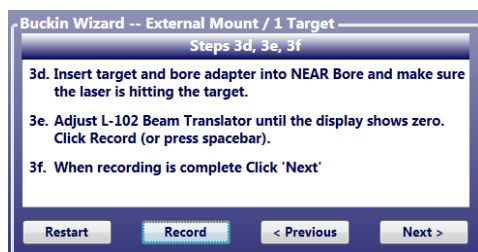
Data for the **Near Target** are displayed in **Results** and highlighted by a green background.
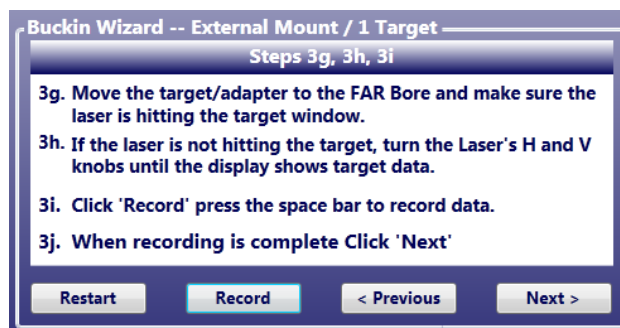
Results		
Target	**Vertical**	**Horizontal**
Near Target	.1302	.0082
Far Target		
Set Point		

`Retake Data`

5. Follow the on-screen instructions to take data for the **Far Target** and click **Next**.

Buckin Wizard -- External Mount / 1 Target

Steps 3g, 3h, 3i

3g. Move the target/adapter to the FAR Bore and make sure the laser is hitting the target window.

3h. If the laser is not hitting the target, turn the Laser's H and V knobs until the display shows target data.

3i. Click 'Record' press the space bar to record data.

3j. When recording is complete Click 'Next'

`Restart` `Record` `< Previous` `Next >`

Data for the **Far Target** are displayed in **Results** and highlighted by a green background.
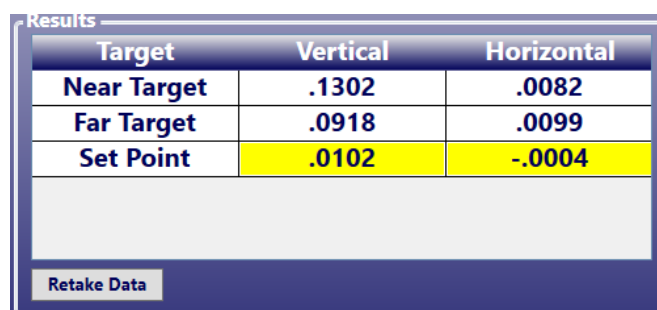
Results		
Target	**Vertical**	**Horizontal**
Near Target	.1302	.0082
Far Target	.0918	.0099
Set Point	.0102	-.0004

`Retake Data`

6. After clicking Next, the Laser **Set Points** are calculated and highlighted in yellow in Results.

Results		
Target	**Vertical**	**Horizontal**
Near Target	.1302	.0082
Far Target	.0918	.0099
Set Point	.0102	-.0004

`Retake Data`

7.   Follow the on-screen instructions to steer the laser beam so that the V and H displays match the V and H **Set Points.**
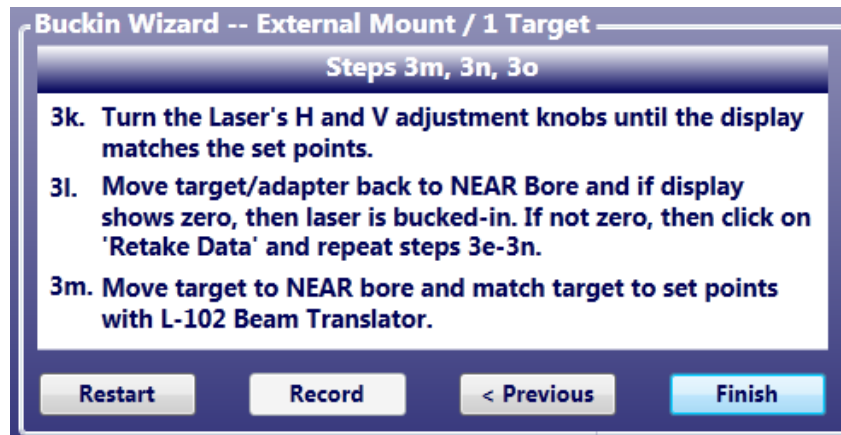
8.   If the display does not show zero after moving the target back to the Near Bore, repeat the above steps until the target displays zero in both the near and far bore locations.
9.   When the target reads zero in both locations, then you are ready to move on to **Step 4** to take data.

Step 3 -- External Mount Laser Procedure with 2 Targets –L-706/L-708 Bore Lasers + L-111 Laser Stand + L-102 Beam Translator

Bore9 gives you the flexibility to use 2 targets for the buck-in for those applications where it's hard to move the targets to the near and far bores. Normally this would require one of our "see-through" targets, the T-218, T-1220 or T-1240 targets. Here is a procedure to use two targets for the buck-in.

1. Going back to Step 1, you can select 2 targets to be used for setting up the laser. **Target A** is used in the Near Bore and **Target B** is used in the Far Bore.

Note: *Two targets can only be used with the R-1307B-2.4ZB technology. It is not possible to use 2 targets with an R-358 or R-358 HiRes interface. You cannot select the same specific target for the A and B targets.*

2. If using the T-218 Bore Target + T-225L Large-Bore Adapter, you will need to remove mounting errors from the target. If not using this target, then skip to Step 8.

3. Go To Step 2. Click on *Select Target A* to work on **Target A.** For **Target A** Rotate the target to the inverted position and insert it into the **Near Bore**. Click and then click **Record** for the **Target A** data box.

4. Rotate **Target A** to the normal position. Click **Record** for the **Target A** data box. This automatically calculates a display offset that is applied to raw values for **Target A**.
    Note: *The calculated offset is the target mounting error and it is subtracted from all readings taken with **Target A**.*

5. Click on **Select Target B** to calculate its mounting error offsets.
6. Rotate **Target B** to the *Inverted* position, insert it into the **Far Bore** and click **Record**

7. Rotate **Target B** to the *Normal* position and click **Record**. This automatically calculates a display offset that is applied to raw values for **Target B**.
   Note: *The calculated offset is subtracted from all readings taken with **Target B**.*

8. Click **3** at the bottom of the screen and select **External Mount** to display the Buckin Wizard (External Mount/2 Targets). Click **Next**.

9. Select **A + B** and click **Next**.

10. Enter the distance from the laser pivot to the Near Target and the distance from the Near Target to the Far Target (see graphic at the bottom screen to see how to measure the dimensions – shown here). Click **Next**.

Buckin Wizard -- External Mount / 2 Targets
Step 3c: Provide Distances

Enter distances for D1 and D2 then click 'Next'

| Distance from Laser Pivot to Near Target | D1 | 10.50 |
| Distance from Near Target to Far Target | D2 | 63.250 |

Restart   Record   < Previous   Next >
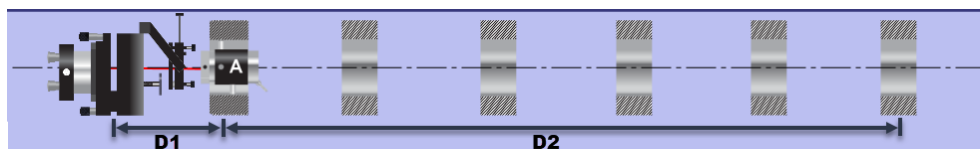
11. Ensure that **Target A** is mounted properly in the Near Bore and **Target B** is mounted in the Far Bore as displayed on the screen. Click **Next**.

12. Following the on-screen instructions, we then Adjust L-102 Beam Translator until Target A's value is zero. Click **Record**

Buckin Wizard -- External Mount / 2 Targets
Steps 3g, 3h, 3i

3g. Adjust L-102 Beam Translator until Target A's display shows zero.

3h. Click Record (or press spacebar).

3i. When recording is complete Click 'Next'

Restart   Record   < Previous   Next >

Results

Target	Vertical	Horizontal
Near Target	.0000	.0000
Far Target		
Set Point		

Retake Data

13. Flip the T-218 Target's prism out of the way to allow the beam to pass through to **Target B**. Then click **Record**. This will calculate **Set Points** for the **Far Target B.** We want to adjust the laser to those **Set Points.**

Buckin Wizard -- External Mount / 2 Targets
Steps 3j, 3k, 3l, 3m

3j.   Flip target prism to allow beam to pass through Target A (or remove Target A) to hit Target B. Make sure laser is hitting target window.

3k.   Click Record (or press spacebar) to record Target B.

3l.   Turn H & V adjustment knobs until the display matches Set Points.

3m. Click 'Next'

Restart   Record   < Previous   Next >

Results

Target	Vertical	Horizontal
Near Target	.0000	.0000
Far Target	.0039	.0089
Set Point	.0006	.0000

Retake Data

14. Adjust the H and V knobs on the L-706/L-708 until the **Target B** display values equal the **Set Points.**
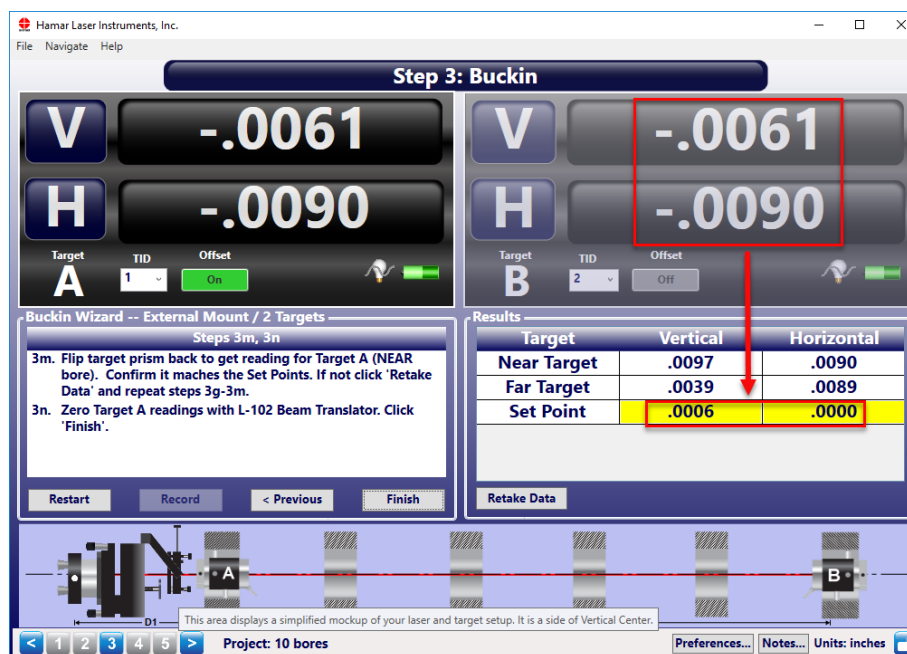
15. Flip the prism on the T-218 Target back into the laser beam and note the reading. The readings should match the **Set Points**. If not, they will be close. Repeat Steps 11-14 to fine tune the setup to get it closer to zero.
16. If the readings match to the **Set Points** or are very close, you can move on to **Step 4.**

Step 4 – Record Data – Single Target

Once the laser is bucked in, we can begin taking data. Normally a single target is used to take the data.

Recording a Data Point
To take a data point, press **Record** or press the space bar. The point will show up in the box selected.
The default position is Bore #1.

Auto Step
Auto Step automatically moves from one point to the next, either
in NORMal Mode, INverted Mode, or in both modes. Check the
box marked Auto Step to toggle the Auto Step feature on and off.
When Auto Step is ON, the cursor automatically advances to the
next position when data is recorded. When Auto Step is OFF,
data records at the same position and overwrites the previous data recording. Disabling Auto Step allows
the user to move the target to a point where data has previously been recorded, select that point on the
plot and retake the reading.
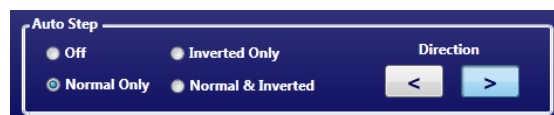
Direction
To change the direction to record data, click the left or right **Direction** arrow in the
Auto Step area of the screen.

Re-Recording Data Points
To re-record a data point, click on the point in the data table and
press Record. Bore9 will then ask if you want to overwrite that
point. Click *Yes* to accept and *No* to not record.
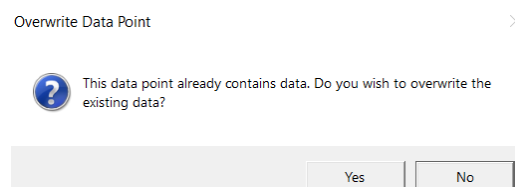
The **Target Orientation**, **Measure Target** and **Laser Position** icons illustate the settings being used by the software.

- When clicking on a NORMal data point in the grid table, **Target Orientation** shows an image of the target with an **N** on it.
- When clicking on an INverted data point in the grid table, **Target Orientation Orientation** shows an image of the target with an **I** on it.
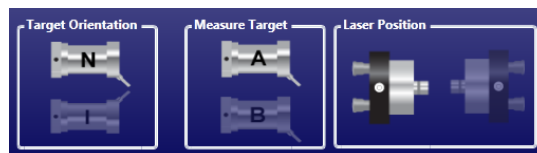
Bore Number	1	2	3	4	5	6	7	8	9
Distance	.00	11.50	24.00	35.50	48.00	59.50	72.00	83.50	96.00
Normal VC									
Normal HC									
Inverted VC									
Inverted HC									
TBM VC									
TBM HC									
TSCE V									
TSCE H									

Taking Data in Step 4 (Single Target – typical use)

1. Select the **Auto Step** method to use in the **Auto Step** box at the bottom of the screen – normally this defaults to **Normal Only**.
2. Insert the target/adapter into the first bore. Click **Record** or press the spacebar to record the data point. The green highlight box ("cursor") will move to the next point if **Normal Only** in **Auto Step** is selected. If **Auto Step** is *Off*, then click on the next point to record.
3. Move target/adapter into the second bore and repeat Step 2 (see Page 30) to record data.
4. Continue until all the data has been recorded.

Step 4 – Record Data – 2 Targets

In some case, it may be required to use 2 targets to take bore data, such as in marine applications where the bores are in different rooms in a ship. In this case, Bore9 needs to be put into 2-target mode by selecting a second target in Step 1 see page 25. When this is done, you will see 2 readout displays. One is marked "Target A" and the other "Target B".
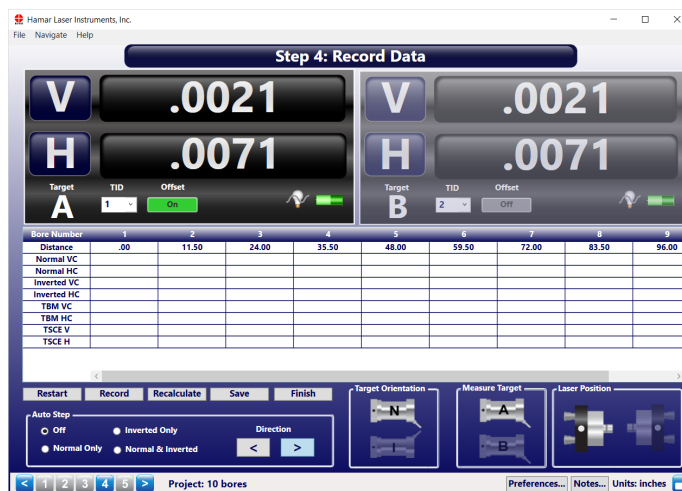
Recording Data with 2 Targets

When recording data with 2 targets, the *source* of the data point needs to be selected by clicking in **Measure Target** either the icon for Target A or Target B. The default is *Target A*.

To change to Target B, click on the greyed-out Target B image in **Measure Target**. You will see the readout for Target A greyed-out and Target B displays normally.
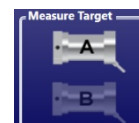
Figure 17 - Target A Selected as Measuring Target
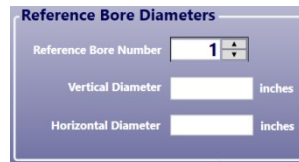
Figure 18 - Target B Selected as Measuring Target

With the desired target selected, click **Record** to record the data point from that target in the grid. You can switch back and forth between targets for any point in the data grid table.

Step 4 – Recording Alignment Data and Bore-Diameter Changes

When using Hamar's bore targets in measurement mode, the alignment data can be recorded as well as the change in bore diameters. You must first measure the reference bore using a set of calipers. You must measure the diameter at 6:00 and 12:00 (vertical) and 3:00 and 9:00 (horizontal) and enter those values into **Reference Bore Diameter** entry boxes in **Step 1**. You can also select which bore number you want to use as the reference. All other bore diameters are compared to the Reference Bore Diameter to calculate the diameter shown in the data table.
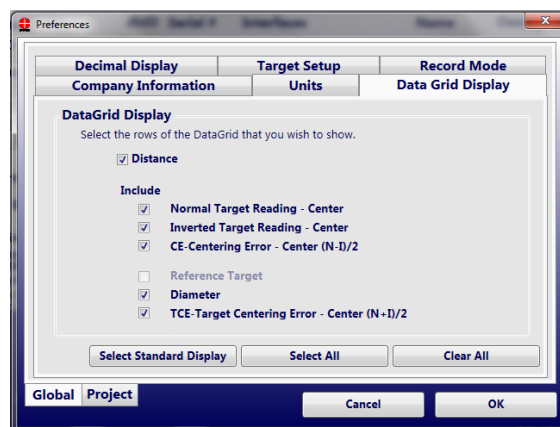
Note: Measuring for bore diameter changes cannot be performed with an A-512 Target in the A-514 Adapter. These adapters are self-centering only and cannot be used for measuring bore bore-diameter changes. However, you can use the A-512 with the A-512STA and A-512LTA Bore Adapters in to measure bore-diameter changes. Ensure that the target is inserted into the measurement mode side of the adapter.

You can also use the A-510 Target in with the A- A-510STA and A-510LTA Bore Adapters. Ensure that the target is inserted into the measurement mode side of the adapter.

You can also use the T-218 2-Axib Bore Target and the T-225L Large-Bore Flange Adapter.

Procedure:

1. Ensure all of the boxes are checked in the Preferences/Data Grid Display **except** Reference Target.

2. In **Step 1: Setup**, (see Page) enter both a Vertical and Horizontal Reference Bore diameter.

3. Record readings in both the *Normal* and *Inverted* positions for each bore location (number). The user can take all of the *Normal* readings (select **Normal Only** in **Auto Step)** and then all of the *Inverted* readings (select **Inverted Only** in **Auto Step)** or take *Normal + Inverted* readings at each location (select **Normal and Inverted** in **Auto Step)**.

   Note: The self-centering target adapters and handles are designed to firmly hold the target in place when inserted in the Normal position. When the target is inserted in the Inverted position, it is necessary to hold the pole or handle with upward pressure to firmly hold it in place or it will fall out.

4. During the data recording you will notice that the Diameter V and H rows will show the word "Processing". This is normal. The diameters will not be calculated until all the data has been taken. When the last data point has been taken, the calculated diameters will appear in their respective rows. This data will also appear in the data grid in the report and can also be viewed by clicking **View Data** in **Step 5**, which brings up the data table from the report.

Normal VC	-.0040	.0004	.0061
Normal HC	.0090	.0054	.0054
Inverted VC	.0061	.0004	.0061
Inverted HC	.0090	.0054	.0054
TBM VC	-.0050	.0000	.0000
TBM HC	.0000	.0000	.0000
Diameter V	Processing	Processing	Processing
Diameter H	Processing	Processing	Processing
TSCE V	.0011	.0004	.0061
TSCE H	.0090	.0054	.0054

Alignment Data -- Bore-To-Bore Straightness

Bore #	Distance	V TBM (Straight.)	H TBM (Straight.)	V Plot (1,10)	H Plot (1,10)	V Diam	H Diam	Concentricity (1,10)	Ang Pos
1	.00	-.0050	.0000	.0000	.0000	5.0002	4.9998	.0000	0°
2	11.50	.0000	.0000	.0045	.0000	4.9988	4.9926	.0045	270°
3	24.00	.0000	.0000	.0039	.0000	5.0102	4.9926	.0039	270°
4	35.50	.0039	.0000	.0072	.0000	5.0066	4.9926	.0072	270°
5	48.00	.0043	-.0011	.0071	-.0011	4.9902	4.9948	.0072	279°
6	59.50	-.0062	-.0090	-.0040	-.0090	4.9922	4.9804	.0098	24°
7	72.00	.0000	.0000	.0017	.0000	5.0158	4.9984	.0017	270°
8	83.50	.0000	.0000	.0011	.0000	5.0002	4.9940	.0011	270°
9	96.00	-.0013	-.0013	-.0008	-.0013	5.0028	4.9966	.0015	30°
10	107.50	.0000	.0000	.0000	.0000	4.9864	4.9992	.0000	0°

5. To view the alignment results, click **5** on the **Status Bar** to go to **Step 5: Results**.

Step 5 – Results and Analysis

Bore9 offers several different ways of viewing and analyzing the recorded data depending on the application. The alignment results are displayed in the Summary Table and tolerance bands are shown on the graphs. The Overall and Bore-To-Bore tolerances are illustrated on each graph.

Plot Reference

Bores – Concentricity Plot – Select **Bores – Concentricity**

This plot reference makes the designated bore numbers the *zero* point and plots the positions of the remaining bores in relation to selected bore numbers. For each bore location, the horizontal and vertical target-data values are converted into a radial measurement (length of the radius and the angle the radius is located). The radial measurement represents the concentricity error for that bore relative to the reference bores chosen. These values are then plotted in a single graph and a tolerance band (green shaded area) is shown. Any data point outside the green shaded area means it is out of tolerance for that axis.

Bores – Straightness Plot – Select **Bores – Straightness**

This plot reference makes the designated bore numbers the *zero* point and plots the positions of the remaining bores in relation to selected bore numbers. For each bore location, the horizontal and vertical target-data values are adjusted to the chosen reference bores and the results are plotted out individually for the H and V axes. Any data point outside the green shaded area means it is out of tolerance for that axis.
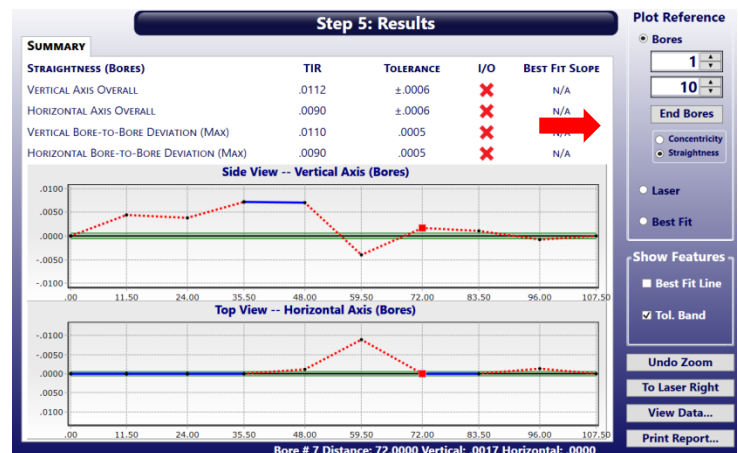
Bores Plot - Changing Reference Bores

To change the reference bores, click the up/down arrows and the reference bores change. The data and graphs adjust to reflect the new reference bores. Clicking **End Bores** sets the bore reference to the first and last bores.
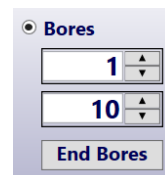
Best-Fit Plot – Select **Best Fit**
This plot shows the alignment of the bores relative to the Best-Fit line, which is calculated by using the Least-Squares, Best-Fit algorithm. The data is then analyzed and overall straightness TIR values are calculated for the V and H axes. Then for each bore location, the raw data is adjusted to take out the slope of the Best-Fit line and then result is plotted out (the Best-Fit line becomes the X axis) with upper and lower tolerance bands (green shaded area) for the H and V axes. Any data point outside the green shaded area means it is out of tolerance for that axis.

The Best-Fit Plot is especially useful because it removes any excess error in the data from the laser beam not being perfectly aligned to the end bores. It also makes the laser setup faster since the laser beam does not have to be exactly centered in the bore to get accurate straightness measurements.
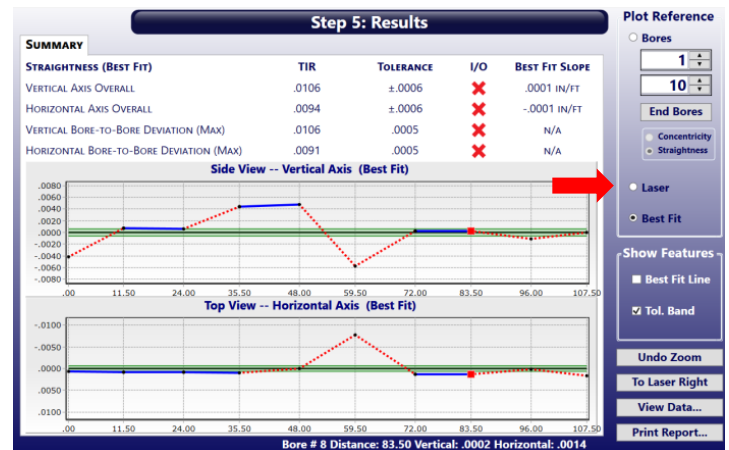
Laser (Raw Data) Plot – Select **Laser**
This plot shows the alignment of the bores relative to the laser beam (raw data) and shows individual plots for the H and V axes. A dashed black line indicates the Best-Fit line and is shown with upper and lower tolerance bands, which are displayed ± around zero as a green shaded area. Any data points outside the gray area indicate that the data set is out of tolerance relative to the laser buck-in.

Show Features

To show or hide a descriptive line on the plot, either check or uncheck the appropriate box.

Best Fit Line

For the Laser Plot, the Best Fit line is shown on the plot as a dashed black line. Click on the check box to toggle the Best-Fit line on/off.

Tol. Band

Click to toggle the Overall Tolerance Bands (green shaded area) **ON** or **OFF**.

Red Dotted Line on Graph

A red dotted line indicates that the difference of one bore's data is greater than the next bore's data by more than the Bore-to-Bore tolerance. The calculation compares the data from a bore location to the *previous* location. For example a red dotted line between bores #1 and 2 means the data for bore #2 is greater than the data for bore #1 by *more* than the allowable Bore-To-Bore tolerance value.

Detailed Data at Each Bore Location – Laser, Best Fit and Bore-Straightness

Hover the mouse cursor over any *data point* to view the data for that point. A red square displays on the graph to indicate which point is selected. At each point, you will see:
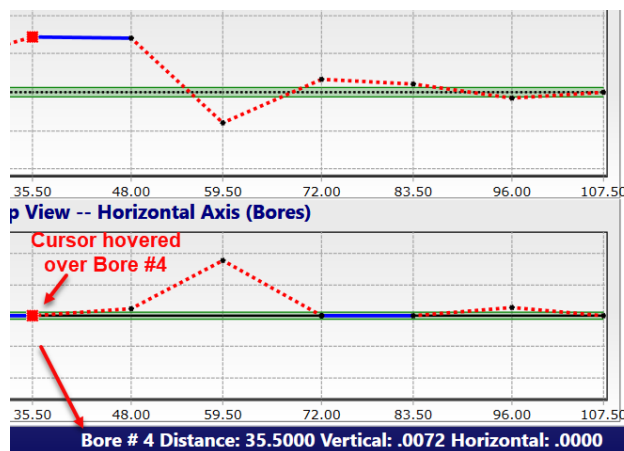
- The cumulative distance to the data point/bore
- The Vertical Value (adjusted for the **Plot Reference** selected)
- The Horizontal Value (adjusted for the **Plot Reference** selected)

Detailed Data at Each Bore Location – Bore-Concentricity

For the **Bore-Concentricity** plot, hover the mouse cursor over any *data point* to view the data for that point. A red square displays on the graph to indicate which point is selected. At each bore location, you will see:

Bore # 9 Distance: 96.00 Vert: -.0008 Horiz: -.0013 Radius: .0015 Angle: 30°

- The cumulative distance to the data point/bore
- The Vertical Value (adjusted for the **Plot Reference** selected)
- The Horizontal Value (adjusted for the **Plot Reference** selected)
- Radius value – the converted radial value (adjusted for the **Plot Reference** selected)
- Angle – the angle for the radius value

Other Features of the Bore Plot Screen

Zooming in on Graph Data
For a large number of data points, it may be desired to view a smaller part of the graph to better see the results. To zoom-in on an area, just click and drag a box over the data points to zoom in to and the graph will display the zoomed-in data points.

Undo Zoom
Click **Undo Zoom,** to remove the zoomed in area**.**

Laser Right/Left
To change the orientation of the laser beam on the screen to reflect the physical setup, select **Laser Right/Left**. This flips the data back and forth to reflect the orientation.

View Data
Click to view the recorded data and analysis to print in the report. Any box in the data table that is highlighted in **red** indicates that it is out of bore-to-bore tolerance relative to the bore before it.

Bore #	Distance	V TBM (raw)	H TBM (raw)	V Plot (Laser)	H Plot (Laser)	V Diam	H Diam	Radial	Ang Pos
1	.00	.0005	.0001	.0005	.0001	18.0000	18.0000	.0005	225°
2	12.00	-.0010	-.0004	-.0010	-.0004	17.9938	17.9986	.0011	45°
3	24.00	-.0006	.0001	-.0006	.0001	17.9970	17.9998	.0006	45°
4	36.00	-.0009	-.0002	-.0009	-.0002	18.0070	18.0002	.0009	45°
5	48.00	.0013	.0001	.0013	.0001	18.0044	18.0014	.0013	225°
6	60.00	.0000	-.0001	.0000	-.0001	18.0016	18.0010	.0001	180°
7	72.00	.0003	.0003	.0003	.0003	17.9978	18.0004	.0004	225°
8	84.00	-.0009	-.0002	-.0009	-.0002	18.0018	18.0004	.0009	45°
9	96.00	.0008	.0001	.0008	.0001	18.0008	18.0016	.0008	225°
10	108.00	-.0004	.0001	-.0004	.0001	17.9992	18.0004	.0004	45°
11	120.00	.0008	.0001	.0008	.0001	17.9972	18.0006	.0008	225°
12	132.00	-.0003	-.0001	-.0003	-.0001	17.9954	18.0000	.0003	45°

ViewData

Alignment Data -- Laser (Raw Data)

Undo Zoom

Laser Right

View Data...

Print Report...

Close

Generating a Report

Click **Print Report** to print the alignment report to a selected printer (see **Figure 19**).

A report may also be saved as a .pdf file, however it is necessary to have software such as Adobe Acrobat installed on your computer in order to generate this type of file. Click **Print Report** and select your .pdf generating software as the printer name. You are asked to specify a file name for the report (see **Figure 20**).
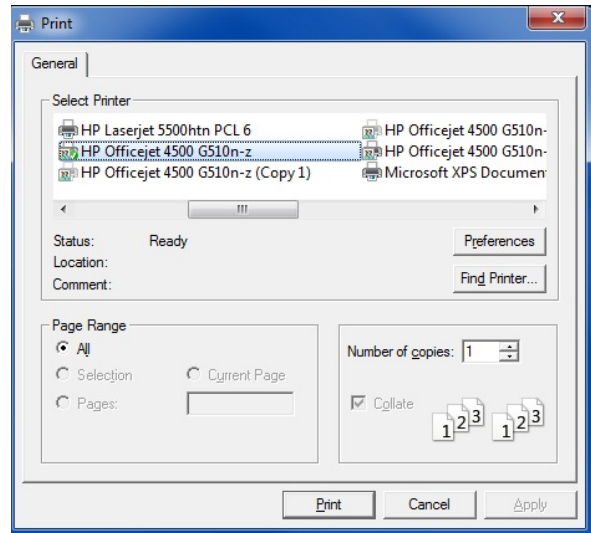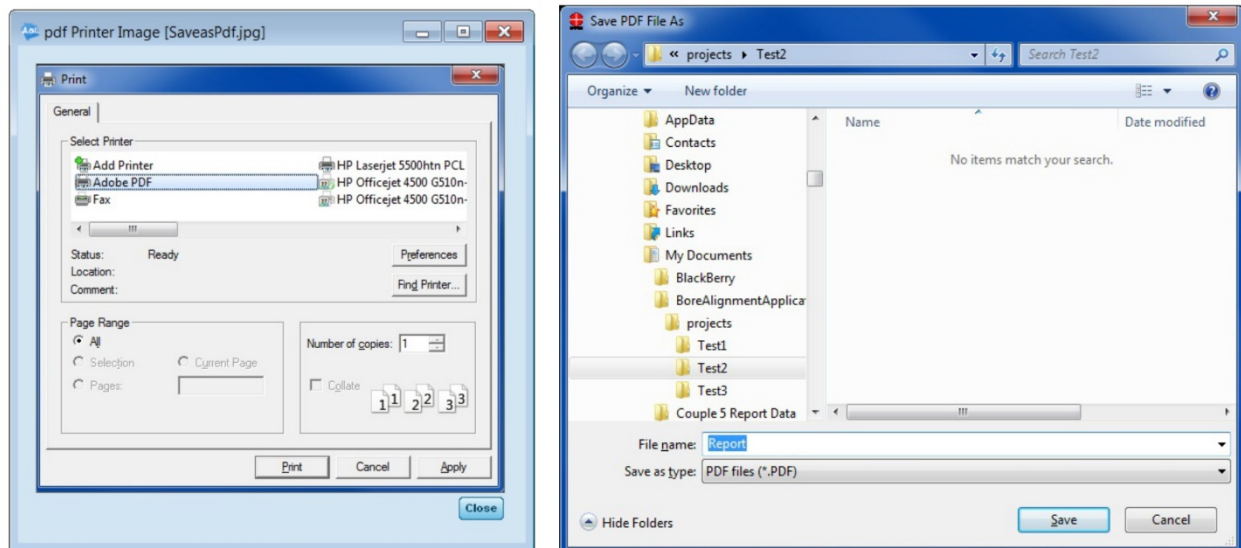

Figure 19 – Printing a report to a printer

Figure 20 – *Saving a report as a .pdf file*

Figure 21 shows a sample 4-page report generated by the Bore9 software.

Project: 30bores

Report Issued By

Company Name:
Address:
City, State Zip:
Phone/FAX:
Company EMail:

Machine Information

Factory Name:
Machine Information:
Notes:

Alignment Results

Alignment Check	Value	Tolerance	In/Out
Vertical Straightness	.0084	0	
Horizontal Straightness	.0113	0	
Vertical Bore To Bore	.0073	0	
Horizontal Bore To Bore	.0073	0	

Setup Information

Number of Bores	30
Distance between bores	12.00
Units	inches
Overall Tolerance	0
Bore to Bore Tolerance	0
Target / Interface	
Serial Number	
Calibration Date	1/1/0001

Result Graphs

Side View -- Vertical Center

Top View -- Horizontal Center
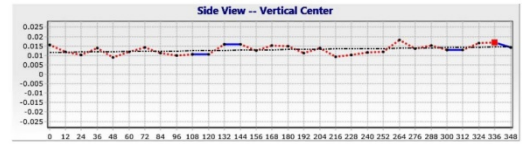
Alignment Data

Bore #	Dist	V Raw	H Raw	V Plot	H Plot	Rad	Ang Pos
1	0	.0154	.0137	.0037	.0009	.0039	255
2	12	.0118	.0155	9.6907	.0027	.0027	182
3	24	.0101	.0129	.0017	.0001	.0017	265
4	36	.0138	.0083	.0018	.0044	.0048	203
5	48	.0091	.0124	.0029	.0003	.0029	263
6	60	.0118	.0144	.0003	.0016	.0016	191
7	72	.0144	.0156	.0021	.0027	.0035	218
8	84	.0112	.0146	.0011	.0017	.0020	212
9	96	.0099	.0127	.0025	.0001	.0025	267
10	108	.0106	.0095	.0019	.0033	.0038	210
11	120	.0106	.0153	-.0020	.0024	.0031	220
12	132	.0158	.0130	.0030	.0001	.0030	268
13	144	.0158	.0131	.0029	.0001	.0029	266
14	156	.0127	.0162	.0002	.0032	.0032	184
15	168	.0152	.0070	.0021	.0059	.0063	200
16	180	.0150	.0143	.0018	.0013	.0023	234
17	192	.0112	.0141	.0020	.0011	.0023	241
18	204	.0139	.0088	.0005	.0041	.0042	188
19	216	.0092	.0126	.0042	.0003	.0042	265
20	228	.0102	.0088	.0033	.0042	.0053	218
21	240	.0117	.0130	.0019	-3.1064	.0019	269
22	252	.0120	.0101	.0017	.0029	.0034	210
23	264	.0181	.0094	.0042	.0036	.0056	229
24	276	.0137	.0146	.0002	.0015	.0015	188
25	288	.0153	.0184	.0012	.0053	.0054	194

Alignment Data (Continued)

Bore #	Dist	V Raw	H Raw	V Plot	H Plot	Rad	Ang Pos
26	300	.0130	.0130	.0011	.0001	.0039	255
27	312	.0130	.0126	-.0012	.0005	.0027	182
28	324	.0164	.0186	.0020	.0054	.0017	265
29	336	.0168	.0093	.0023	.0038	.0048	203
30	348	.0141	.0165	.0004	.0033	.0029	263

Figure 21 – *Bore9 Report*

Exporting Alignment Data to Excel Spreadsheets

To export alignment data to an Excel spreadsheet for further analysis, do the following:

1. Locate the Project Folder where your data is saved – the default is: Documents/Bore Alignment Application/Projects
   Note: *When data is saved, a project folder with the name you entered is automatically created. For example, if you save a project named* **Test***, a folder is created called* **Test** *that is located in My Documents/Bore Alignment Application/Projects. This folder includes several files as well as the alignment data for the saved file.*

2. Open the folder and locate the file with the same name as the folder name, followed by *RecordData*. For example, for the **Test** project name, the Excel data filename is **test.recordData.csv**. Also created is a file called (*projectname*)**.results.csv** file, which contains additional data not provided in the (*projectname*)**.recordData.csv** file.
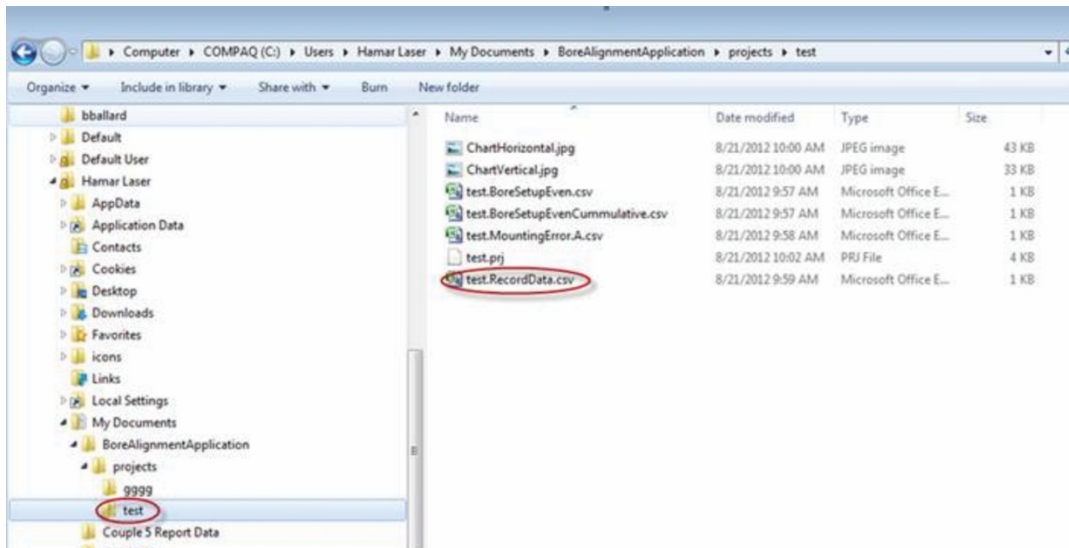
3. Assuming you have Microsoft Excel installed, double-click the file name. This automatically opens Excel and displays the data.

Where:

Distance = distance between each set of bores.
Normal VC = the Vertical-axis misalignment data relative to the reference points chosen (Best Fit, Laser, Bores, End Bores).
Normal HC = the Horizontal-axis misalignment data relative to the reference points chosen (Best Fit, Laser, Bores, End Bores).
Ref. Target VC = the Vertical-axis misalignment data of the reference target taken at the same time as the bore misalignment data.
Ref. Target HC = the Horizontal-axis misalignment data of the reference target taken at the same time as the bore misalignment data.
Inverted VC = the inverted Vertical-axis misalignment data (if selected in Preferences).
Inverted HC = the inverted Horizontal-axis misalignment data (if selected in Preferences).

See **Appendix G – Entering Data Manually in Bore9** beginning on for instructions on how to enter data manually into Bore9.

Appendix A - The NORMIN Procedure

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.

There are three centers involved in bore alignments: the True Bore Center, the Target Center, and the Laser Reference Centerline. If

Figure 22 -- *Three centers of bore alignment*

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 22**.

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.

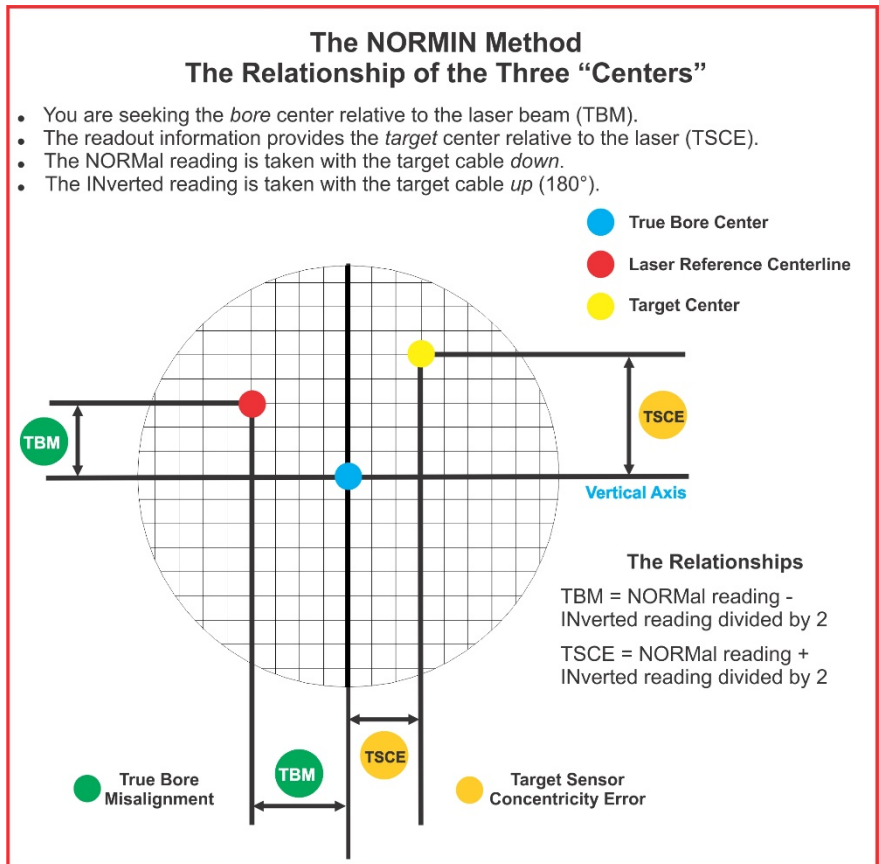The general rule is: buck in to the TSCE and measure the TBM.

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 23 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.).
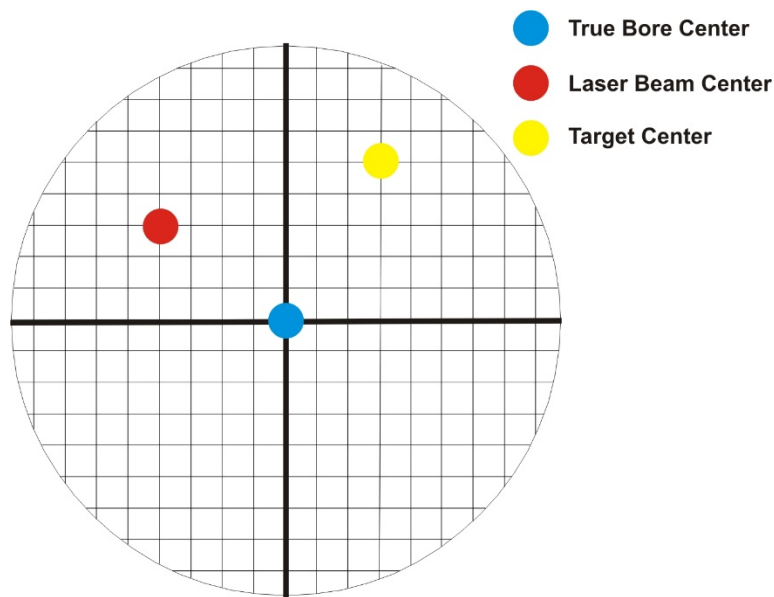
Figure 23 – *Target in the NORMal position*

Figure 24 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 24**, 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.
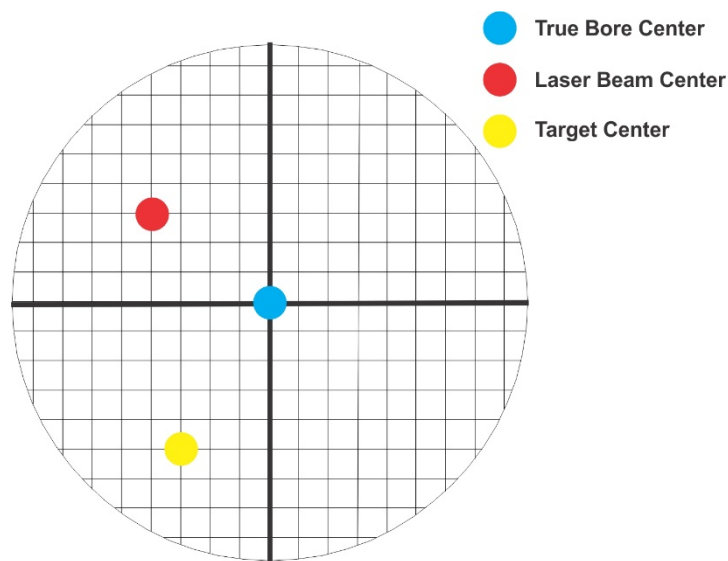
Figure 24 – *Target in the INverted position*

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 – The A-910 Radio Transceiver/Hub

Front Panel Features

1. **Power ON indicator and Low Battery indicator**
2. **Internal backup battery charging indicator and USB LINK ESTABLISHED indicator**
3. **TX indicator:** blinks when device is transmitting data to the target(s)
4. **RX indicator:** blinks when the device is receiving data from targets or other transceivers.
5. **System ID setting switch:** set to the same number as the R-1307's CH (Channel) number.

Rear Panel Features

1. **Not used**
2. **USB/Data I/O Port**
3. **Power Switch**
4. **External power supply:** required only for computers that cannot provide adequate power (5V, 400 mA) through the USB port.
   Note: *When using the USB Extender™ cable extension kit, plug the A-910-2.4 into an A/C power supply.*
5. **Antenna**

Figure 25 – *The A-910 Radio Transceiver/Hub FRONT PANEL*

Figure 26 – *The A-910 Radio Transceiver/Hub REAR PANEL*

See Appendix C on Page 58 for radio specification details.

MODEL NUMBER	PRIMARY FREQUENCY
A-910-900	*900 MHz*
A-910-2.4	*2.4 GHz*

Using the R-1307 with a Local Target and the A-910 Radio Transceiver

Setting the Target Network ID and System ID for the R-1307 Readout

To make the unit visible to all other radio-enabled devices, you must set the Target Network ID and the System ID for the readout.

1. **Set the Local Readout/Target Network ID**
   Press the MENU button until the *upper* display shows ɪd.ː ɴɴ (nn is also equal to the R-1037 number) and the matching Target number with the current Target ID (ɴɴ) blinking. Use the UP and DOWN arrow keys to set the Target ID.

   Press the MENU button again until the lower display shows ɪd.ː ɴɴ □with the current Target ID (ɴɴ) blinking. Use the UP and DOWN arrow keys to set the Target ID to the same value as that of the upper display's Target ID.

2. **Set the System ID (Radio Channel)**
   Press the MENU button until the upper display shows ɕh.ː ɴɴ, with the current System ID (ɴɴ) blinking. Use the UP and DOWN arrow keys to set the System ID.
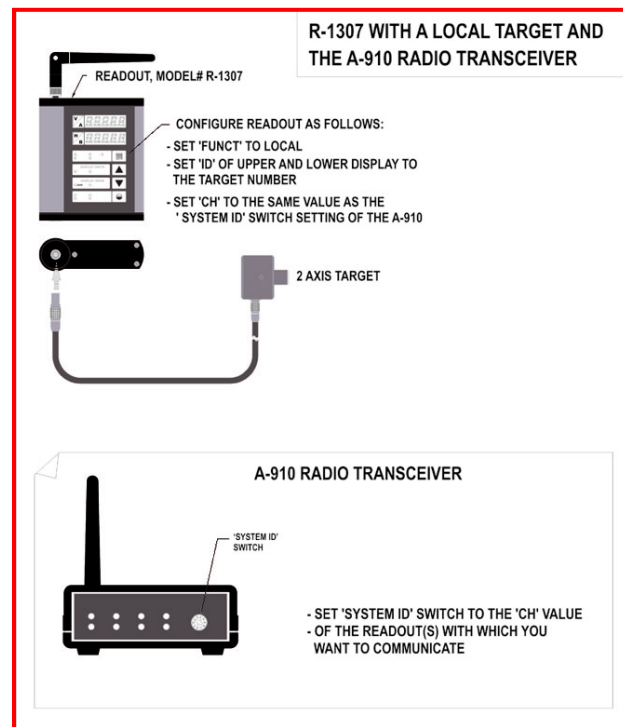
Figure 27 -- *R-1307 with Local Target and A-910 Radio Transceiver*

Note that **nn** must be set to the same number as the channel switch setting of the A-910 radio transceiver (see **Figure 25**, #5).

Miscellaneous Display Messages

-HLɪ-	
ɾɪ_00	Startup Message. Lower Display shows firmware Revision Number.
. . .	3 moving dots. Wireless target is not responding to a polling request from Readout. Check ID and Channel settings. Check Target(s).
- - -	3 dashes. Target detected but the laser is not on target. Check laser.
ɕh_ːno	
ɾAdɪo	Radio channel cannot be selected because no Radio is present or detected. Standard message for R-1307C. For Models R-1307 or R-1307W, this message indicates a fault in the radio module.
FAuʟt	
PSd	Indicates a problem with the connection to the Local Target's Position Sensing Device (PSD). Check plugs and cable(s).
tɕt_n	
UncAL	Target 'n' descriptor does not contain target calibration data.

See Appendix D on Page **59** for the complete R-1307 menu.

Appendix C - Agency Certifications

Agency Certifications for the 2.4 GHz Radio Transceiver

FCC (United States of America) Certification

Contains FCC ID: OUR-24XSTREAM
The enclosed device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.

⚠ RF EXPOSURE WARNING: This equipment is approved only for mobile and base station transmitting devices, separation distances of (i) 20 centimeters or more for antennas with gains < 6 dBi or (ii) 2 meters or more for antennas with gains ≥ 6 dBi should be maintained between the antenna of this device and nearby persons during operation. To ensure compliance, operation at distances closer than this is not recommended

IC (Industry Canada) Certification

Contains Model 24XStream Radio (2.4 GHz), IC: 4214A 12008
Complies with IC ICES-003

CE ⓘ

Complies with ETSI. *France – France imposes restrictions on the 2.4 GHz band. Go to www.art-telecom.Fr or contact MaxStream♦ for more information. Norway – Norway prohibits operation near Ny-Alesund in Svalbard. More information can be found at the Norway Posts and Telecommunications site (www.npt.no).*

Since the 2.4 GHz band is not harmonized throughout Europe, other restrictions may apply to your country.

Technical Data:
• OEM radio transceiver, model number: 24XStream
• Frequency Band: 2400.0 – 2483.5 MHz
• Modulation: Frequency Shift Keying
• Channel Spacing: 400 kHz
• ITU Classification: 400KF1D
• Output Power: 100 mW EIRP max.
• Notified Body Number: 0891

♦ The radio Transceiver contained in the A-1519/A-1520 Type II Universal Wireless Targets is manufactured by MaxStream®. For more information pertaining exclusively to the Radio Transceiver please contact MaxStream at 1.801.765.9885 or visit their web site: http://www.maxstream.net

Appendix D – The R-1307 Menu

READOUT FUNCTIONAL MODE:

LOCAL : DISPLAY POS. OF TARGET CONNECTED TO LOCAL PORT
POLL : REQUEST AND DISPLAY POSITION OF WIRELESS TARGET(S)
L.Stn : DISPLAY POSITION OF WIRELESS TARGETS CONTROLLED
   BY ANOTHER R-1307 OR RADIO TRANSCEIVER
   IN POLL (MASTER) MODE.

FUnct=
LOCAL

PSD TYPE: ☐ SC-10D (T-218, T-212, T-214, etc)
            ☐ DL-10 TYPE

TARGET (PSD DESCRIPTOR) NUMBER

TARGET NUMBER (TYPE), SELECTION ONLY
NOTE: USE THE R-1307 CONFIGURATION UTILITY TO DEFINE
THESE TARGETS AND ENTER CALIBRATION DATA FOR
EACH TARGET

PSD HEIGHT (MM)

PSD WIDTH (MM)

LASER MODE: F FIXED BEAM
            S SCANNING LASER

tgt_1
F 10_10

R-1307 - SETTINGS MENU, FLOW DIAGRAM
NOTE: SOME FUNCTIONS ARE MODEL SPECIFIC.

INSTRUCTIONS: PRESS THE 'MENU' KEY TO
SEQUENCE THROUGH THE FOLLOWING SETTINGS:
USE THE 'UP' AND 'DOWN' KEYS TO CHANGE
THE SETTINGS

CURRENT DISPLAY MODE
rEL RELATIVE (DATUM) POSITION
AbS ABSOLUTE POSITION (DEFAULT)

diSP=
rEL

MEASURMENT UNITS
inch :INCHES
mm :MILLIMETERS

Unit=
inch

DAMPENING
NUMBER OF SAMPLES TO AVERAGE
CHOICES: 2, 4, 8, 16, 32

AuG_=
2

DISPLAY RESOLUTION

rES_=
.0001

(UPPER DISPLAY) ID OF FIRST WIRELESS SCANNING TARGET
(LOWER DISPLAY) ID OF SECOND WIRELESS SCANNING TARGET
FOR FIXED BEAM WIRELESS TARGET, OR LOCAL TARGET:
SET BOTH UPPER AND LOWER ID TO SAME #

id_=01
id_=02

SYSTEM ID OF WIRELESS TARGET(S) OR LOCAL TARGET
RANGE: 0 TO 9

ch_=0

DISPLAY BRIGHTNESS
RANGE: 1(DIM) TO 5(BRIGHT)

br itE
=1

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Appendix E – Manually Selecting the COM Port

The A-910 Utility should automatically detect the COM Port upon startup. If not, use the following steps to locate the correct COM Port.

Windows XP

1. Right-click My Computer.
2. Click **Properties** and then select the **Hardware** tab.
3. Click **Device Manager**.

Windows 7

1. Click the **Start** button and select **Control Panel**.
2. Click the **System** icon.
3. In the **System** window, click on the Device Manager link located under the **System** heading.
4. In Device Manager, scroll down to **Ports.** Expand the listings under **Ports** to reveal all the ports installed.
5. Locate **SILICON LABS CP210x USB to UART Bridge (COM x)** (see **Figure 28).**
6. Note the COM Port listed and select that COM Port in the A-910 Zigbee Utility software using the drop-down arrow.
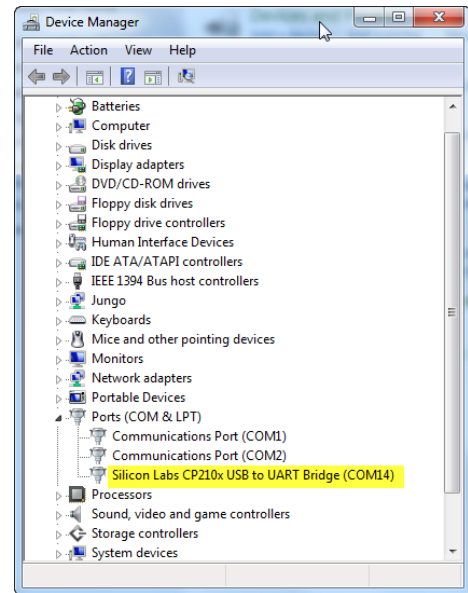

Figure 28 -- *Device Manager showing COM Port for A-910 Dongle*

Setting the Target System ID and Target Network ID

The System ID is a Radio Network Address that is used by the Radio Communications Protocol to filter unwanted data from other radio transceivers and targets using a different address. Only targets and radio transceivers that are set to a matching System ID can communicate with each other.

Because no two targets with the same System ID can transmit simultaneously, it is necessary for each target to be programmed to respond only when it is being addressed. The Target Network ID is the target address on the communications network. Under Host (computer) control, the radio transceiver transmits a message called a *polling request* that contains the Target Network ID of one specific target. All targets receive all polling requests, but only the target with a Network ID matching the ID contained in the polling message will reply (Transmit Data to the Host).

Figure 29 – *Unitarget ID Switch set to1*

There are three rotary DIP switches located on the right side of the target, shown in **Figure 29**:
- The uppermost switch sets the System ID.
- The two lower switches are used to set the target network ID.

Setting the System ID
Note: Before selecting a System ID, ensure that it is not already in use by another system within the radio coverage area.
Using a small screwdriver, rotate Switch 1 to align the arrowhead with the System ID number (0-9). **Figure 29** shows the System ID switch set to 1.

Setting the Target Network ID and System ID for the R-1307 Readout

To make the unit visible to all other radio-enabled devices, you must set the Target Network ID and the System ID for the readout.

1. **Set the Local Readout/Target Network ID**

   Press the MENU button until the *upper* display shows Ɪᴅ=ꞯꞯ (nn is also equal to the R-1307 number) and the matching target number with the current target ID (ꞯꞯ) blinking. Use the UP and DOWN arrow keys to set the Target ID.

   Press the MENU button again until the lower display shows Ɪᴅ=ꞯꞯ, with the current target ID (ꞯꞯ) blinking. Use the UP and DOWN arrow keys to set the Target ID to the same value as that of the upper display's Target ID.

2. **Set the System ID (Radio Channel)**

   Press the MENU button until the upper display shows ᴄʜ = ꞯꞯ, with the current System ID (ꞯꞯ) blinking. Use the UP and DOWN arrow keys to set the System ID.
   Note that **nn** must be set to the same number as the channel switch setting of the A-910 radio transceiver (see **Figure 30**).
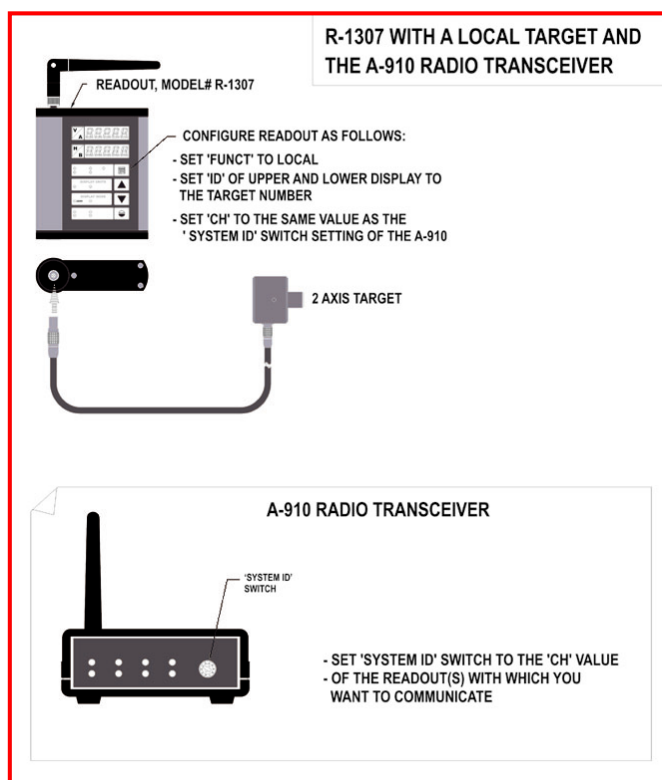

Figure 30– *R-1307 with Cabled (Local) Target and A-910 Radio Transceiver*

Miscellaneous Display Messages

-HLꞮ-	
r I_00	Startup Message. Lower Display shows firmware Revision Number.
. . .	3 moving dots. Wireless target is not responding to a polling request from Readout. Check ID and Channel settings. Check Target(s).
- - -	3 dashes. Target detected but the laser is not on target. Check laser.
ᴄʜ_=ꞯo	
rАd ꞮƆ	Radio channel cannot be selected because no Radio is present or detected. Standard message for R-1307C. For Models R-1307 or R-1307W, this message indicates a fault in the radio module.
FАᴜᴸᴛ	
PЅd	Indicates a problem with the connection to the Cabled (Local) Target's Position Sensing Device (PSD). Check plugs and cable(s).
ᴛƃᴛ_ꞯ	
ᴜꞯᴄАᴸ	Target 'ꞯ' descriptor does not contain target calibration data.

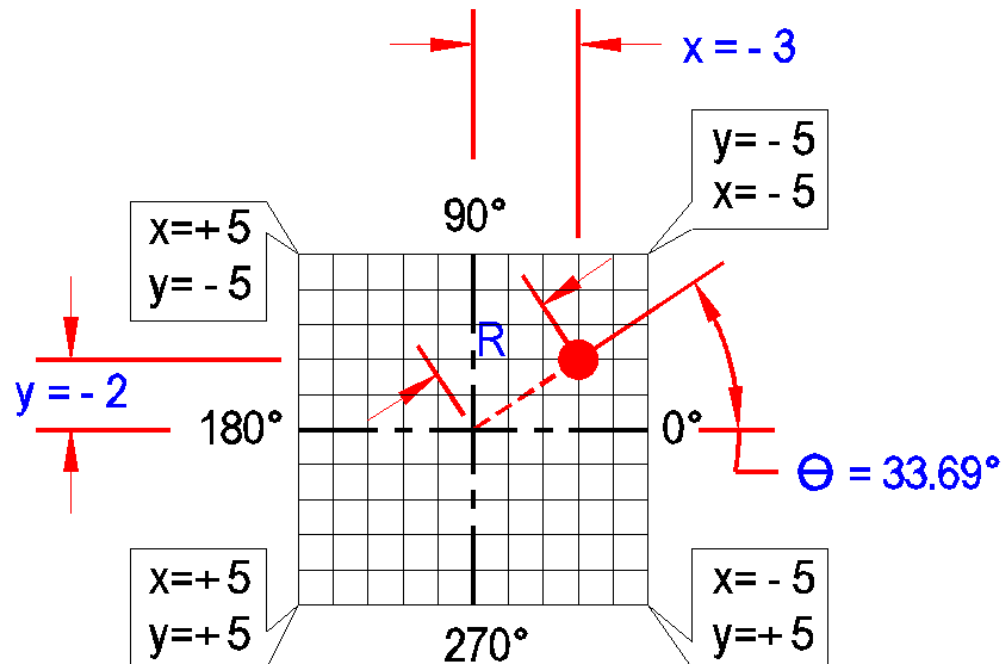# Appendix F – Converting X-Y Coordinates to Polar Coordinates in Alignment Reports

Figure 31 – *Corner position coordinates*

Figure 31 illustrates the corner position coordinates, as if the laser beam was located at the four respective corners. Also shown is an example of a laser beam located in the upper right quadrant of the PSD. The beam rotation angle is displayed in standard polar coordinates, as shown in **Figure 32** (zero degrees at three o'clock and counter-clockwise rotation).

Note that Y = Vertical Position and X = Horizontal Position. Hamar lasers position readings are not in Cartesian coordinates (i.e. above center positive, below center negative, right of center positive, left of center negative). For that reason, the signs of both the X and Y position values used in the ATAN2 function must be inverted.

Figure 32 – *Normal Polar Chart Orientation*

Ө (the beam rotation angle) is calculated as follows:
[1]Ө (radian) = ATAN2 (-1*X, -1*Y) or
Ө (radian) = ATAN2 (-1*(-.3), -1* (-.2)) = 0.588
[2]Ө (degrees) = DEGREES (.588) = 36.690.
Finally, convert the angle to all positive values: If Ө (degrees) < 0, add 360
R (radius) = SQRT($X^2 + Y^2$) = 3.6056

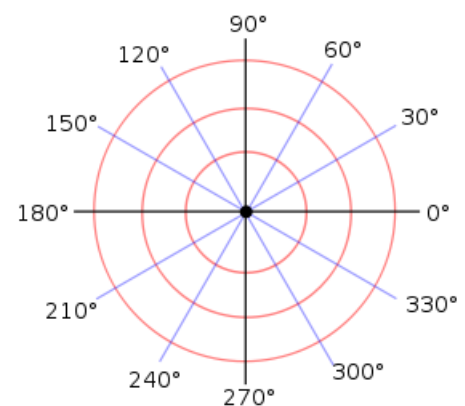[1] *In Excel: In MS Visual Studio, use Ө (radian) = Math.ATAN2 (-1*Y, -1*X)*
[2] *In Excel: To manually convert radians to degrees, multiply radians by 57.29577951308232 (180/ Π).*

Appendix G – Entering Data Manually in Bore9

If it is necessary to enter data manually in the Bore9 software, follow the procedure below.

1. Open Bore9 and create a new project file as described in *Creating a New Project File or Opening an Existing Project File* on Page **16**.
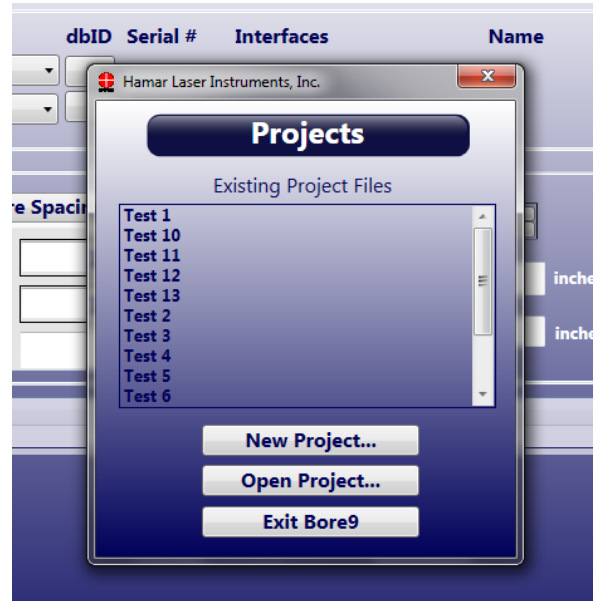

2. Select the target to be used, the number of bores, and the spacing between the bores. If you are measuring bore diameters, enter the vertical and horizontal bore diameter of the reference bore and select the reference bore number. Enter the tolerances for Overall Straightness Tolerance and Bore- to-Bore Tolerance. Click **4** at the bottom of the screen.
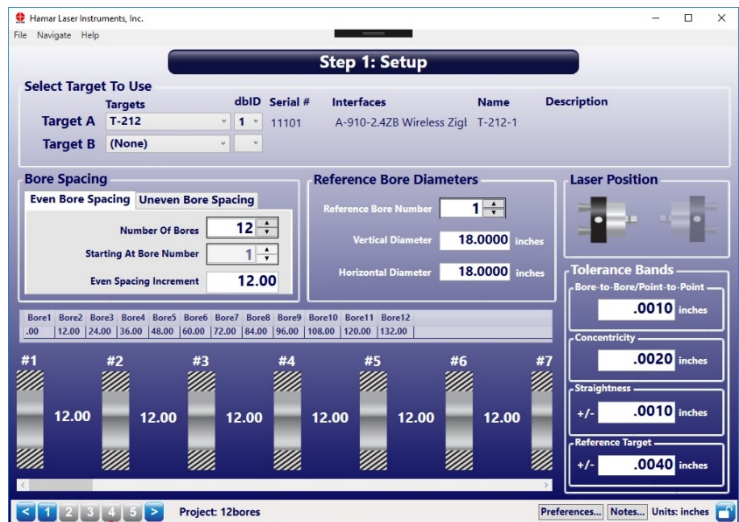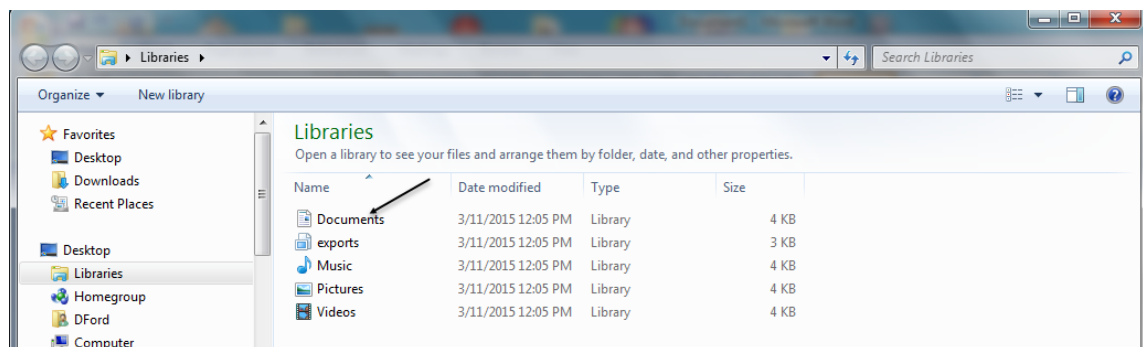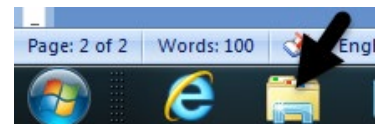
3. If there is no equipment connected, the **Comm Port Will Not Open** message displays. Click **OK**.
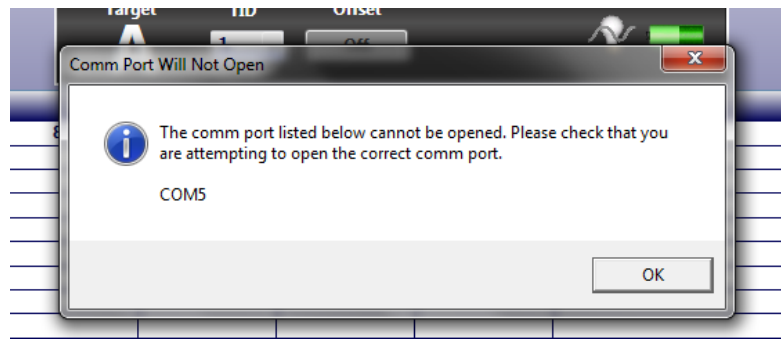
4. Click the **Save** button and close Bore9.
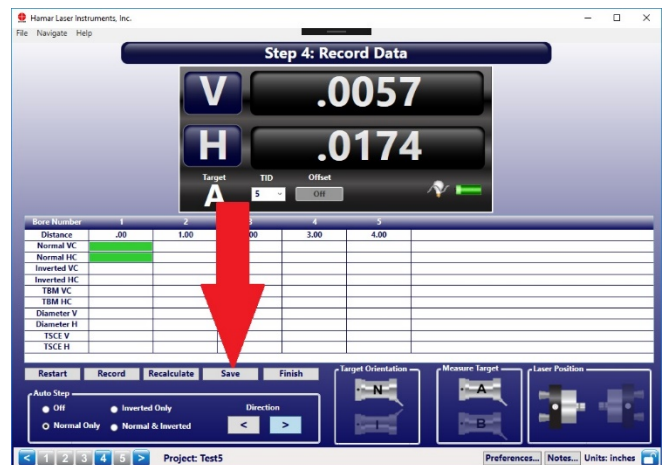
5. Click the Windows Explorer icon and select **Documents**.
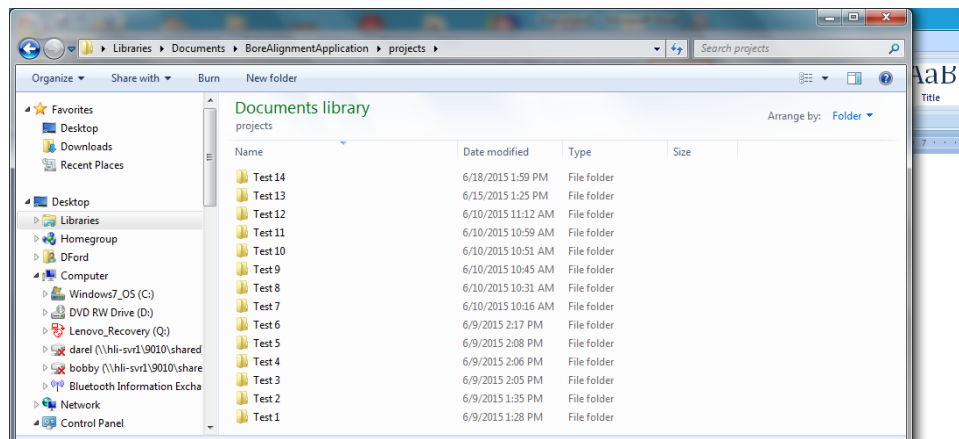

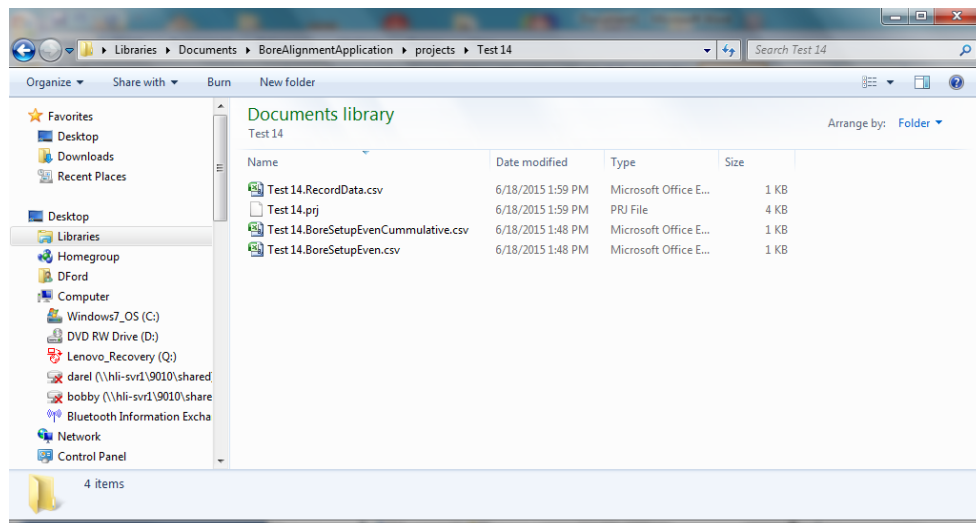6. Locate the **BoreAlignmentApplication** folder and open it.

7. Open the **Projects** folder and then open the new project created in Step 1 on Page 63.
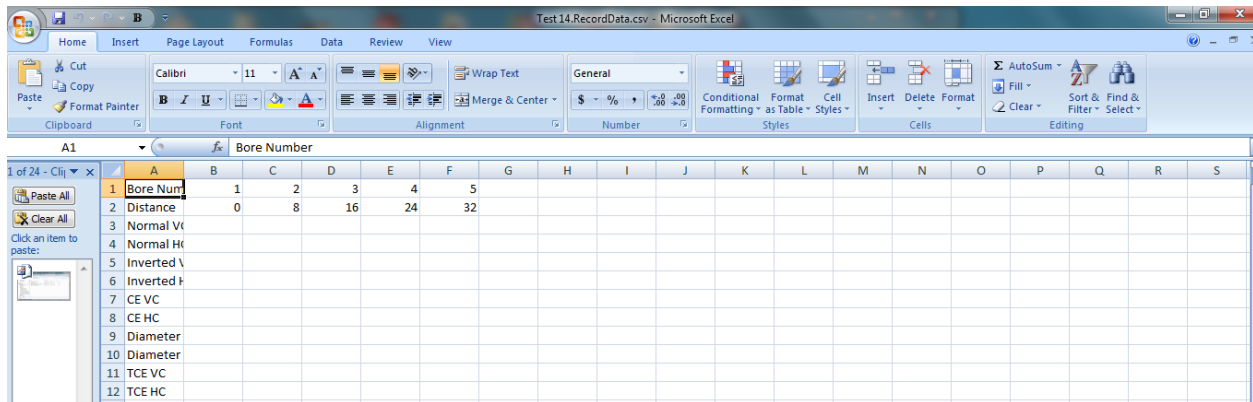
8. Open the ___RecordData.csv file.

9. An Excel spreadsheet opens.

10. Enter the Normal Vertical readings for each bore in the **Normal VC** row and the Normal Horizontal readings for each bore in the **Normal HC** row. If inverted readings were taken, enter them in the **Inverted VC** and **Inverted HC** rows.
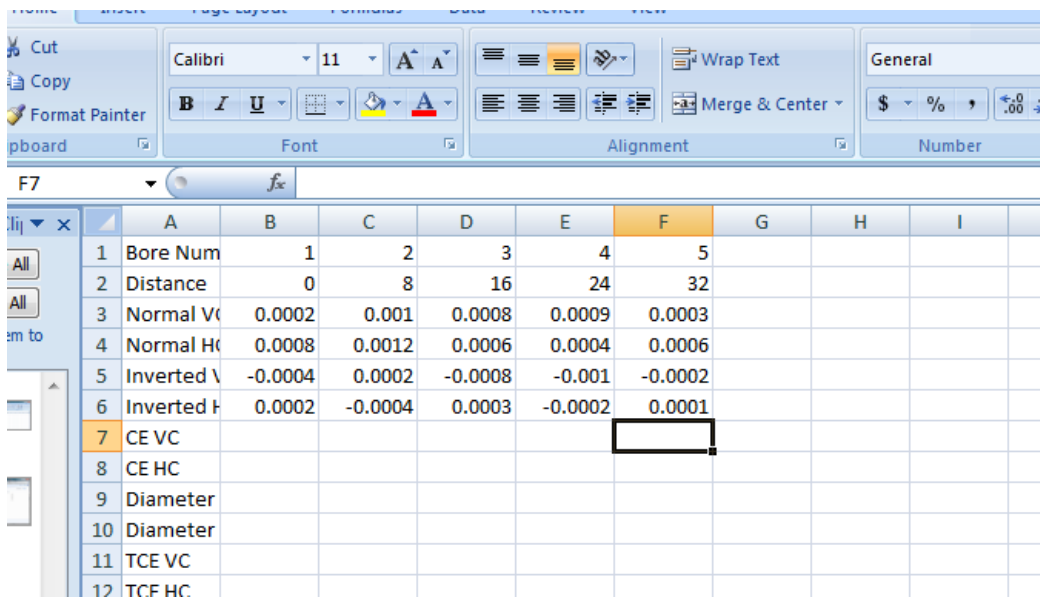
11. Click **File** and **Save**. You will receive a warning that the data may contain features that are not compatible with CSV (comma delimited. Click **Yes** to keep the current format.
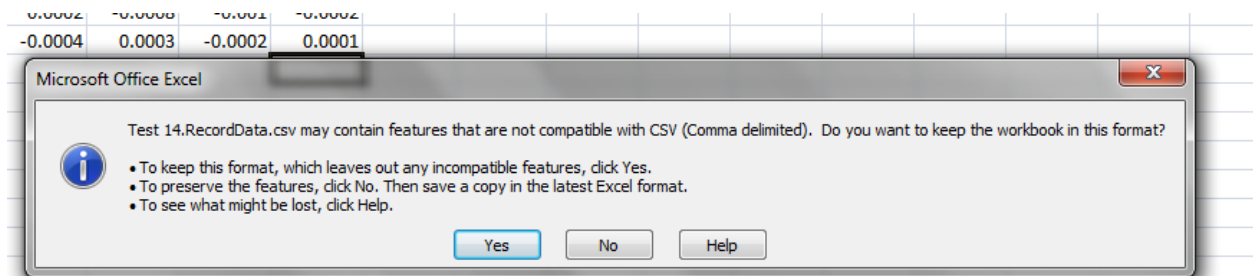
12. Click the red **X** in the top right corner of the screen to close Excel. When asked if you want to save the changes you made to the file, click **No**.

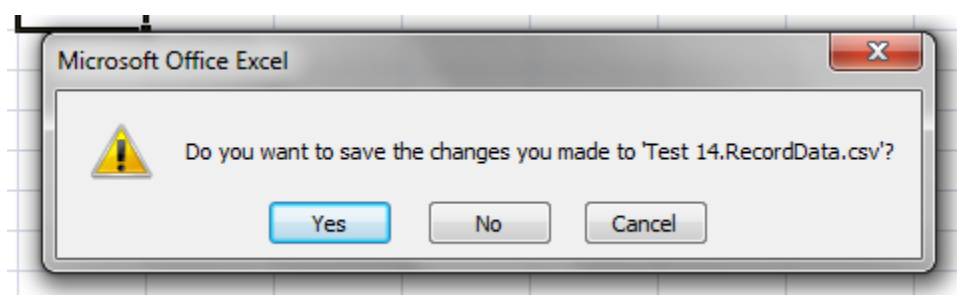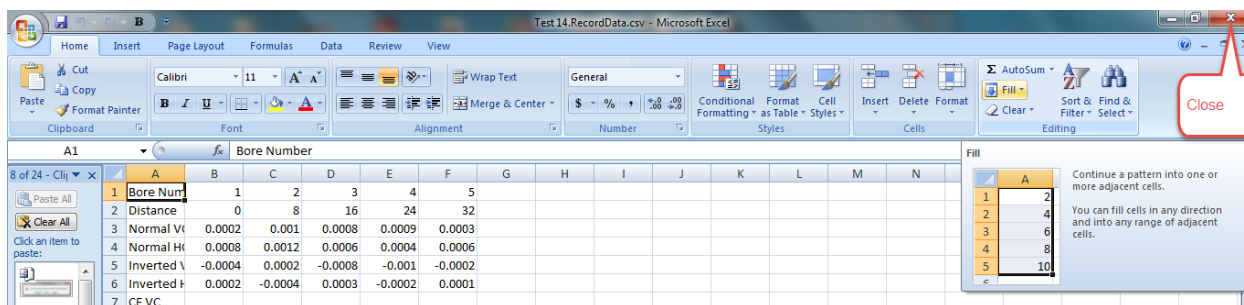13. Open Bore9 and click on the name of the project file you created in Step 1. Click **4** at the bottom of the screen.

14. If the **Comm Port Will Not Open** message displays, click **OK**.

Comm Port Will Not Open

The comm port listed below cannot be opened. Please check that you are attempting to open the correct comm port.

COM5
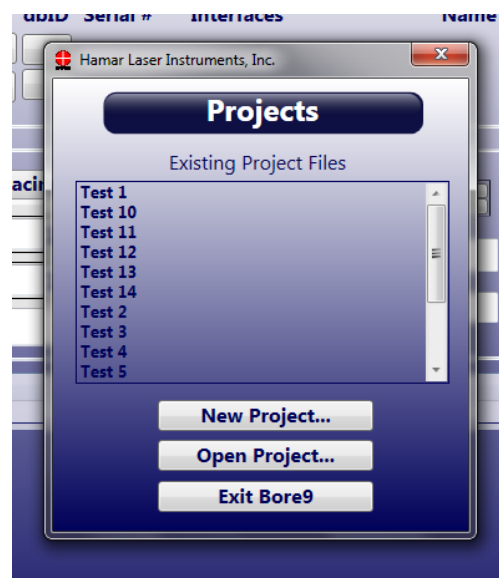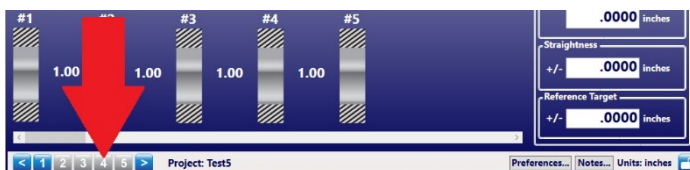
OK

15. Click **Recalculate** at the bottom of the grid. Click **Save**.

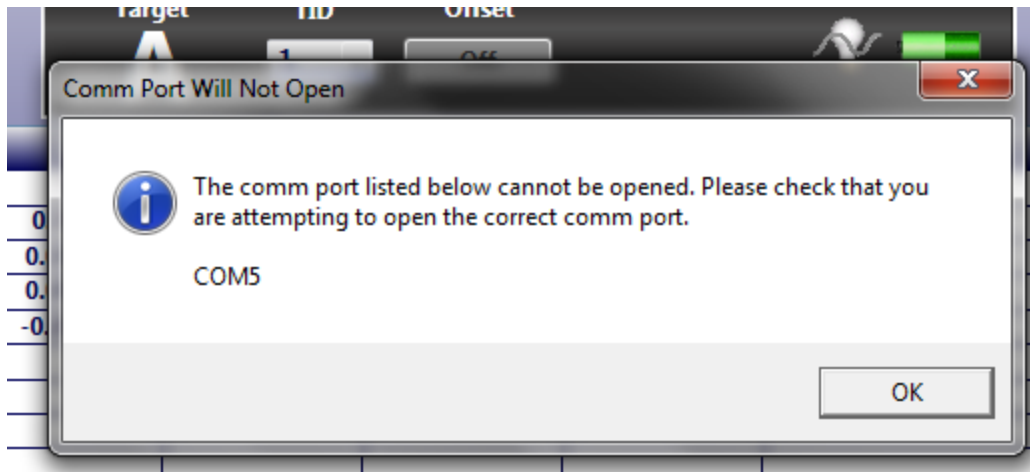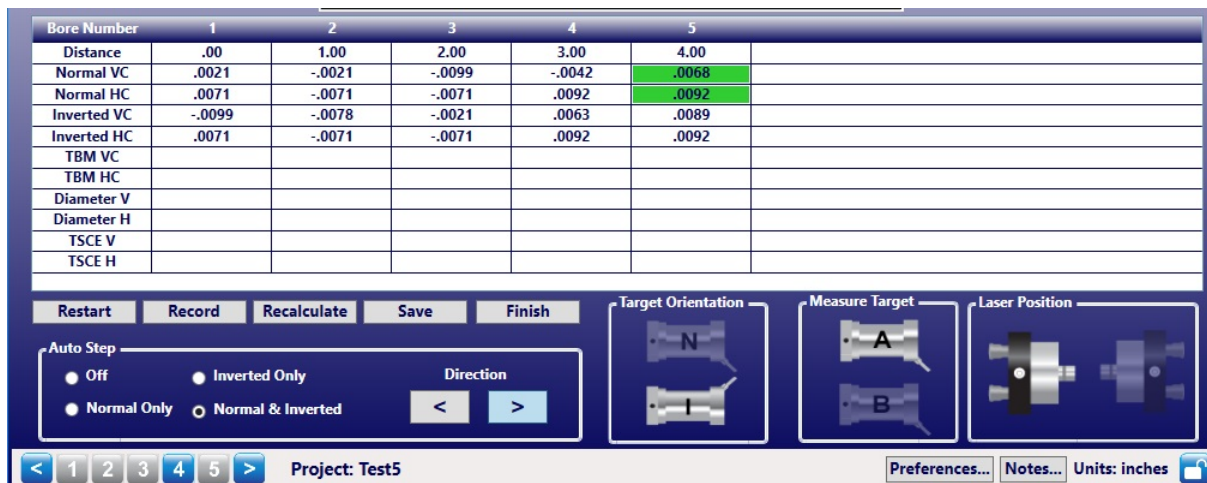| Bore Number	1	2	3	4	5	
Distance	.00	1.00	2.00	3.00	4.00	
Normal VC	.0021	-.0021	-.0099	-.0042	.0068	
Normal HC	.0071	-.0071	-.0071	.0092	.0092	
Inverted VC	-.0099	-.0078	-.0021	.0063	.0089	
Inverted HC	.0071	-.0071	-.0071	.0092	.0092	
TBM VC						
TBM HC						
Diameter V						
Diameter H						
TSCE V						
TSCE H						

Restart | Record | Recalculate | Save | Finish

Target Orientation | Measure Target | Laser Position

Auto Step
- Off
- Inverted Only
- Normal Only
- Normal & Inverted

Direction: < >

N
I
A
B

< 1 2 3 4 5 > Project: Test5

Preferences... | Notes... | Units: inches

16. When the **Overwrite Data?** message displays, click **Yes**.

Overwite Data?

Performing a recalulate will overwrite existing data in CE, Diameter and TCE values. Do you wish to continue?

Yes   No

68
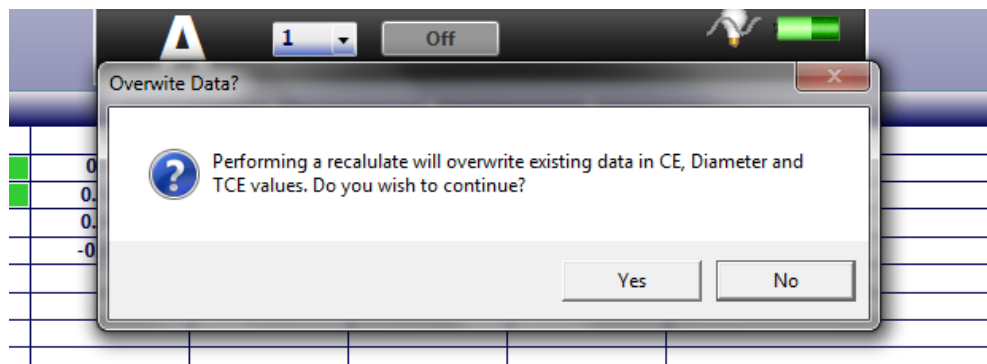
All of the manually-entered data has now been recalculated by the program. When you go to **Step 5 – Results**, this data is plotted on the Plot Screen.
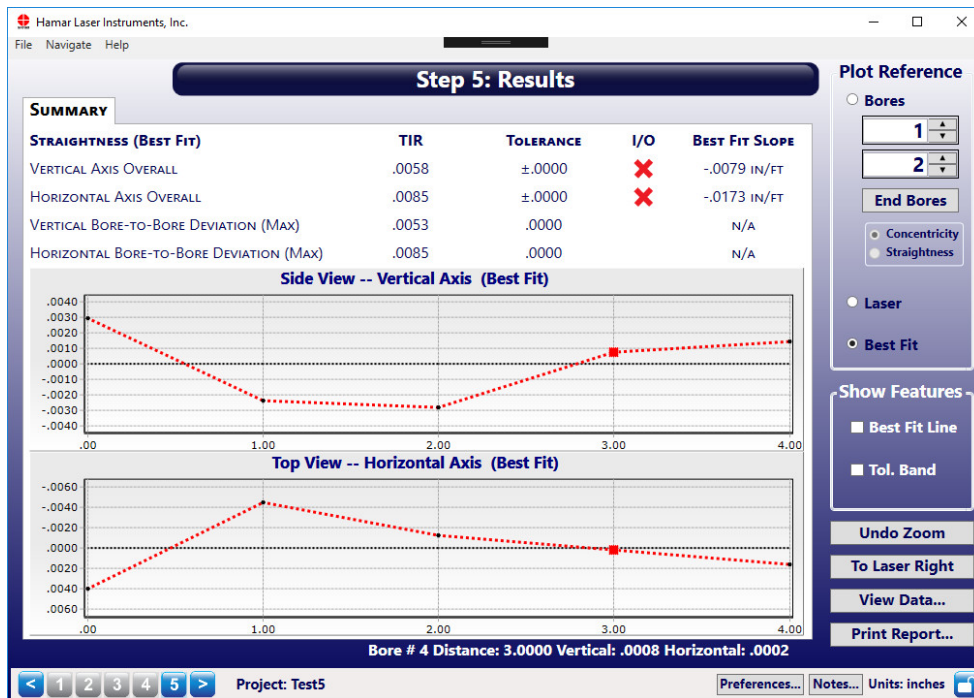
Appendix H – Laser Buckin for Gearbox AOR (Manual Method)

Laser Buckin AOR Procedure

Insert L-705/706/708 laser into spindle fixture and set the micrometers to the Nominal Settings. Turn on the laser to either **Pulsed Mode** (standard) or **Continuous Mode** (legacy).


1. Rotate the laser to the INverted position (Vertical Arrow pointed at 6:00) until the bubble is centered in the level vial window. **Note:** *There is a bubble vial on both the top (*NORMal*) and bottom (*INverted*) of the laser.*
2. Insert the target and bore adapter into the far bore location.
3. Ensure the laser is hitting the target. If not, then use *Rough Laser Buckin Using the Visual Method* described on Page **34** to visually buck in the laser.
4. Connect the R-1307 Readout (or R-358) and turn it on, making sure to match the laser mode (Pulsed or Continuous) in Step 1. See Page **4** for more details on changing the laser mode in the R-1307. Insert A-910-2.4ZB Radio Receiver into the USB port on the computer.
5. Open Bore9 and follow the steps in this manual (see Page 4) to configure the target to the readout so that the displays are showing live data.
6. Write down the V and H values for the INverted Position.
7. Rotate the spindle (holding the laser) 180 degrees to the NORMal position until the bubble is centered in the level vial window. Write down the V and H values.
8. Find the sum of the readings and divide by 2 (the number of readings) to calculate the laser *Set Points*.
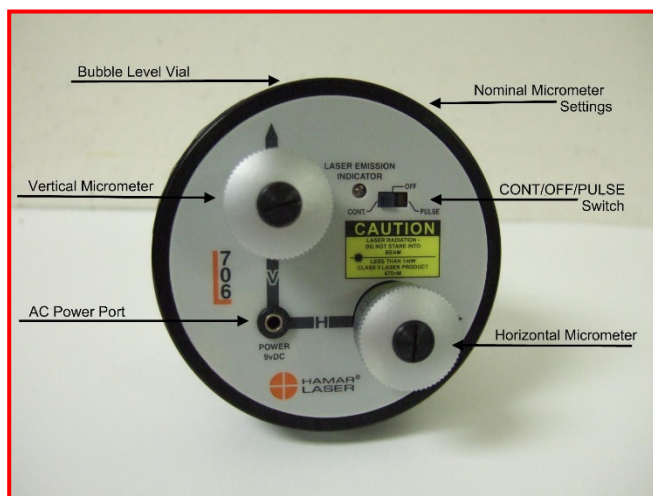
<u>**(Normal reading + Inverted reading)**</u>
2

Calculations for vertical and horizontal readings must be done separately. The formulas for vertical and horizontal set points are:

<u>**(Normal V + Inverted V)**</u> = **V SET POINT**
2

<u>**(Normal H + Inverted H)**</u> = **H SET POINT**
2

Example of calculating the Vertical Set Point.
.

V_N	=	-.016		V_N	=	-.016
V_I	=	<u>+.008</u>		V_I	=	<u>-.008</u>
		-.008				-.024
Divide by 2				**Divide by 2**		
V Set Point =	**-.004**			**V Set Point =**	**-.012**	

9. Turn the V and H micrometers (adjustment knobs on the L-708) until the V display value equals the *V Set Point* and the H display value equals the *H Set Point*.
10. Rotate the laser to the INverted position.
11. The V and H values should be the same as when the laser is in the NORMal position. If not, then repeat Steps 7 thru 11 until the values are the same within your desired tolerance.

Appendix I – Laser Buckin for Gearbox AOR (Rough Buckin Visual Method)

Rough Laser Buckin Using the Visual Method

Note: This procedure is performed *without* the target inserted in the barrel.

1. **Cover the far end of the barrel with white paper.**
   Using a compass, draw a circle the same size as the bore diameter on a piece of white paper. Mark the center of the circle. Tape the paper to the far end of the barrel. The laser beam must be visible through the paper.
   Note: *Another way to make a circle in the paper is to lightly press the paper at the edge of the barrel and trace your fingers around the inside edge of the bore. This will create a round crease showing the ID of the barrel. Take a ruler to find the approximate center of the barrel and mark it with a pen/pencil.*

2. **Mark the laser beam location on the paper.**
   Set the laser to *Continuous Mode* (see Page **4**). With the laser placed in the NORMal (upright) position, draw a small circle where the laser beam hits the paper.

3. **Invert the laser, spindle adapter and the spindle *AS A UNIT* and mark the laser beam location on the paper.**
   Using the bubble levels as a reference, rotate the spindle, laser, and adapter *as one unit* a total of 180 degrees until the level bubble on bottom of the laser is on top and centered. Now draw a small circle where the laser beam hits the paper.
   Note: *The laser, adapter, and spindle must be rotated **AS ONE UNIT**. Do not rotate the laser by itself. Also make sure that the circular level bubble is centered, or the results will not be accurate.*

4. **Measure to find the *Visual Set Point* and adjust the laser beam.**
   Using a ruler, measure the distance between the centers of both circles and mark the halfway point (see **Figure 33**) on the paper. This is the *Visual Set Point*. Turn the vertical and horizontal micrometers until the laser beam is centered on the *Visual Set Point* mark.
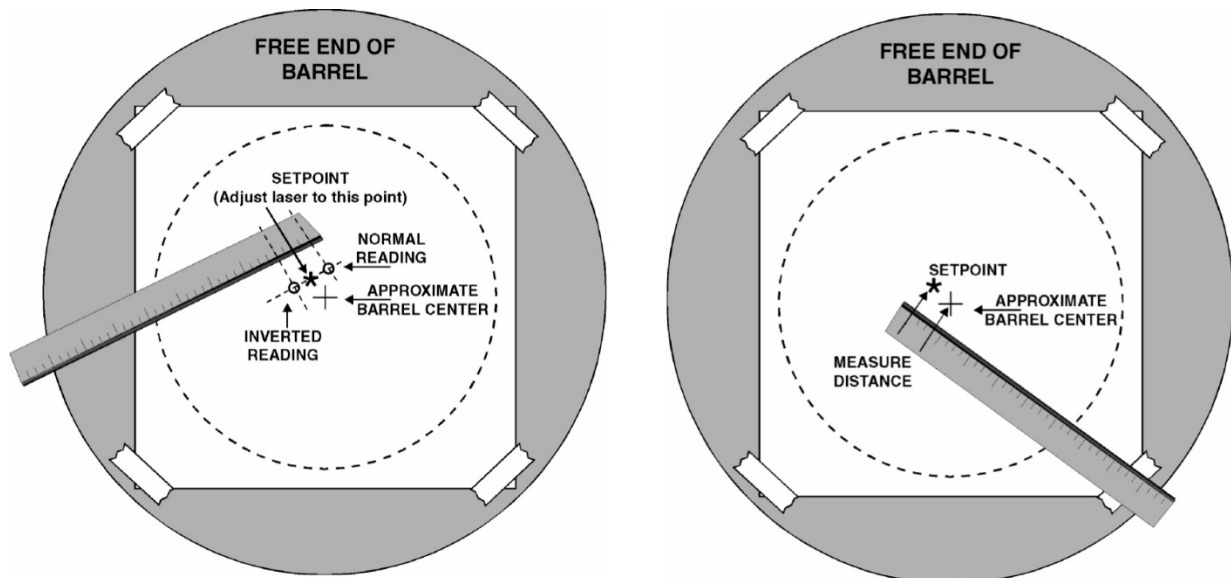

Figure 33 – *Visual Set Point*

5. **Invert (rotate) the laser, spindle adapter and spindle *AS A UNIT* to ensure that the laser beam remains at the *Visual Set Point.***
Following the instructions in Step 3, invert (rotate) the laser, spindle adapter and spindle *AS A UNIT* to ensure that the laser beam is still centered on the set point mark. If not, repeat Steps 2 thru 5 until the laser stays centered on the *Visual Set Point.*
6. **Measure the distance from the *Visual Set Point* to the mark at the center of the bore.**
If the distance from the set point to the mark at the center of the circle is 0.4 in. (10 mm) or greater, move/align the end of the barrel until the center mark lines up with the *Visual Set Point* mark (see **Figure 33**). This is called a rough alignment.
7. **Complete the setup procedures.**
Remove the paper and insert the target in the barrel, as described on Page **32**, then follow the Laser Buckin procedure.