



S-1410 Calibration and Utility Software
for the R-1307 Series Readouts
(R-1307, R-1307C, and R-1307W)

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**HAMAR
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HAMAR LASER INSTRUMENTS, INC.
www.hamarlaser.com

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

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Mounting Lasers and Targets for Calibration

The S-1410 Calibration software for the R-1307 Readout series provides the capability to calibrate any Hamar Laser bore alignment laser, such as the L-705, L-706 or L-708, and any 2-axis cabled target to the R-1307 Readout. The A-808 X-Y Angle/Center Calibration Fixture, which comes with the X-Y stage with certified micrometers and a mount for the L-705/L-706 Lasers, is used with the lasers/targets and their appropriate adapters to detect centering and span errors. The calibration factors are then uploaded to the R-1307 Readout via the S-1410 Calibration software.



Figure 1 -- A-808 Calibration Fixture with X-Y Target Stage for T-218/219 Targets and L-705/706 Laser Mount

Mounting a Target for Centering on the A-808 Fixture

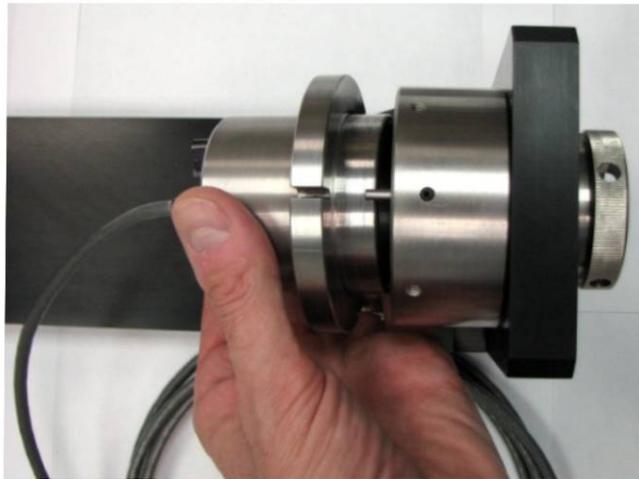
The following figures display the procedures for mounting lasers and targets into their adapters and for mounting a target to the X-Y Stage.



T-218 Target Centering Adapter



T-218 Target Centering Adapter Mounting

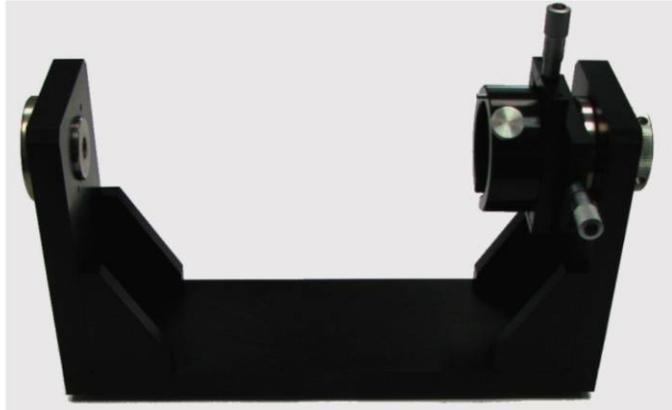


T-218 Target Inserted into Centering Adapter

Mounting a Target for the X-Y Stage



Mounting the X-Y Target Stage



A-808 Calibration Fixture with X-Y Target Stage for T-218/219 Targets and L-705/706 Laser Mount



Inserting T-218 Target in X-Y Stage

Mounting a Laser to the A-808 Fixture



Mounting Hardware for the L-700 Laser



L-700 Laser Mounted



L-705 Laser Mounted

Using the Target Calibration Procedure

There are two calibration parameters that must be entered into the S-1410 Calibration and Utility Software:

1. **Gain Adjustment (Span) Error** – this is a measure of how accurately the target (combined with the R-1307 Readout) displays a known amount of displacement. Typically, an X-Y micrometer stage is used to move the target a known amount (usually .025 in. or one full turn on a micrometer) and this is compared to the value displayed on the R-1307 Readout. If the value displayed on the R-1307 is not the same as the micrometer value, then a calibration factor is entered into the S-1410 software to be uploaded to the R-1307 to correct this error.
2. **Concentricity (Center) Error** – this is a measure of how far off center the sensor (PSD) is from the target housing's OD mounting surface. Typically, this is calculated by placing the target into a centering fixture and taking two readings: one at 0 degrees and one at 180 degrees. If the 0 and 180 degree values are not the same, a calibration factor is entered into the S-1410 software to be uploaded to the R-1307 to compensate for this error.

Gain Adjustment Factor (Span Error) Calculation

1. Mount the L-705 laser and T-218 Target (or another 2-axis target) in the A-808 Fixture (Figure 2).
2. Connect the target to the R-1307 Readout as shown in Figure 3.
3. Click and hold the **Menu** button on the R-1307 until **dI SP=** displays in the upper window. 
4. Use the **Up** and **Down** arrow keys to set the Display Mode to **AbS**. 
5. Continue clicking the **Menu** button (8X) until **Funct_** displays in the upper window. Use the **Up** and **Down** arrow keys to change the lower display to **LOCAL**.
6. Click the **Menu** button until the target record number displays in the upper window.



Figure 2 – Laser and Target mounted in A-808 fixture



Figure 3 – Connect target to R-1307

7. Use the **Up** and **Down** arrow keys to select the target record. For example, **Target_1** in the display window indicates Target Record #1; **Target_2** indicates Target Record #2, etc. (see Figure 4).

Note: The R-1307 readouts can save separate calibration factor sets for up to 9 targets, so it is important to select the correct target ID when performing this procedure. It is also important to match the target ID on the serial number to the ID in the R-1307. All HLI serial numbers have a 1, 2 or 3 at the end of the serial number to identify the target. You may also use your own ID system to identify the target IDs. Please keep a record of target serial IDs and the target ID used in the R-1307.



Figure 4 – R-1307 Menu Setup

8. Ensure that the flip lever is securely seated in the proper position (for T-218 targets only) as seen in Figure 5.
9. Set the laser micrometer to the **Nominal** settings (Figure 6) and turn the bubble level vial to the 12 o'clock position.
10. Adjust the X-Y Stage micrometer to approximately zero, using the vertical and horizontal micrometers, making sure to leave the micrometer set to the nearest number (write down the number setting on the micrometer, ie: **V=13 H=6**).
11. Trim out minor errors using the laser micrometers.

Note: In the event the X-Y Stage micrometer settings are not exactly on a definitive number, for example between .112 and .113, adjust to the nearest number and use the micrometers on the laser to re-zero the target.



Figure 5 – T-218 Flip Lever seated in proper position



Figure 6 – L-705 Laser showing Nominal settings

12. Performing a Positive Span Error Check

Using the X-Y Stage micrometers, turn the Vertical micrometer clockwise one full turn (.025 in.) and record the readings. The difference between the R-1307 Vertical reading and .025 in. is typically less than .002 in. Return the readout display to zero by adjusting the Vertical micrometer counterclockwise one full turn.

13. Performing a Negative Span Error Check

Ensure the R-1307 Vertical display reads zero. Turn the micrometer one full turn (-.025 in.) counterclockwise and record the result (see Figure 7). The difference between the reading and -.025 in. is typically less than .002 in. Return the readout Vertical display to zero by rotating the Vertical micrometer one full turn in the clockwise direction.

- Repeat Step 11 on Page 5 and the Positive and Negative Span Error checks for Horizontal readings.
- Repeat this procedure after the factors have been uploaded to the target to confirm the calibration.



Figure 7 – Vertical reading after clockwise turn

Please see the R-1307 Calibration Utility Program beginning on Page 7 for the procedure to load calibration factors into R-1307.

Zero Offset (Concentricity) Target Calibration Procedure

1. Mount the laser into the Hamar Laser holding fixture.
2. Mount the target into the V-block and clamp in place, ensuring that the cable is down.
3. Connect the target to the readout.
4. Using mirror reflect, beam back to the laser to assure minimum angle error. If using an L-102 Beam Translator or the X-Y Translation Stage, translate the laser up/down, left/right to get as close to zero as possible, (.001 in. is preferable) then use the micrometers on the laser to adjust the laser until the readings are as close as possible to zero (.0001 in. is preferable).
5. Rotate (Invert) the target 180° and record the numbers, divided by 2.

Example:

Vertical N: .0000

I: .0010 $(N+I)/2 = -.0005$

Horizontal N: .0000

I: .0012 $(N+I)/2 = .0006$

6. The concentricity error for each axis should be less than .0005 in. (0.013 mm) but will most likely be .0001 to .0002 in. (0.003 to 0.005 mm).

The R-1307 Calibration Utility Program

Entering Calibration Factors into R-1307 Readout

1. Connect the R-1307 Readout to any available USB port using the R-1307 USB Cable (sold separately). Power on the R-1307 Readout.
2. **Run the Utility** by clicking **Start>Program>Hamar Laser Software>R-1307 Configuration Utility**. Note that your menu layout may be different than what is displayed in depending on your operating system and desktop settings.

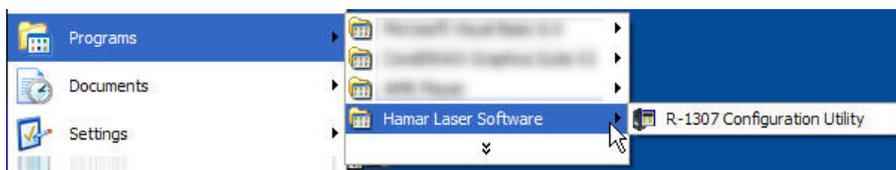


Figure 8 – Starting the utility from the Windows Main Menu

3. **The Initial Screen.** Upon startup, the utility prompts to scan for readout devices. Click **Yes** to begin the scan or **No** to bypass the scan. Note that you can always click **Scan Ports** to rescan the COM ports.

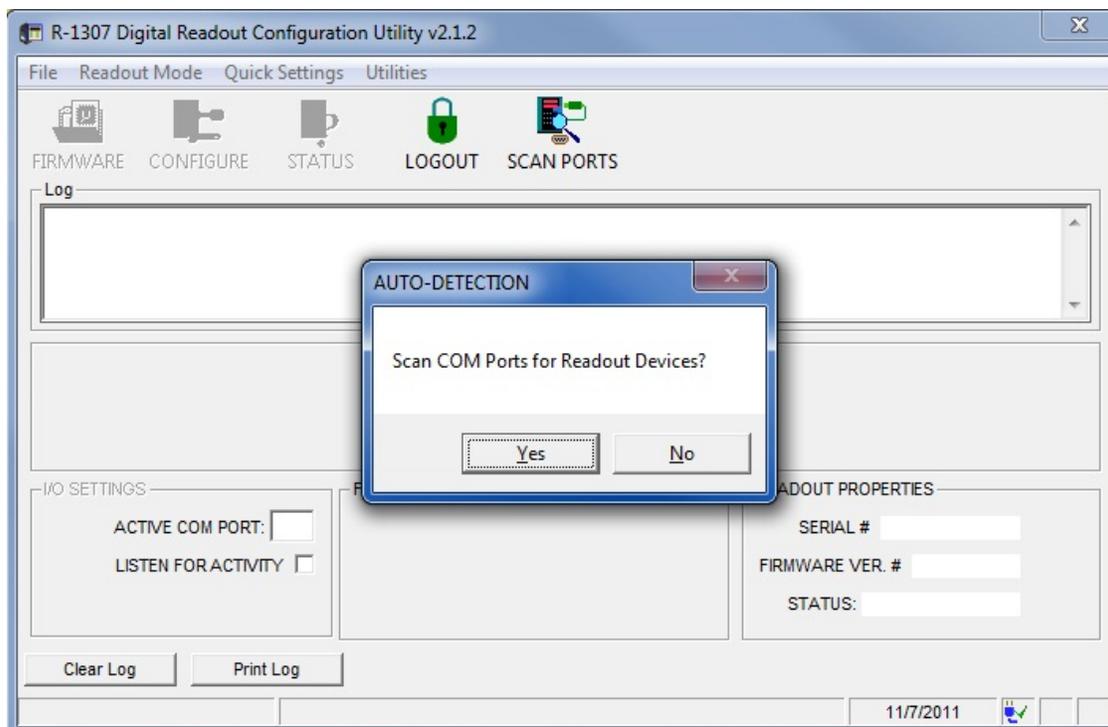
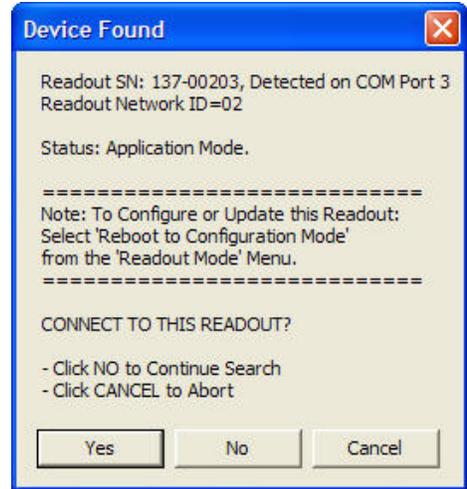


Figure 9 – Initial Screen, Scan Ports prompt

4. You will be prompted to confirm if the R-1307 Readout that is detected is the one that you wish to configure. Verify that the Serial Number displayed matches the Serial Number of your R-1307. Click **Yes** to connect to the listed device, Click **No** to continue searching for other devices. Click **Cancel** to abort the search.



5. If the Utility fails to detect the R-1307 Device, check the following:
 - Is the R-1307 connected to the computer through the USB cable?
 - Is the R-1307 powered on?
 - Is the Common USB driver installed? If the driver installation failed or if you have not installed the USB driver, you will need to re-install it using the provided CD.

6. To configure the R-1307, click the **Readout Mode** menu and select **Reboot to Configuration Mode**. Wait a few seconds to allow the R-1307 to switch to Configuration Mode, indicated by the AP n.nn on the upper display, where n.nn is the firmware version number. For example: Version 1.29 is displayed as **AP1.29**. Note that the **Firmware** and **Configure** buttons are enabled when the R-1307 is in Configuration Mode and disabled when it is in Application Mode.



Figure 12 – Firmware and Configure Buttons Enabled

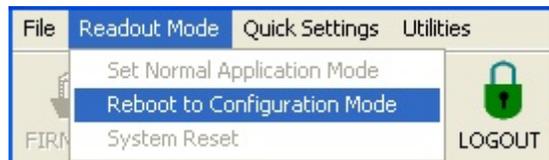


Figure 11 -- Enabling Configuration Mode

7. Click **Configure** to load the Configuration Screen.

9. Click **Edit Calibration/Compensation Records** to add or edit compensation data for local (cabled) targets. The following screen displays.

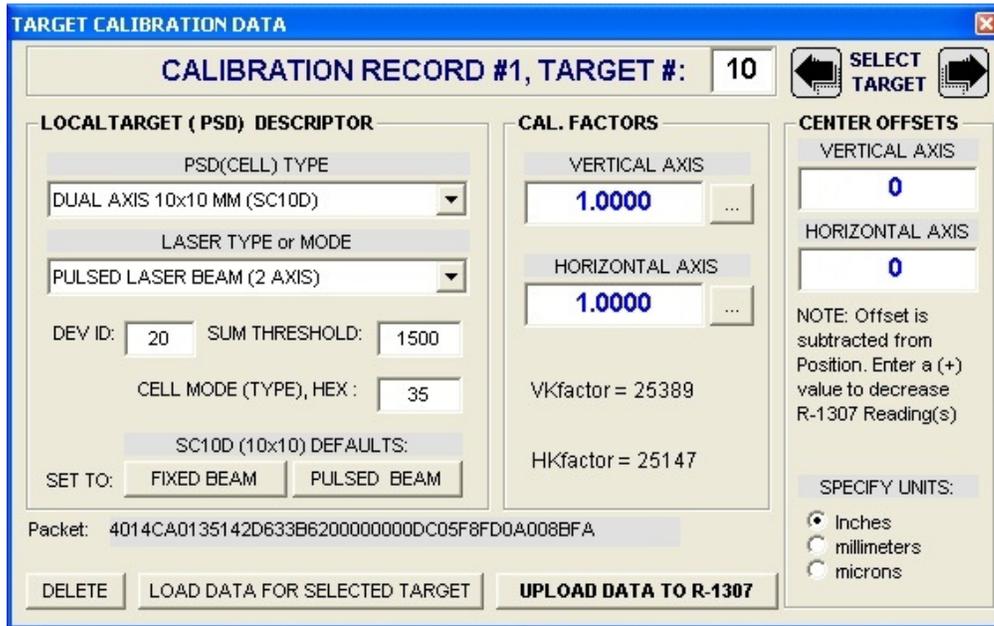
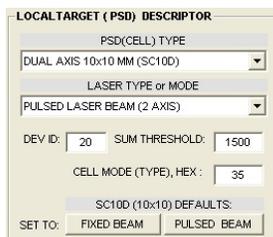


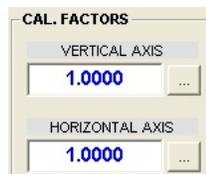
Figure 14 – Target Compensation/Calibration Window

10. **Preparing to Calibrate a Target – Select the Calibration Record and disable compensation.** The R-1307 can store compensation data for up to 8 cabled targets. The compensation data for different targets is stored in separate records numbered 1 through 8.

Select the Record number that you wish to edit, using the **Left** or **Right** arrows.
 Enter the Target number in the box adjacent to the **Left** arrow and set the target number equal to the record number.



The **Local Target (PSD) Descriptor** contains settings that describe the type of Position Sensor (PSD) and the type of laser assigned to the selected record. Default values are shown.



The **Cal. Factors/Gain Adj.** are the gain compensation adjustment factors for the Vertical and Horizontal axes.



The **Center Offsets** are the target center offsets for the Vertical and Horizontal axes.

11. **Preparing to Calibrate a Target - Disable compensation.**
 - Double-click the **Cal. Factors** windows to set the gain values to 1.000 and the **Center Offsets** to zero to disable old calibration values.
 - Click **Upload Data to R-1307** to program the R-1307 Calibration Record. 
12. Close the Calibration Window(s) and exit the Utility. The R-1307 will return to Application Mode (normal display mode). Power down the R-1307 and unplug the USB Cable.

13. **Connect the target to the R-1307.** Power on the R-1307 and select the Target Record as follows:

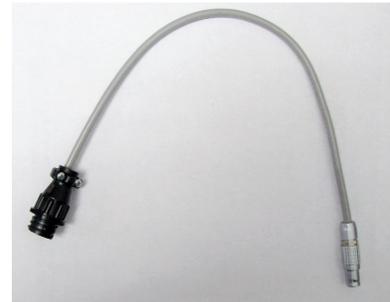
- Click and hold the **Menu** button until the R-1307 displays **dl SP=** in the upper window.
- Use the **Up** and **Down** arrows to set the display mode to **ABS**.
- Continue clicking **Menu** (8X) until **Funct.** displays in the upper window. Use the **Up** and **Down** arrows to change the lower window to **LOCAL**.
- Click **Menu** once more until the Target Record number appears on the upper window. Use the **Up** and **Down** arrows to select the Target Record: **1** for target record #1, **2** for target record #2, etc. Select the target with same record number that you uploaded in Step 8.



Figure 15 – Set the R-1307 Menu to LOCAL

T-231-A21 Adapter Cable

The T-231-A21 Adapter cable provides the ability to connect an older (cabled) target that has a 7-pin Amp connector to the R-1307's 14-pin Lemo connector. Newer targets come with Lemo connectors and older targets can be retrofitted if necessary.



14. Two point Procedure for Calculating the Gain Factors, using a calibrated X/Y Stage

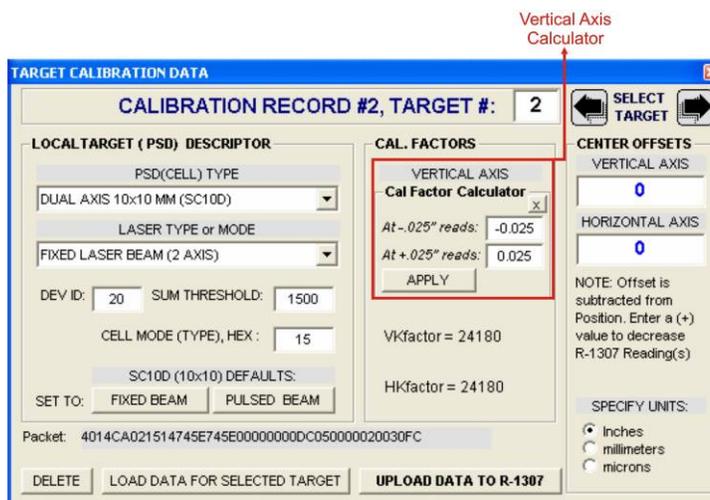
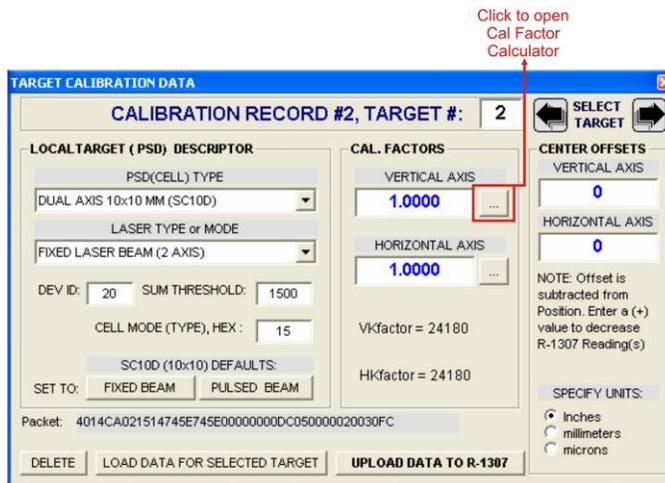
- **Procedure for the Vertical (Y) Axis**
 - a) Translate the target until the R-1307 upper and lower windows display 0.0000 (zero).
 - b) Translate the target up, along the Vertical (Y) axis by a precise distance of +.0250 in. Record the R-1307 Vertical reading (V_P)
 - c) Return the target to zero, described in **Step a**.
 - d) Translate the target down, along the Vertical (Y) axis by a precise distance of -.0250 in. Record the R-1307 Vertical reading (V_N)
 - e) Calculate the Vertical Gain Factor = $[(-.0250 / V_N) + (+.0250 / V_P)] / 2$.
 - f) Record this value. This is the **Vertical Axis** gain value that must be entered into the **Cal. Factors/Gain Adj. Factors** section of the Utility.



Figure 16 – R-1307 shows 0.0000 in the display windows

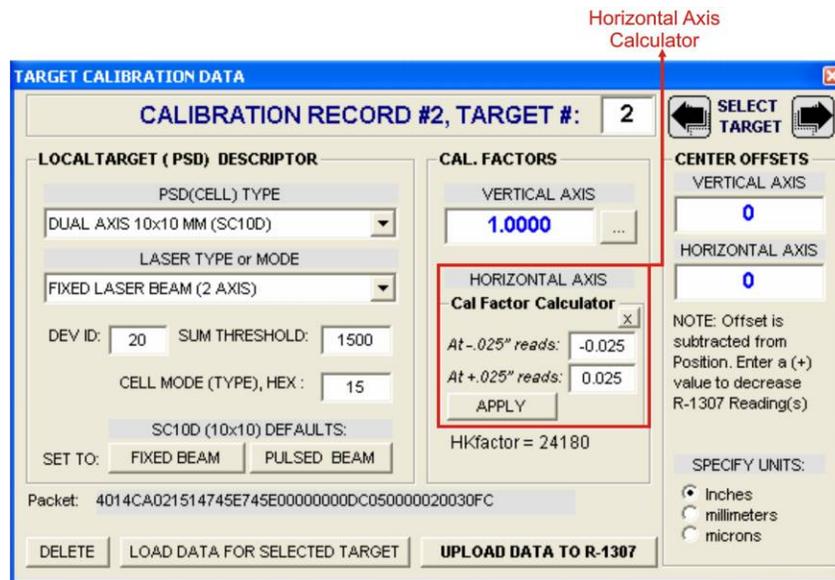


Figure 17 – R-1307 showing Vertical reading of +.0250 in.



Procedure for the Horizontal (X) Axis.

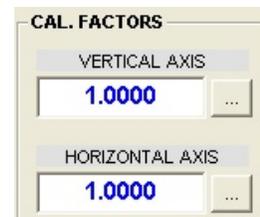
- a) Translate the target until the R-1307 upper and lower windows display .0000 (zero).
- b) Translate the target to the right, along the Horizontal (X) axis, by a precise distance of +.0250 in. Record the R-1307 Horizontal reading (H_p)
- c) Return the target to zero, described in **Step a**.
- d) Translate the target to the left, along the Horizontal(X) axis by a precise distance of -.0250 in. Record the R-1307 Horizontal reading (H_N)
- e) Calculate the Horizontal Gain Factor = $[(-.0250 / H_N) + (+.0250 / H_p)] / 2$
Record this value. This is the **Horizontal Axis** gain value that must be entered into the **Cal. Factors/Gain Adj. Factors** section of the Utility.



14. **Programming the Gain Factors:** Power down the R-1307. Disconnect the target and re-connect the USB cable from the R-1307 to the computer. Turn the power back on and run the R-1307 Configuration Utility. Follow steps 5-7 to re-enter the **Target Calibration** window.



Select the target record and enter the Gain Values obtained in Step 10. Click **Upload Data to R-1307** to program the R-1307 Calibration Record with the new values.



15. The Center Offsets: Hamar Laser targets are typically mounted by a rear stud. The target position sensor concentricity is aligned (or compensated with offsets) so that the R-1307 will read zero when the laser beam intercepts the center of the mounting stud at the mounting surface.
16. The targets are checked for concentricity using a fixture that allows for the precise rotation of the target about the center of the mounting stud. In its simplest form, the fixture consists of a plate with a precision hole that matches the diameter of the target stud, with a maximum clearance of .0002 in. The laser is mounted so that the beam is perpendicular to the plate within 0.0005 in/ft or better, and concentric to the hole within .001 in. or better.

Programming Options for the R-1307

All menu options for the R-1307 may be enabled (default) or suppressed (hidden), which causes the readout to operate in simple mode.

R-1307 Menu Enable Map (0 = Enable, 1 = Suppress Menu)

Field #	Flag Value (2 ^{^(Fields # - 1)})	Menu Item	Default Value	
1	1	Rel/Abs	Absolute	
2	2	Units	Inches	
3	4	Averaging	8	
4	8	Resolution	0.0001	
5	16	Target 1 ID	1	
6	32	Target 2 ID	9	
7	64	Channel	8	
8	128	Brightness	3	
9	256	Mode	Local	
10	512	PSD Number	0	
11	1024	RelZero	Target	
16	65536	<i>Simple Mode</i>	0	If =1, Up/Down keys select Min/Max averaging. LEDs change also.

L-705/L-706 Laser Centering

Laser Centering requires an angle-sensing target (T-261), Hamar Laser's Read8 software, and an R-358 Readout.

1. Mount the laser in its fixture. The laser should be set to the **Nominal** settings (Figure 18).
2. Power on the laser and allow it to warm up for 15 minutes.
3. Place the test target (T-261) in mounting fixture (P-403). See Figure 19.

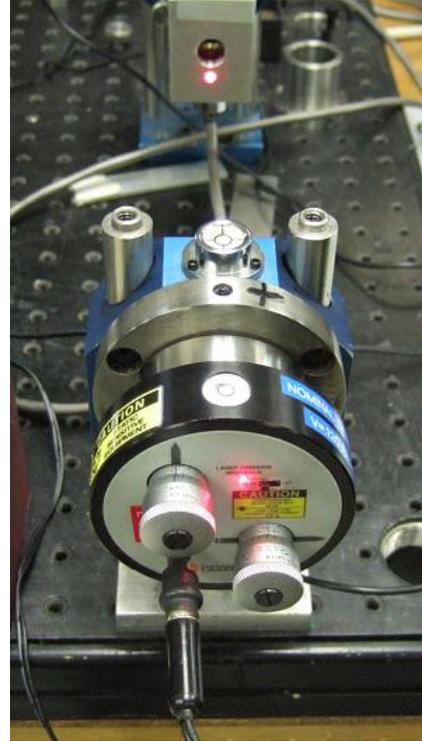


Figure 18 – Step 1: Mount the L-705 Laser

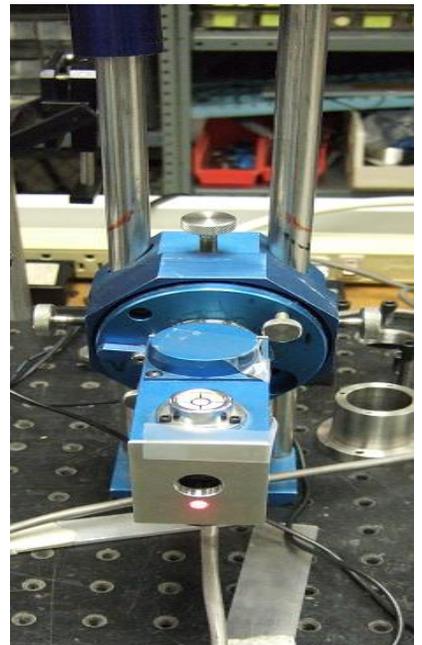


Figure 19 – Step 3: Target in P-403 Mounting Fixture

4. Coarse align the laser beam to the target (see Figure 20).
5. Invert the laser 180 degrees (see Figure 21).
6. Using the Offset screen of the Read8 software, select **Quality Laser**. Click **Restart** to clear any previous recorded data.
7. **Invert laser** should be highlighted in blue. Adjust the raw numbers so they are less than .010 by adjusting the P-403 mounting fixture. Click **Record Offset Data**.

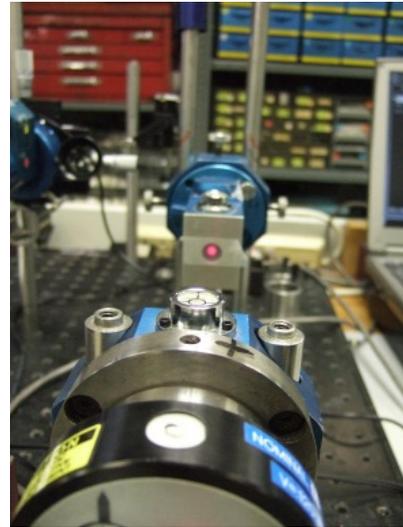


Figure 20 – Coarse align beam to target

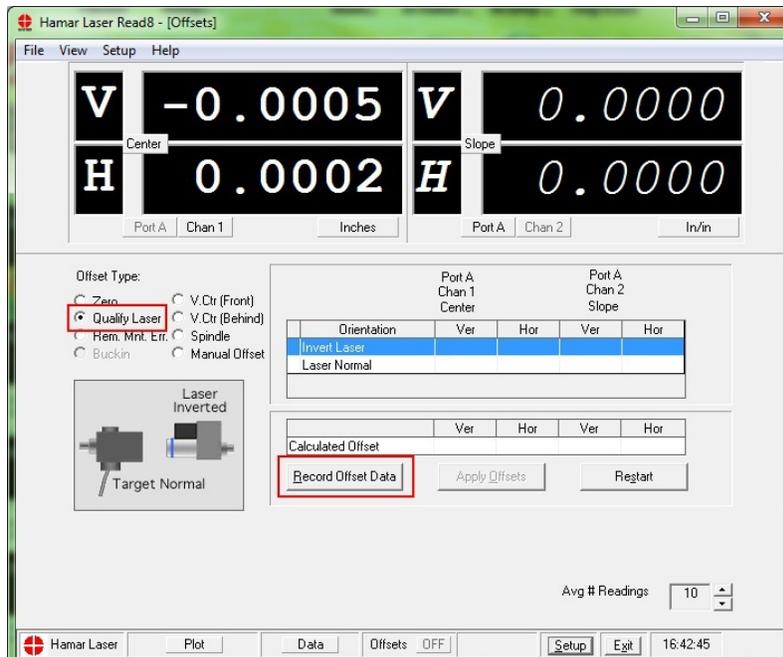


Figure 22 – Read8 Offset Screen Recording L-705 offset data



Figure 21 – Invert L-705 Laser 180 degrees

8. Invert the laser to the normal position and record Offset Data readings again.
9. Trim out any angular errors using the laser micrometers (readings should read zero).
10. Record numbers to indicate centering error (errors should be below .0005 in.).



Figure 23 – Use laser micrometers to trim out angular errors