Application Note

Machine Tool Alignment

Multiturn Machining Centers
Parts 2&3- Main Spindle to Sub-Spindle
B-Axis Parallelism

System Recommendations:
L-702SP 5-Axis Machine Tool Alignment System

How it Works –Part 2 - Checking Main Spindle (C1) to Sub-Spindle (C2) Alignment

After checking the machining axes of the multiturn, we need to now focus on the main spindle alignment (C1) to the sub-spindle (C2) in 4 axes. Here is a procedure to get that data and to align them if necessary.

1. MultiTurn10 Step 1 - Project Setup

Select the tolerance for the alignment:

- **Sub-Spindle (C2) – Center** – this is the allowable centering error between the C1 spindle and the C2 spindle.
- **Sub-Spindle (C2) – Angular** – this is the allowable angular error between the C1 spindle and the C2 spindle.

Enter the dimensions between the mounting bolts and the target location so MultiTurn10 can calculate shim values.

Note: *Entering dimension is not needed for the alignment data but only if adjusting the spindle head is needed. Otherwise, entering this can be skipped.*

2. Go to Step 5: Record Sub-Spindle/ Turret Rotation Axis Data

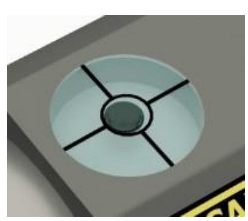
Go to **Step 5** to record the rotation axis data of the 2 spindles. You will need to take a total of 6 data points, 3 for center and 3 for angle. Start with the Center.

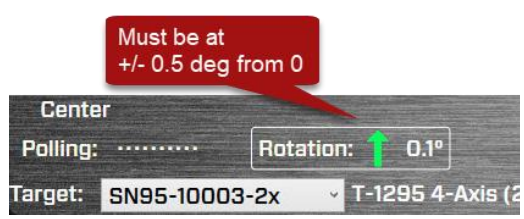
Note: *when taking data in Step 5, you must always turn the spindle and the target* *<u>together</u>* *to ensure you are measuring the rotation axis and not the center of the chuck's jaws.*

First, make sure the T-1295/1296 Target is in the NORMal position (± 0.5 deg from 0).

Next, rotate the C1 spindle+laser to the inverted position (A/C Adapter plug facing you), level the bullseye level and hit **Record**.

L-702 A/C Adapter Connector





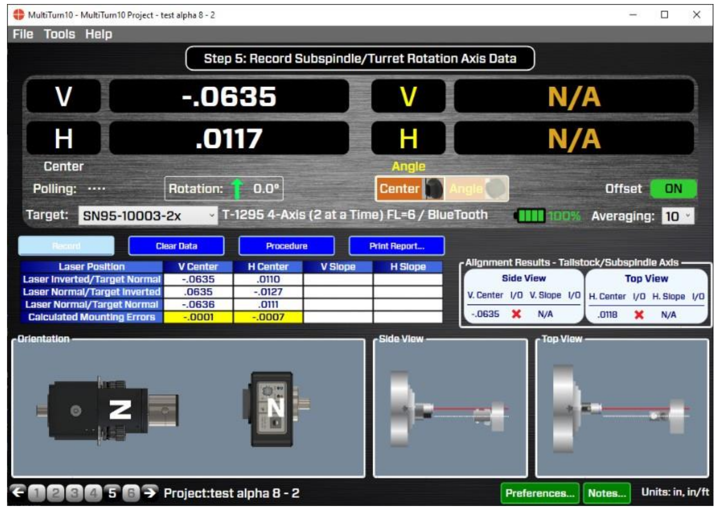
3. Rotate the Laser Back to NORMal and Rotate Target to INverted Position

Rotate the laser back to the NORMal position (L-702 Switch Panel facing you) and level it.

L-702 Switch Panel

Rotate the C2 spindle+T-1295/1296 to the INverted position watching the rotation axis sensor and stopping to be within ±0.5 deg. of 180 deg.

Click **Record**. The data for the Center parameters has been taken.



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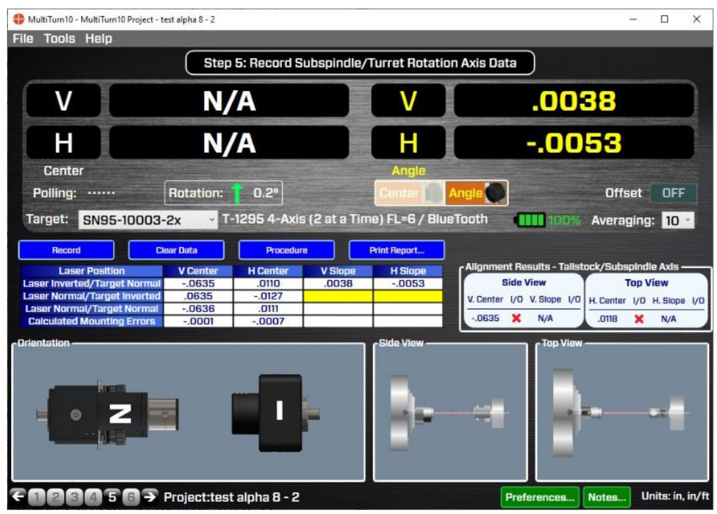
4. Insert Lens, Switch to Angle Mode and Record First Point

The center values are recorded, now record the angular values. First, insert the lens into the target and switch the display to **Angle Mode**. The H & V angular values will display in the right-hand displays with yellow numbers.

Note: make sure the target type selected matches the lens. "FL=3" is the 3 in. (76 mm) lens.

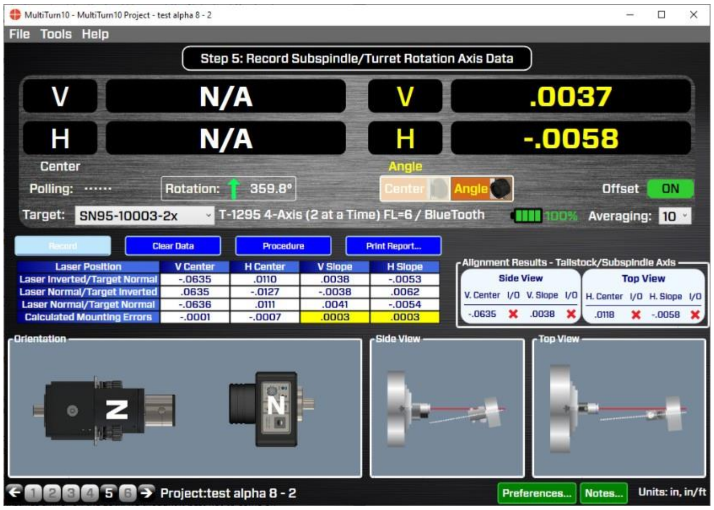
Invert the Laser/Spindle, make sure the bubble is leveled, make sure the Target Rotation indicator is at 0 deg., and hit **Record**.



5. Rotate Laser to NORMal positon and Target/C2 Spindle to INverted position.

Rotate Laser+C1 Spindle to NORMal positon and Target+C2 Spindle to INverted position, making sure the Rotation indicator is set to 180 degrees and the laser bubble level is leveled. Hit **Record**.

Rotate the target back to 0 degrees and hit **Record** again.



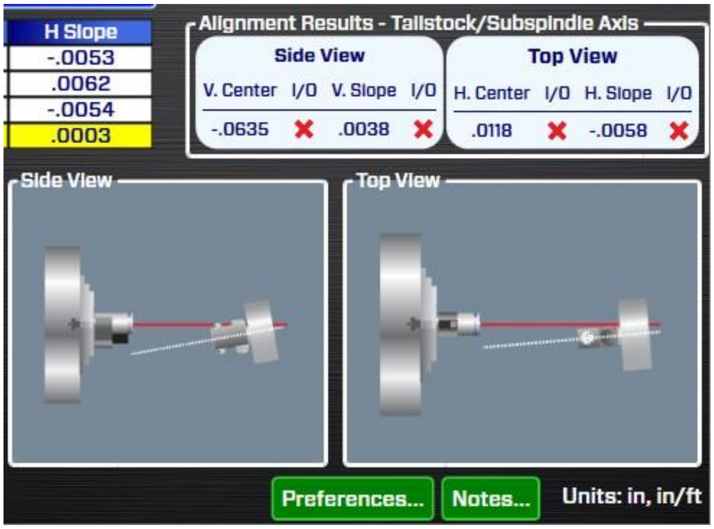
6. View Results

The data has now been taken and MultiTurn10 calculates mounting errors and subtracts them from the data to produce the alignment Results, which are displayed in the **Alignment Results – Tailstock/Sub-spindle Axis** – area. It also indicates if the results are in or out of tolerance by a red X (out) or green check mark (in).

Below the Alignment Results are graphics that illustrate the 4 alignment parameters:

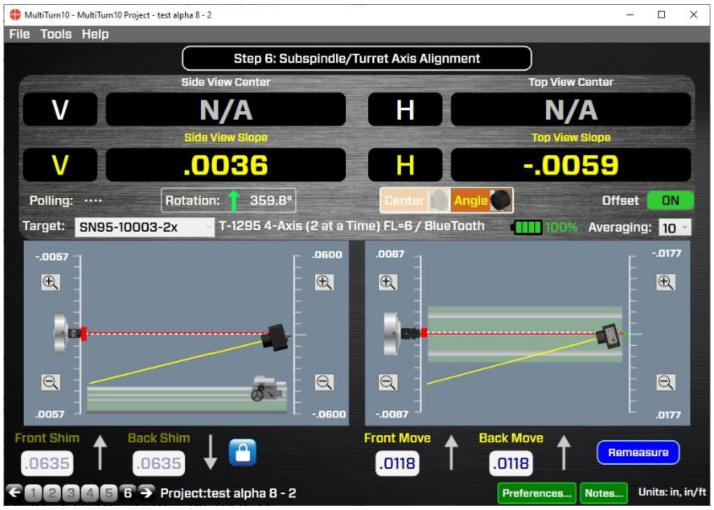
V Center (offset)
V Slope (angle)
H Center (offset)
H Slope (angle)

In the example to the right, the C2 spindle rotation axis is below the C1 spindle and tilted down. It is also to the right of C1 rotation axis and pointed to the left.



7. Step 6: Sub-Spindle/Turret Rotation Axis Data Move Screen

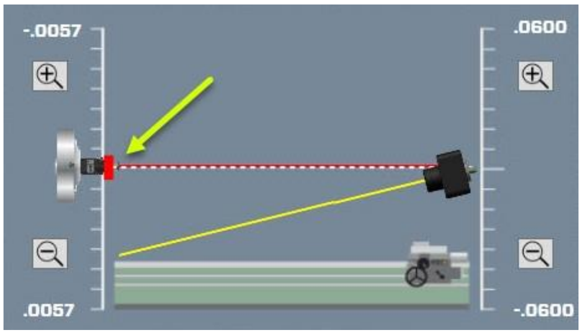
If the alignment values are out of tolerance and they need to be re-aligned, then hit the “Next” button (right arrow) or the “6” at the bottom of the screen to go to the Sub-**Spindle/Turret Rotation Axis Data Move Screen**, where you have on-screen graphics showing the alignment and which way the C2 rotation axis is tilted or offset from the C1 rotation axis.



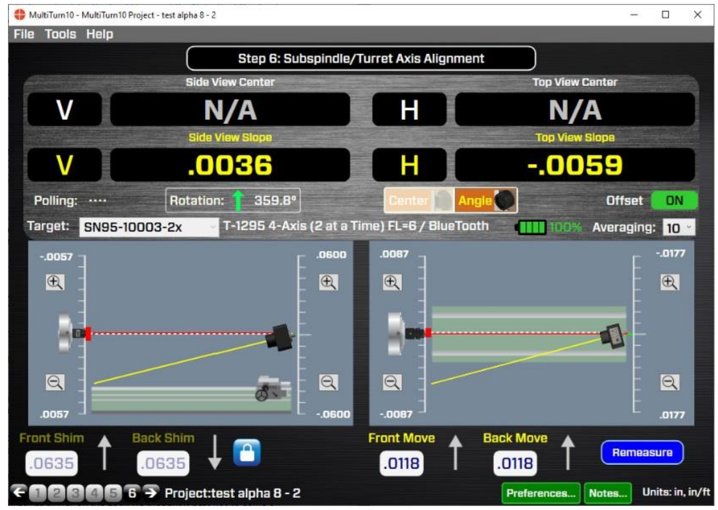
8. Fix Angular Errors First

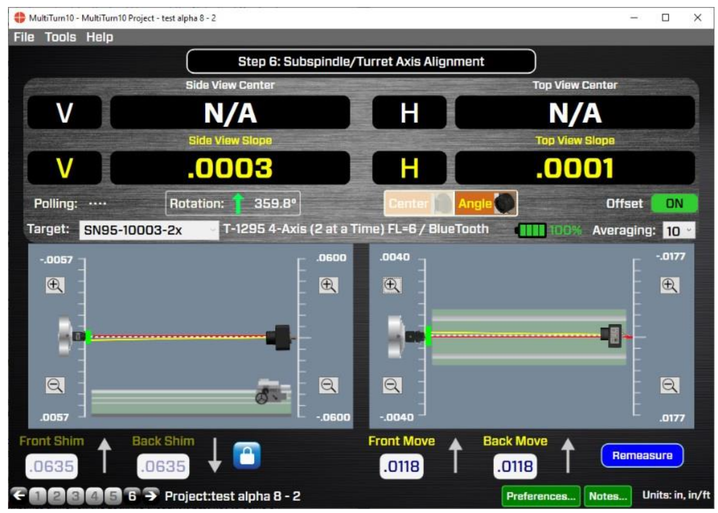
The program should still be in Angular Mode (and the lens still attached) when switching to Step 6. Start by fixing the angular errors. The values update in real time, as do the on-screen graphics. The target icon and yellow sloping line will move as the angle is adjusted.

There is a red vertical line on the *left* scale that represents the tolerance band for the angular error.



When the value gets within tolerance, the tolerance line turns green.

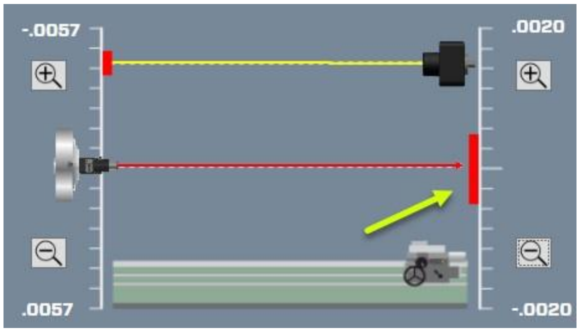




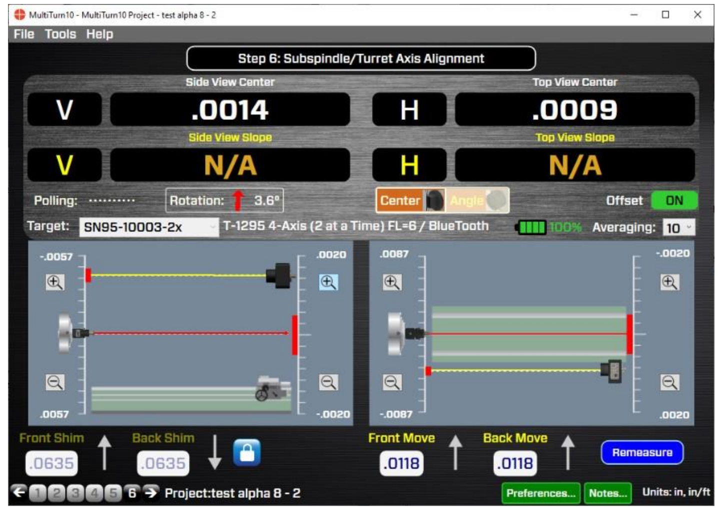
9. Fix Center Values

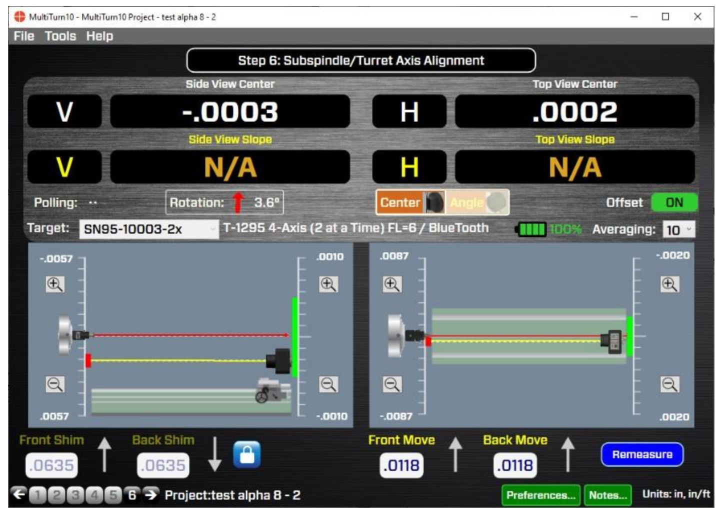
With the Angular parameters being aligned, switch the display to Center Mode by removing the lens and hitting the Center/Angle button. The values will show up in the upper displays and will be white.

There is a red vertical line on the *right* scale that represents the tolerance band for the angular error.



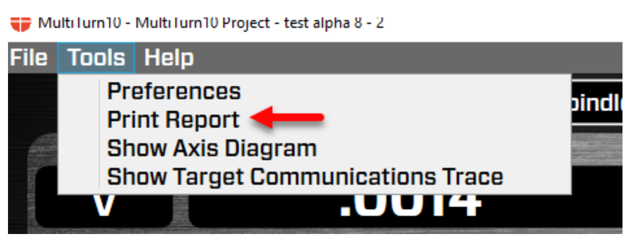
When the value gets within tolerance, the tolerance line turns green





10. Print Report

From the Tools menu, click on Print Report to get a detailed report on the alignment parameters.

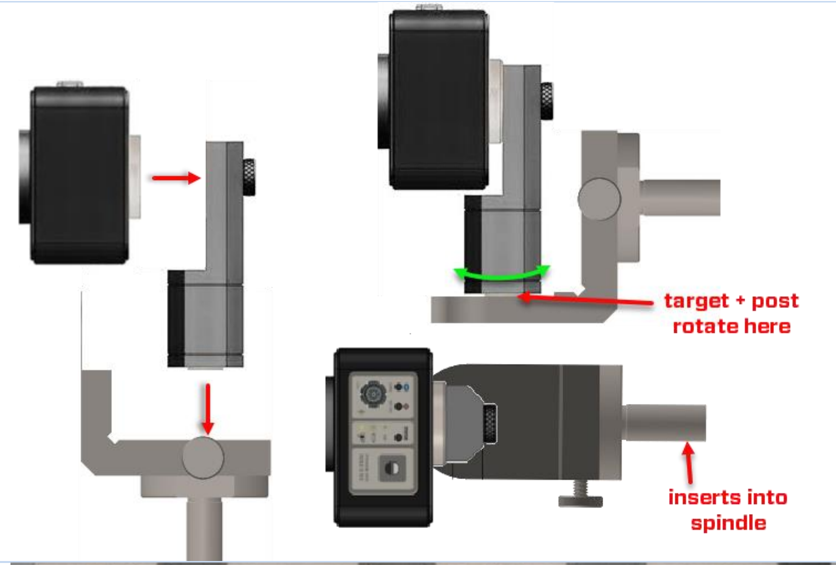


How it Works - Part 3 –B-Axis Rotation Axis Parallelism to C1

After checking the main spindle alignment (C1) to the sub-spindle (C2), we can now focus our attention on the B Axis rotation parallelism to the main spindle (C1). Here is a procedure to check that parallelism.

1. Install Target into Spindle

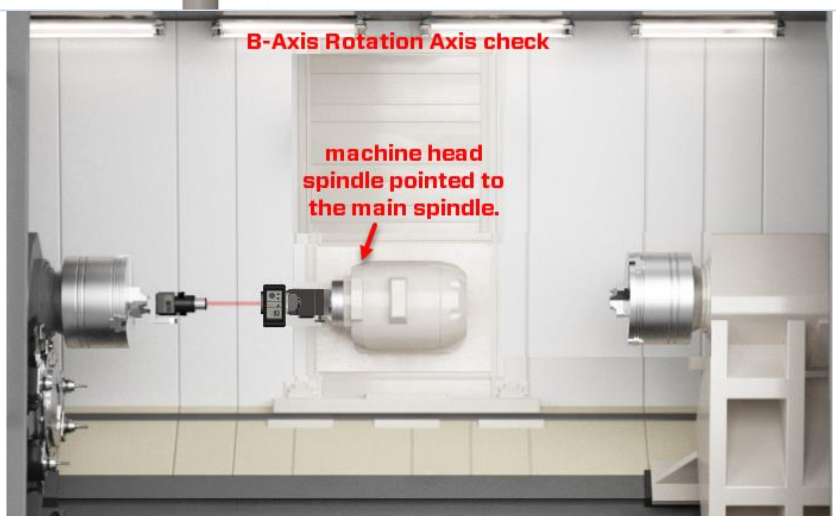
Install the T-1295 target into the T-243 Target Base and install that into the L-702RA Spindle Fixture as shown to the right. The top of the target should be pointing toward the user standing in front of the machine.

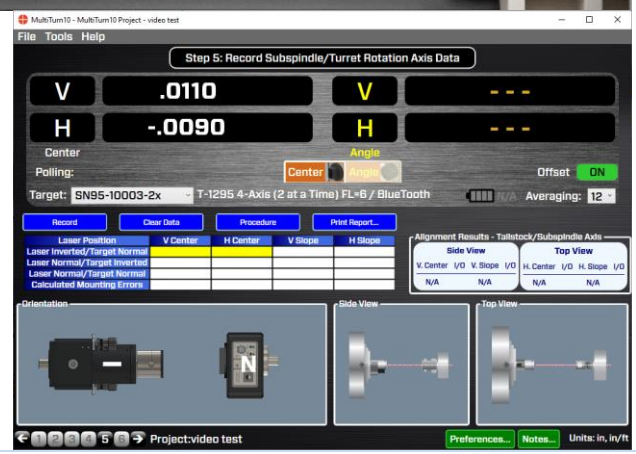


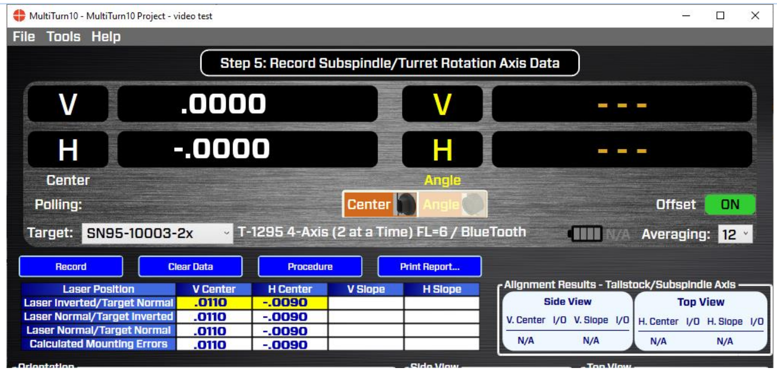
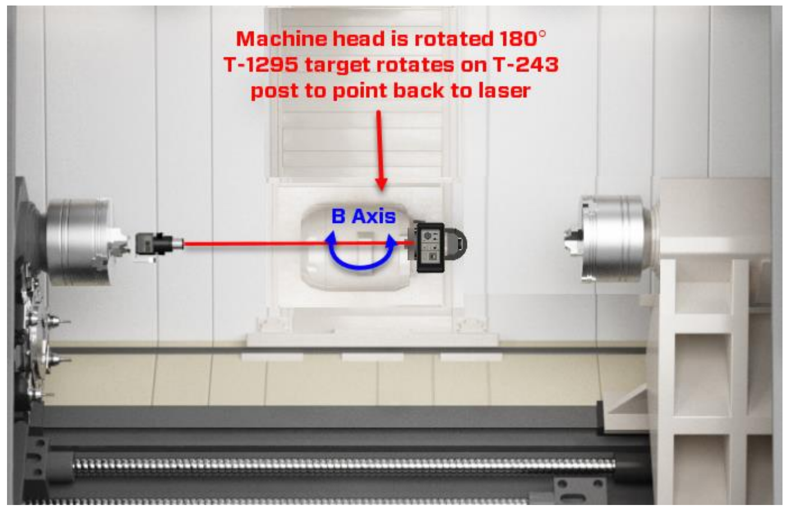
2. Move Machine Head Near C1 & Laser.

Move the machining head so the T-1295 target is in line with the laser. Use the V & H center values in Step 5 to help position the machine head using the T-1295. You will want the values to be roughly:

- V Center: ±.010 (±0.25 mm)
- H Center: ±.010 (±0.25 mm)





3. Zero Out Target Using Step 5, we'll hit **Record** 3 times without doing any spindle rotations, which zeroes the display.	
4. Rotate Machine Head 180° about B Axis Now rotate the B Axis 180° so the spindle is pointed at C2. Then rotate the T-1295 Target head back 180° so it's pointed towards the laser.	

5. Check the V Center Value

The V center value deviation from zero is the measure of the parallelism of the B axis to C1.

Measure the distance between the 2 target locations and divide the V center value by this distance to get the angular parallelism value.

For example, if the V center deviation is +.0009 and the distance (D – see image) between the 2 points is 24 in, then this means the parallelism error is +.00045 in/ft.

A + value means the B Axis moved away from the C1 axis toward the front of the machine as it rotated 180°. A – value means it moved closer to the back wall.