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# L-110 SCANNER FOR L-711 LASER INSTRUCTION MANUAL

## INTRODUCTION

The Model L-110 Scanner was specifically designed as a retrofit for a L-711 Laser in scan operations. It generates an extremely accurate continuous flat plane, used as a reference to check flatness and levelness to earth. The L-110 Scanner can also be used to continuously monitor the flatness of a machine slide, table or spindle.

The scanner adds to the basic L-711 system by providing the option of using multiple targets and the ability to monitor machine movement.

## Principles of Operation

The vertical beam from the L-711 Laser is bent at a precise 90° angle through the L-110 prism unit. The motor-driven prism unit sweeps continuously, forming a flat plane with the laser beam, accurate to better than one-thousandth of an inch anywhere within a fifty-foot diameter circle.

The motor that drives the rotating penta prism is driven at a variable rate to reduce the effect of laser mounting vibration and/or harmonic errors on the accuracy of the reading.

# SET-UP

## Center Beam in L-711 Turret

For accurate sweep work, the beam must be exactly centered on the turret axis of rotation. Any error in centering will produce twice that error in the flatness of the plane.

Place the laser as shown in Figure 4A (see Page 2-4 of the L-711 Instruction Manual) with the long axis level in the front of the laser and the short axis level to the left.

Turn the turret so that the coarse and fine azimuth adjustments on the turret are pointing approximately at the 10 o'clock position.

A small index screw, located on the side of the turret, will then be facing forward and should be lined up at 6 o'clock directly over the middle of the long axis level.

Flip the prism out of the way and flip the target element into position, making sure it is seated properly.

Connect the special cable to the connector on the top of the turret and to the readout unit. (The special cable is a 6' long cable with the same connectors on each end. There is only one cable like this in the system.)

The readout should be set in the fast response and the .0001 scale positions.

Again referring to Figure 4A in the 711 manual, there are two holes located on the left side of the laser unit. Inside each hole is a socket head set screw adjustment. Using the 3/32" allen wrench, adjust first the horizontal and then the vertical adjustments (see Figure 4A for location) until the readout reads .0000 in each axis.

Rotate the turret 180° so that the index screw that was located at 6 o'clock is now located at 12 o'clock.

Check the readings in both axes.

If the readings are any number other than 0, adjust the centering so that half the number displayed on the readout is removed using the appropriate adjustments on the side of the laser. (The upper adjustment affects the vertical axis on the readout, and the lower affects the horizontal).

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For instance, having zeroed both axes in the 6 o'clock position, you would read in the 12 o'clock position the following:

Vertical +.0002  
Horizontal -.0002

You would then adjust the laser so the readout reads as follows:

Vertical +.0001  
Horizontal -.0001

If this has been done correctly, when the turret is rotated back to the 6 o'clock position the meters should continue to read:

Vertical +.0001  
Horizontal -.0001

If the readings change, continue the procedure until readings in the 6 o'clock and the 12 o'clock positions have the SAME NUMBER and SAME SIGN. When this has been done the beam will be perfectly centered on the turret axis of rotation.

## Centering the Beam on the L-110 Spindle

The axis of rotation of the L-110 scanner is adjusted at the factory to be coincident with the main turret axis of rotation. The procedure described above will center both axes of rotation on the laser beam. In time, or with rough handling, the L-110 axis may become decentered relative to that of the main 711 turret axis. A special procedure for making them coincident again is described in appendix I. Below is an emergency procedure which may be used to finish a job in the field.

When the L-110 scanner axis is known to be misaligned, a simple field procedure will allow full use of the scanner. It can be realigned later in the calibration lab. To align the laser beam to the L-110 scanner axis, simply remove the prism module, substitute the T-212 target and the special adaptor, and proceed as above. You will be aligning the laser beam to the L-110 instead of the main 711 turret.

**If you follow this procedure, do not rotate the main L-711 turret without recentering!!**

# INSTRUCTIONS FOR USE

When using the L-711 with the L-110, all the set-ups and buck-in procedures are the same as with the standard L-711.

If multiple targets will be used, each target must first be adjusted to read zero vertically at one common location point on the machine table (next to the laser is recommended). Now these targets can be placed where desired on the table, and multiple flatness readings are obtained simultaneously.

## Bucking in with the L-110

Bucking the scan laser plane into a flat surface or making it parallel to that surface is very easy. The following paragraph describes the procedure. The bold headlines give the basics. Each headline is followed by a more detailed explanation. Read the detail only if you are unsure what the headlines mean.

### **[1] Place laser in proper position**

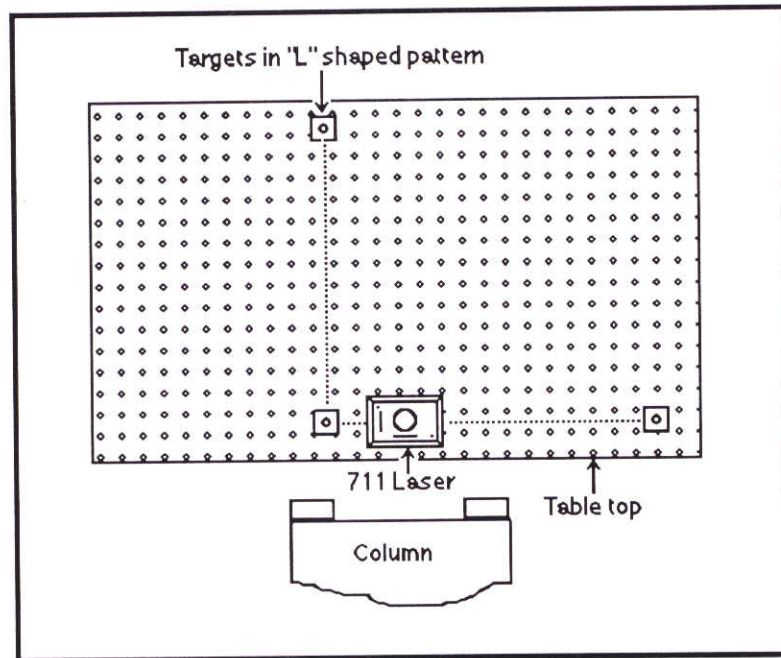
Place the laser in any position that will allow as many other observations as needed without moving the laser. For instance, if column squareness is going to be measured, place the laser under the column quill so the vertical beam will be in proper position. Rotate the laser so that the "long" axis of the laser is parallel to one side of the table. Lock the magnets!! (Remember, always level the laser as a first step, even if bucking into a surface. This will get the laser plane close to parallel with the table top and save time.)

### **[2] Set three targets to the same elevation**

Mark a magnet "footprint" near the laser. Place each of the three targets in the footprint and "zero" each with its own micrometer and readout.

### **[3] Place the targets on the surface in an "L" shaped pattern**

Place the three target in an "L" shaped pattern as shown in the following figure. The "L" shaped pattern should be parallel to the laser. This makes the the adjustments very easy to do and understand.



**[4] Tilt short axis of laser to obtain same reading on two targets**  
 Turn the short axis laser adjustments so the the target in the corner of the "L" and the target on a line from the corner parallel to the short axis both read the same amount. As you adjust, see if the two readings will converge or get closer together as you adjust the laser. If they separate, reverse direction of the adjustment and keep going until both readings are the same.

**[5] Tilt long axis of laser to obtain same reading on two targets.**  
 Turn the long axis laser adjustments until the readings on the corner target and the other target read the same. Readjust the short axis, if needed, to make all the readings the same.

**[6] Rezero three targets as before if final readings exceed .025"**  
 If the three readings agree and exceed .025", it would be wise to rezero the three targets as in [2] above and repeat the process.

**Shortcut:** If the three identical readings are substantially less than .025" and you plan to look at relative motion of a table or slide, then simply rezero all three targets in place and proceed with the measurement.

**[7] Repeat steps 3-5 if needed**

Repeat steps 3-5 to further refine your buckin if you need it exactly parallel to the table top.

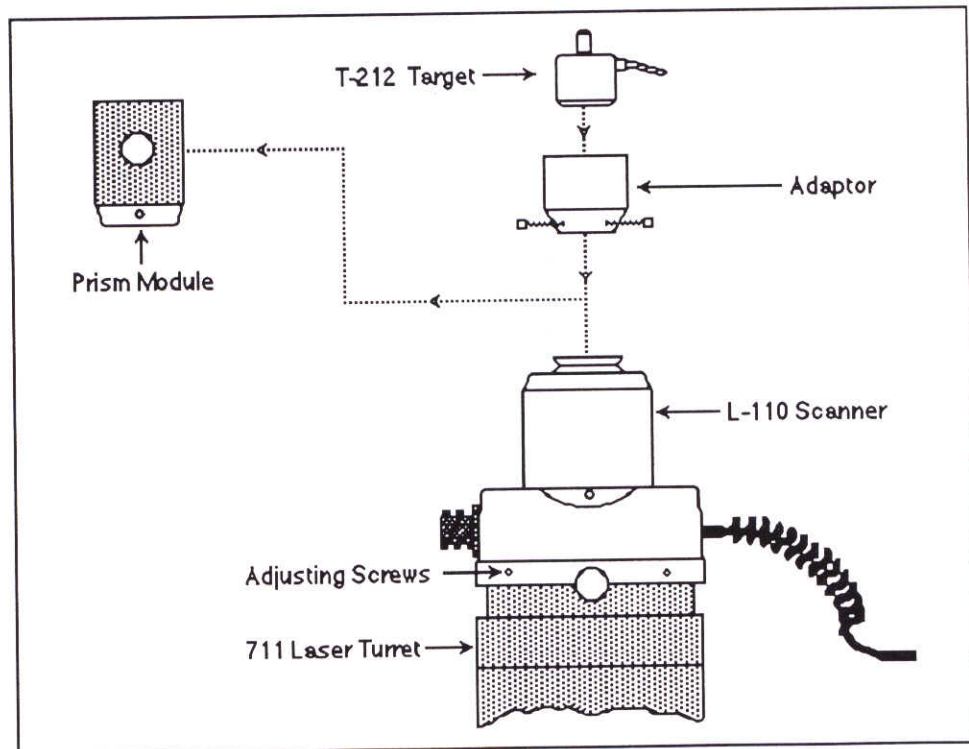
**[8] The laser plane is now parallel to the table top!**

The laser plane is now parallel to the table top as defined by the three points. These may not be the "right" points, but you cannot know this until after you have measured the table top. The three points are picked for our convenience in adjusting the laser.

## Recentering the L-110 on the 711

### Introduction

The L-110 scanner head is usually installed at the factory. It is adjusted for proper operation. The main adjustment, which can be redone in the field, is the centering of the scanner axis of rotation on the laser beam. This is a two-part process. First, the laser beam must be centered on the axis of rotation of the main 711 turret. Second, the L-110 scanner axis is then adjusted to center its axis on the laser beam. This appendix describes how to do this centering. The figure below shows the set-up required to recenter the L-110 scanner head.



**[1] Center the laser beam on the turret axis of rotation**

The laser must be centered on the turret axis first! Follow the procedure described above in the main section of this manual.

**[2] Remove penta prism**

Remove the penta prism module by loosening the three radial SHSS located in the base of the prism module. (Use the 3/32" allen wrench.)

**[3] Install adaptor in place of prism**

Install the adaptor in place of the prism module, tightening the three screws to secure it in place.

**[4] Install target in adaptor**

Install the target in the adaptor, tighten the locking screw, and rotate the assembly so that the cable is exactly over the long axis of the laser. Tape the assembly so it cannot rotate.

**[5] Take normal and inverted readings**

Take both normal (6 o'clock wire) and inverted (12 o'clock wire) readings. Calculate set point as follows:  $(\text{normal} + \text{inverted})/2$ .

**[6] Adjust L-110 to center**

Adjust the L-110 using the radial side screws so the target reads the set point when the target is in the normal position (6 o'clock wire). Lock the L-110 down with the axial screws located on the top.

**[7] +Check for proper center**

Rotate the assembly to the inverted position (12 o'clock wire) and look for same numbers, same sign. If they are the same within your desired tolerance, then the L-110 is aligned.