



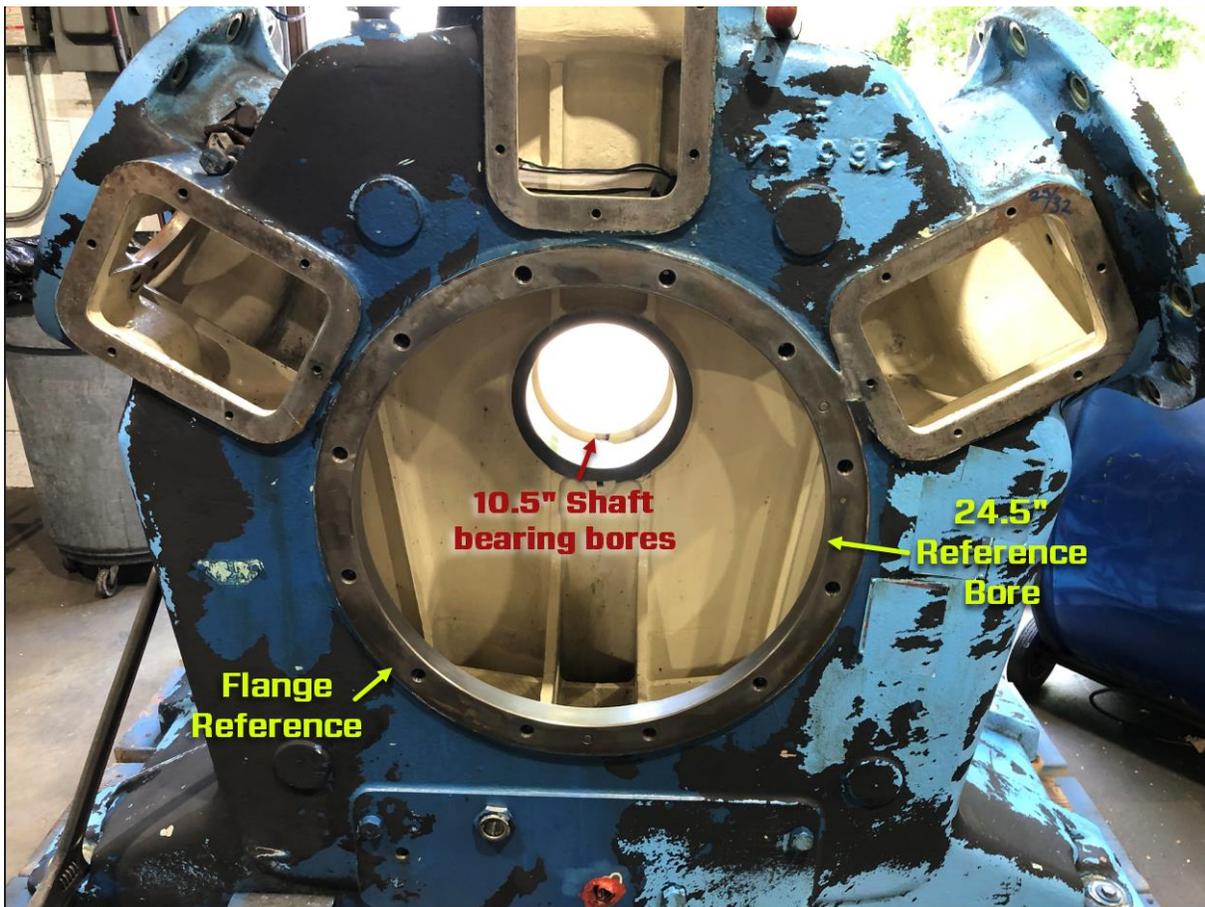
## Using Hamar's L-702SP on Compressors

After a customer presented Hi-Tech Compressor and Pump Products with a challenging compressor frame reconditioning assignment, they worked with Hamar Laser Instruments to develop the procedures to check the large multi-throw compressor frames (Part 1) and align their shaft-bearing bores to a boring mill (Part 2) for re-machining. Hi-Tech used Hamar Laser's versatile L-702SP Scan Laser with Plumb Beam, along with Hamar's laser self-centering targets, beam translator, bore adapters and readout. (See case study "Fair and Square.") Here's how they did it.

### Part 1:

### How to Check Bore Squareness and Concentricity on Compressors

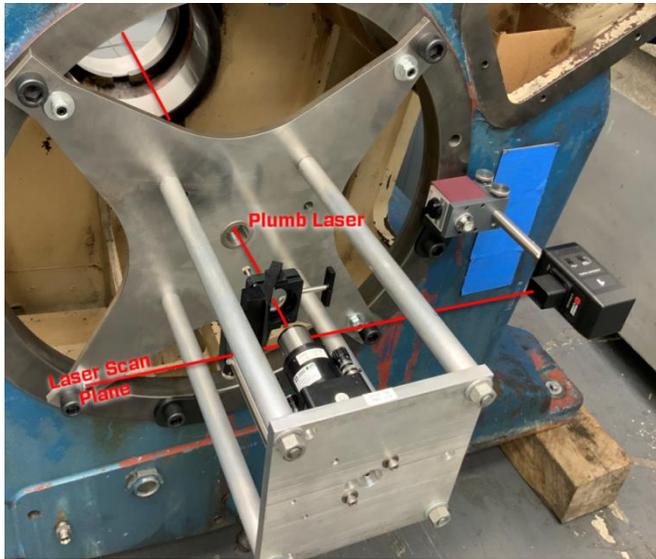
The compressor frame has a large 24.5 in. (622 mm) bore with an outside flange and two 10.5 in. (268 mm) shaft-bearing bores that are 36 in. (914 mm) away that must be square to the flange face and concentric to the large bore to less than .0015 in. (0.038 mm). (See photo, below.)



*View of Compressor Frame Showing 24.5 in. Reference Bore and Two 10.5 in. Shaft-Bearing Bores*

## Setting Up the L-702SP with a Simple Fixture

Hamar's L-702SP has a rotating laser plane with a plumb beam that is perpendicular to the plane. This allows the laser plane to be aligned to the compressor's main bore flange so the plumb laser beam is then perpendicular to the flange. After that, all that was needed was to center the plumb beam to the main bore and then measure the bearing bores for concentricity and squareness.

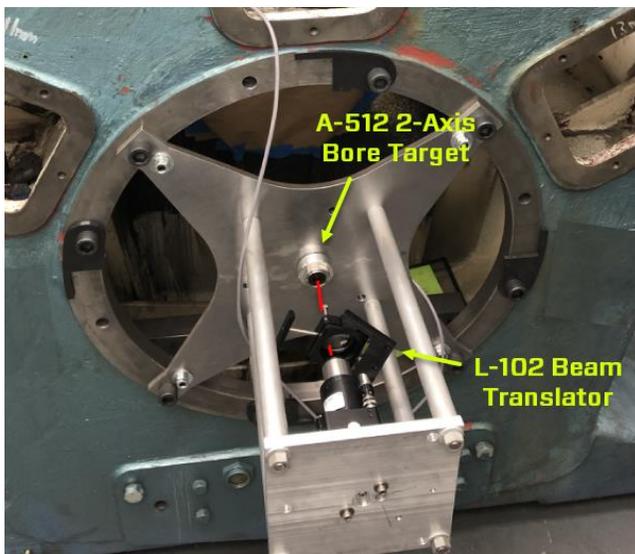


*Figure 1 - L-702SP Mounted in Fixture*

laser plane parallel to those 3 points, which then means the plumb beam is perpendicular to the flange. We used 3D printed plastic target-mounting guides to insure target repeatability.

### Centering the L-702SP's Plumb Beam to the Reference Bore

To center the L-702SP's plumb beam to the 24.5 in. bore center, the fixture's central bore had to be centered

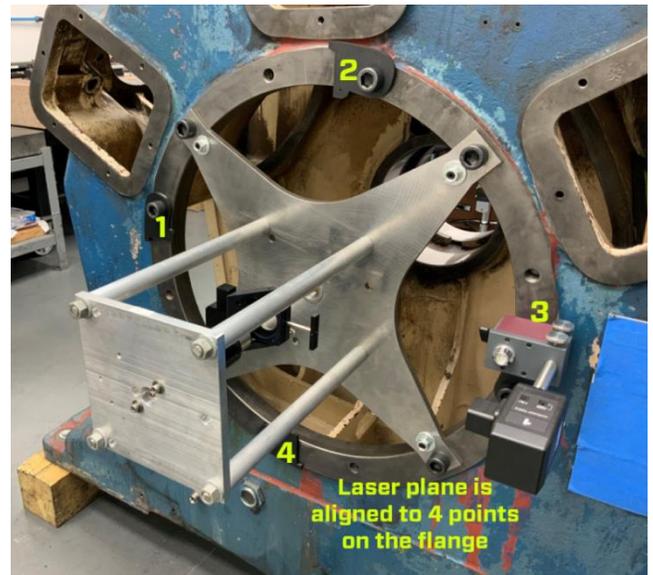


*Figure 3 - L-702SP Setup with A-512 2-Axis Target*

To make this work, a simple fixture was needed to hold the L-702SP nearly on center of the 24.5 in. (622 mm) bore but offset away to allow clearance for the laser (figure 1). The center of the fixture has a 1.2495 in. (31.737 mm) mounting hole for Hamar's A-512 2-Axis Bore Target. The fixture has centering adjustment so that it could be centered to the bore using an indicator to .0005 in. (0.012 mm).

### Aligning the Laser Scan Plane to the Flange

With the fixture all set up, the next step was to align ("buck-in") the laser's scan plane to 3 of the 4 points on the bore flange (1, 2, 3 & 4 in figure 2) using the A-1519-2.4ZB Scan Target. By moving the target between the points and tilting the laser plane, you can make the



*Figure 2 - Laser Scan Plane Reference Points*

to the main bore using an indicator. With that done, Hamar's A-512 2-Axis Bore Target was placed in the center of the fixture and Hamar's L-102 Beam Translator was used to center the beam to the A-512 Target (figure 3). The L-102 translates the beam's position in 2 axes without changing the angle.

Now the laser beam is centered to the 24.5 in. (622 mm) bore and perpendicular to its face, and is ready to measure the shaft bearing bores for concentricity and perpendicularity.

## Checking the Compressor's Bearing Bores for Concentricity and Squareness

With the laser setup square and on center to the main bore, the A-512 Target was removed from the fixture allowing the laser beam to pass through to the shaft bearing bores, where the concentricity is measured by using the A-512 2-Axis Target and A-514B Self-Centering Bore Adapters.

Hamar's A-514 Self-Centering Bore Adapters are adjustable so they need to be set to the nominal bore ID by using a leg-setting fixture. Once that is done they are assembled together and inserted into the bore to determine the concentricity (figures 4 & 5).

### How the A-512/A-514 Self-Centering Bore Adapters Work

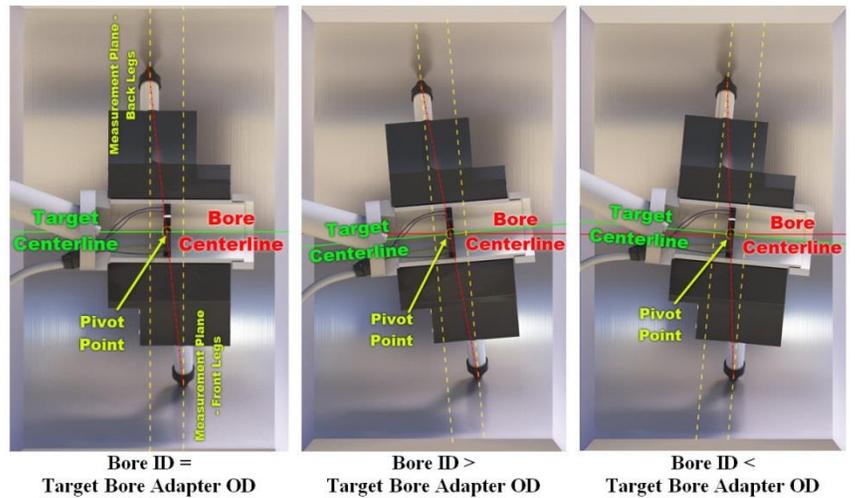


Figure 4 - A-512 2-Axis Target with A-514 Self-Centering Bore Adapters

Since Hamar's A-512 Target automatically finds the center of the bore, there is no need to rotate the adapter 180 degrees. The reading generated by the target is therefore a measure of the concentricity of the bearing bore to the large reference bore, as well as how *square* the bores are relative to the face of the reference bore.



Figure 5 - A-512 Target & A-514B Adapter Inserted into Shaft Bearing Bore



Figure 6 - A-512 Target/Adapter with R-1307 2-Axis Readout

For the initial checks of the compressor frame at Hi-Tech, as shown on Hamar's R-1307 Readout the results were that the bore was perfect horizontally at .0000 in. but vertically was low by -.0027 in., which was out of the customer's .0015 in. specification (figure 6).

To measure the angle of the bearing bore to the centerline, the A-512/514 can be moved deeper into the bore and any deviation from the initial data is a measure of the angle of the bore relative to the centerline. In this case, the inner bore was off a similar amount, so this means the angle was good but it was off center vertically by .0027 in. (0.069 mm). Since there was a second bearing bore deeper inside the housing, we moved the A-512/514 target into the next bore and got similar but different readings, so both bores were out of alignment relative to the main bore centerline.

## Part 2: How to Align a Compressor Frame to a Boring Mill Spindle

The custom fixture and Hamar Laser's L-702SP are set up as before with the part on the boring mill. The laser beam is therefore a reference centerline which is used to align the compressor frame can to the boring mill's spindle axis to accurately machine the bearing bores (figure 1).



Figure 1 - Technician Aligning L-702SP to Bore Flange

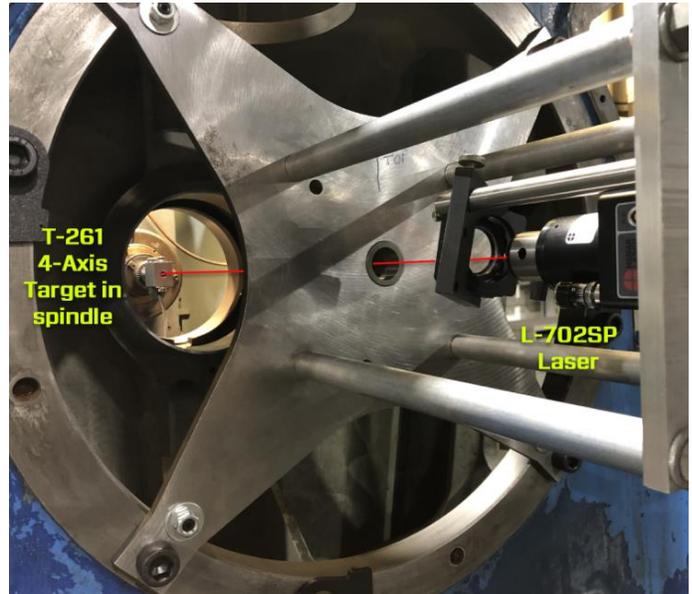


Figure 2 - Close-up of L-702SP Setup with T-261 4-Axis Target Inserted in Spindle



Figure 3 - T-261 4-Axis Target Chucked Up in Spindle

Once the laser is aligned, the A-512 target is removed and the laser beam passes through to the boring mill's spindle (figure 2).

To align the compressor reference bore to the spindle for the boring operation, Hamar's T-261 4-Axis Target is inserted into the spindle and clamped up (figure 3). Hamar's Lathe9 Software is then used to take a quick set of data to remove any mounting errors. What is left over is a real-time, 4-axis display of the mill's spindle rotation axis alignment to the part (figure 4).



Figure 4 - Lathe9 Step 5 Showing Data Taken for Spindle

## Aligning the Gearbox to the Spindle

First, the angles of the gearbox relative to the spindle rotation axis (V -.0021 and H .0084 in/ft) are aligned by shimming in the vertical axis of the frame and pivoting it in the horizontal axis so the angular values are close to zero. The angular data is shown in in/ft, so it's easy to calculate the amount of shim needed to align it.



Figure 5 - Compressor's Front Mounting Foot

In this case, the V Slope is -.0021 in/ft. The distance from the front to the back of the compressor was about 5 feet so a .011 in. shim is installed to the front of the frame (figure 5). The goal is to get the 2 slope values as close to zero as possible.

With the slopes of the frame aligned to the spindle, the next things to correct are the Center values. This is easily done by adjusting the spindle's X & Y position until the V & H center values are near zero (figure 6).

Now the T-261 Target can be taken out and the cutting tool inserted and the milling can begin.

The L-702SP can be quickly set up before final machining so spot checks can be done to ensure the milling is going as planned (figure 7).



Figure 7 - Compressor Frame with L-702SP Mounted in Fixture

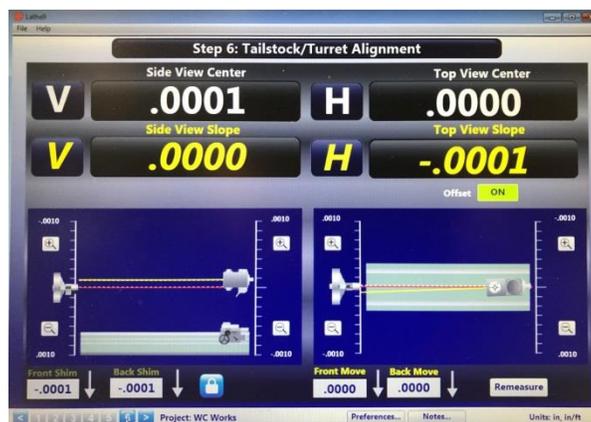


Figure 6 - Lathe9 Step 6 Move Screen Showing the Compressor Angles Aligned

Hi-Tech's Director of Quality is very pleased with the L-702SP. "It only takes about 15 minutes to set up and get the housing dialed into the mill's spindle axis," said Don Weidemann. "This is much faster than our old method.

The L-702SP gives us high Gage Repeatability and Reproducibility. It's saving us a lot of time, increasing our profitability, and earning us more business. (See case study "Fair and Square.")

**Do you have an especially challenging or unique alignment application? For more information about Hamar Laser's [L-702SP Scan Laser with Plumb Beam](#) and our many other alignment solutions, visit our [website](#), e-mail us at [sales@hamarlaser.com](mailto:sales@hamarlaser.com) or call 203-730-4600. The Hamar Laser team is ready to help!**