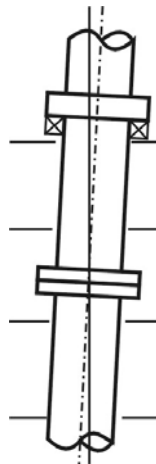


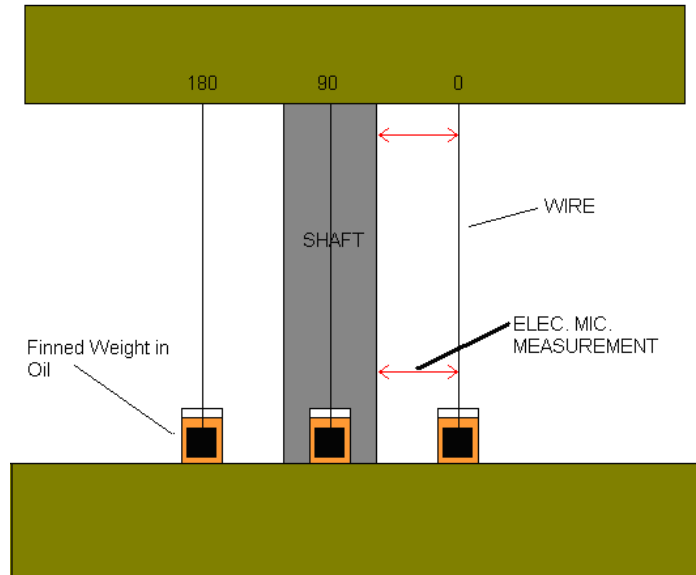
## How to achieve vertical shaft plumbness using laser alignment

By Daus Studenberg, Ludeca Inc.

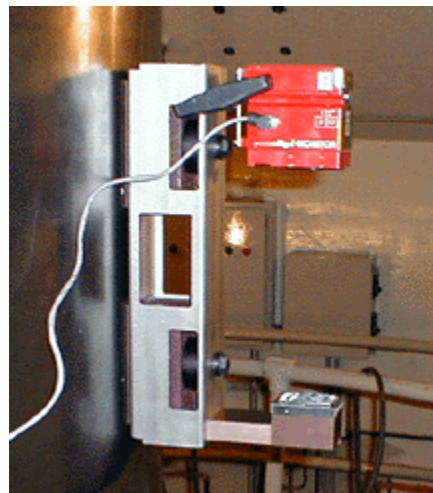
Figure 1  
Figure 2  
Figure 3  
Figure 4  
Figure 5  
Figure 6  
Figure 7  
Figure 8  
Figure 9  
Figure 10  
Figure 11



***Figure 1. Shaft Centerline of Rotation in Relationship to the Plumb Line***



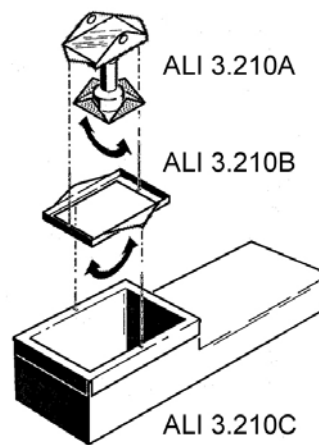
**Figure 2. Tight-wire Plumbness Measurement Concept**



**Figure 3. The PERMAPLUMB and 14-inch Bracket**



**Figure 4. Laser Transducer Mounted upon the Permaplumb Bracket**



**Figure 5. Self-adjusting Mirror Assembly**



***Figure 6. Attaching the PERMAPLUMB to the Hydro Shaft***



***Figure 7. The PERMAPLUMB System Installed on the Hydro Shaft***

File Name

**Thrust Bearing pad data (optional)**

Correction pad radius, inch

Angle from 0 to 1st pad, degrees

Number of Pads

Correction Type ☐ Pads All Up ☒ Pad Up & Dn

**Shaft Centerline Data**

0 to 6 Angularity Target

Tolerance

3 to 9 Angularity Target

Tolerance

Laser to mirror dist. inch

**View**

☒ CW from Top

☐ CW from Bottom

**Translation Data (optional)**

Adjustment Point      Pivot Point to Adjust Point  
Distance, in.

Upper Point

Lower Point

Figure 8. Entering Dimensions, Tolerances and Targets into the WinPLUMB Software

**Raw Data, Averaged mils**

Pos	X	SD	Y	SD
0	-23.2	2	-0.5	1
3	-22.8	1	0.8	1
6	-21.7	1	0.2	1
9	-22.1	1	-1.2	1

**Plumbness Results, Mils/inch**

Plane	Actual	Target	Tol
0 - 6	0.013	0	0.0208
3 - 9	-0.033	0	0

CW From TOP-- using Pads UP / DN  
Effective Lens Length is 26.47

**Thrust Bearing**

Pad #	Degree	Correction
1	2.36	0.7
2	32.36	0.0
3	62.36	-0.6
4	92.36	-1.0
5	122.36	-1.1
6	152.36	-0.8
7	182.36	-0.2
8	212.36	0.5
9	242.36	1.1
10	272.36	1.5
11	302.36	1.5
12	332.36	1.2

**Circular Completion**

Diff X = 3.5527136788005E-15  
Diff Y = 9.9999999999999E-02

**Tolerance**

**Translation Data**

Adjustment Point	Pivot Point to Adjust Point Distance, in.	Radial Adjustment			
		0 - 6 Plane		3 - 9 Plane	
		Mils	Toward	Mils	Toward
Upper Point	260.22	3.38286	-> 6	8.58726	-> 3
Lower Point	-280.14	-3.64182	-> 0	9.24462	-> 9

Figure 9. The Results Screen

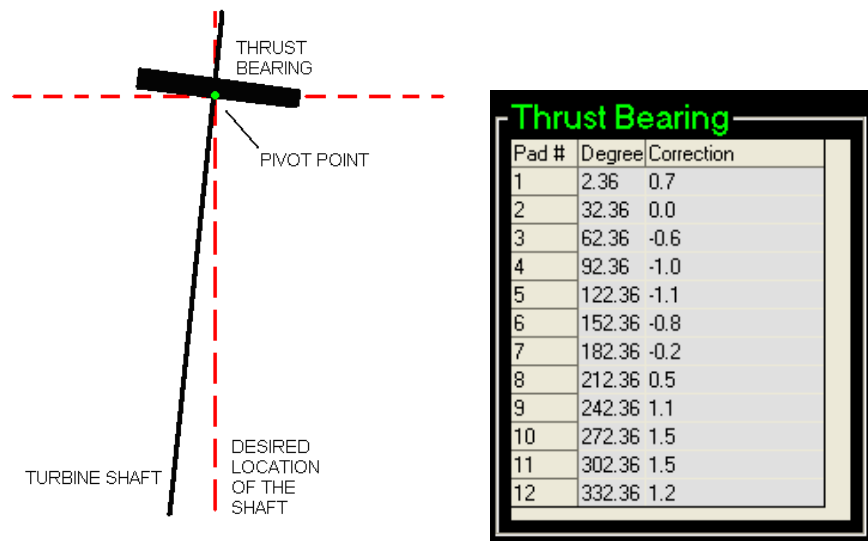


Figure 10. Thrust Bearing Corrections for Each Shoe

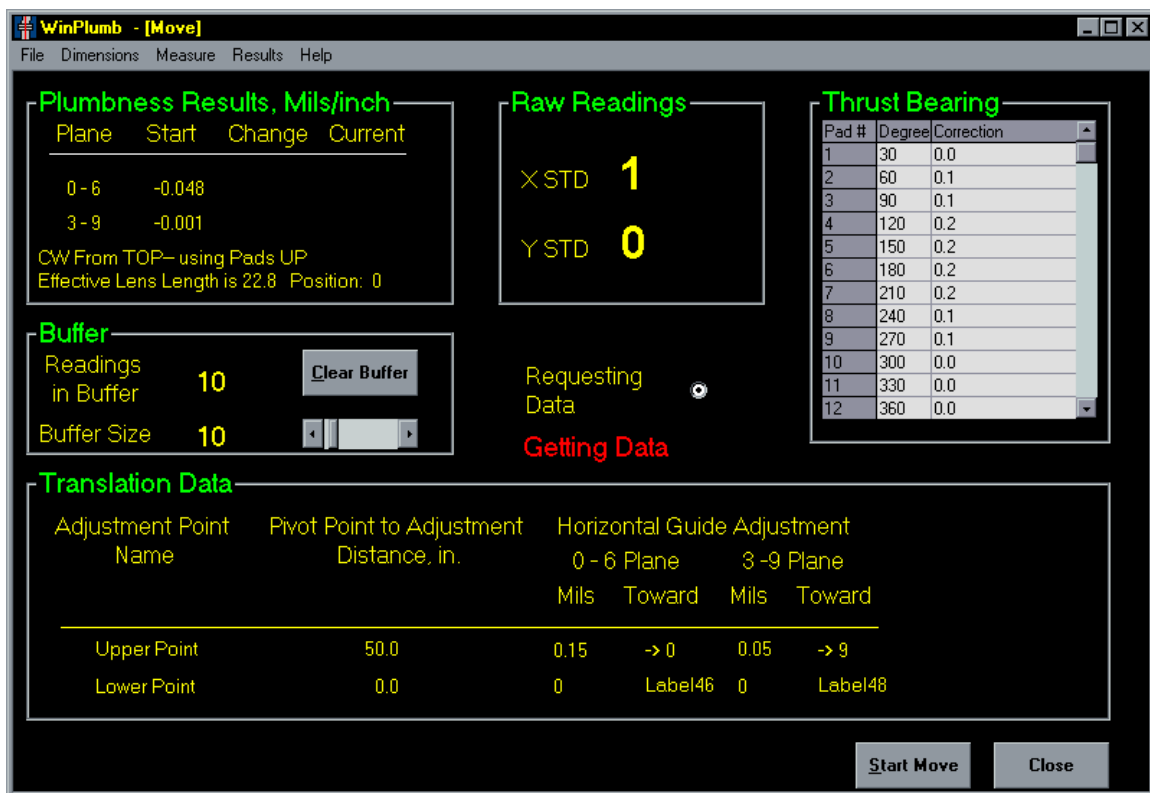


Figure 11. "Live Move" Mode