Written by David Zdrojewski VibrAlign, Inc.
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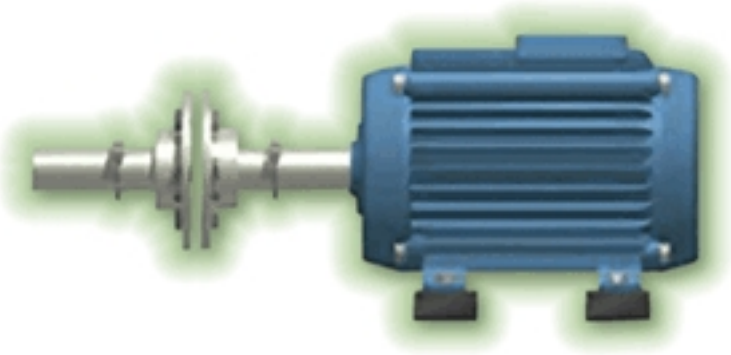


If you’re aligning equipment using foot value tolerances, you may need all the luck you can get and then some. “Modern” as that approach is, this author says it doesn’t stand up in the real world.

My company specializes in laser shaft alignment equipment. Recently, a prospective customer commented that he liked our equipment, but wondered when we were going to get “modern” about alignment tolerances. Generally accepted shaft alignment tolerances in industry use two criteria: Radial shaft centerline offsets at or near the coupling and angular shaft relationships. My customer’s opinion, based on an article he had read, is that shaft alignment tolerances should be based on offset values at the motor feet. If that’s the approach you’re taking, I would have to ask, “Do you feel lucky?”

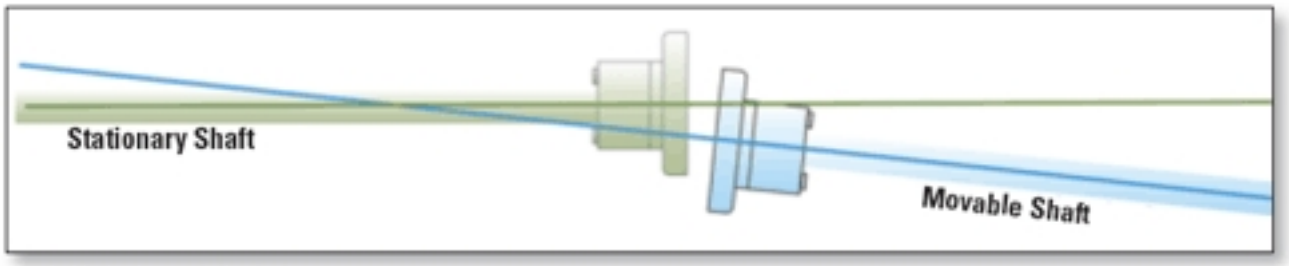


Fig. 1. Shaft alignment basics

Based on 28 years of experience in the alignment field, I have great concerns about using the foot value tolerance scheme. They include the following: 1. Companies will spend an enormous amount of time and labor going the “extra mile’ to achieve this standard. 2. Use of the foot value tolerance vs. angle and offset tolerances will NOT improve machinery reliability. 3. The foot value tolerance method will not improve bearing or seal life. 4. This foot value tolerance method will frustrate and discourage aligners who are motivated to perform precision maintenance, as very small measurement errors will result in large foot value fluctuations. 5. The foot value tolerance method breaks a basic measurement principle by amplifying measurement errors.

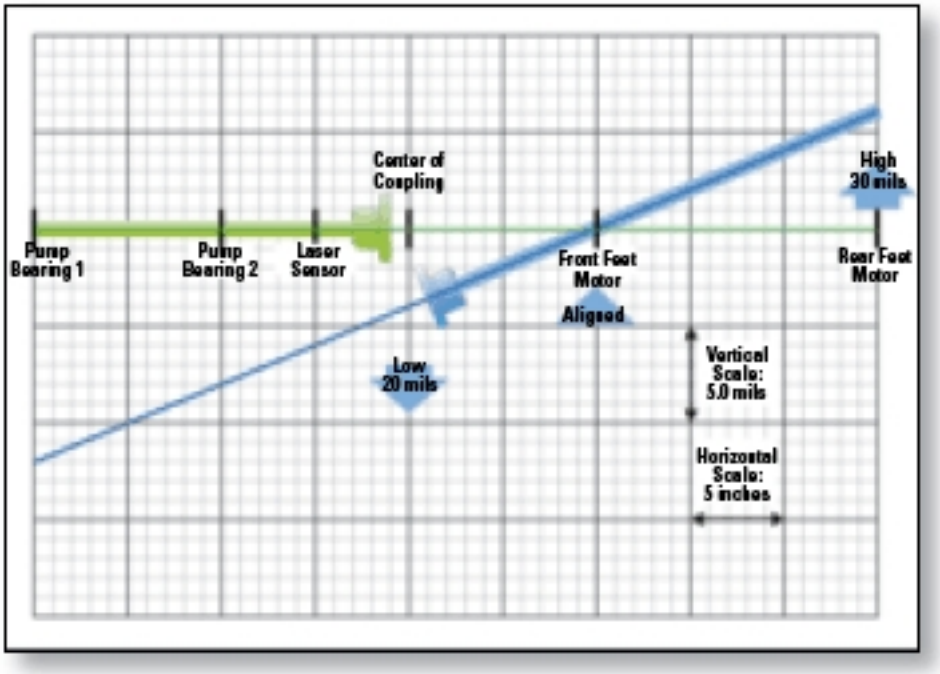


Fig. 2. Misalignment can be represented by expressing the horizontal (x) or vertical (y) position of the movable rotational axis in relation to stationary shaft at various axial positions (z).

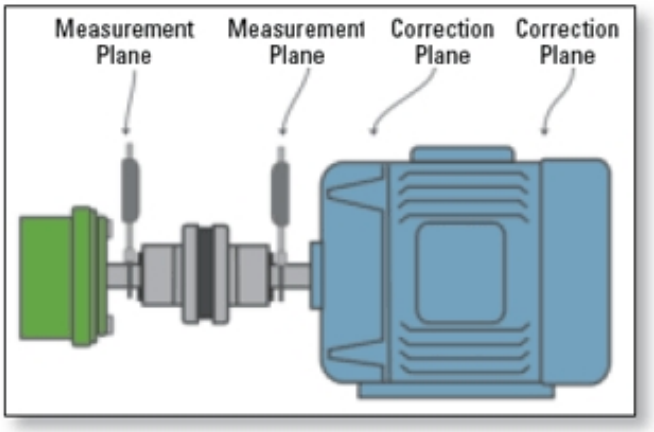


Fig. 3. Measurement planes are defined by axial locations of the sensors. Correction planes are where shims can be added or removed.

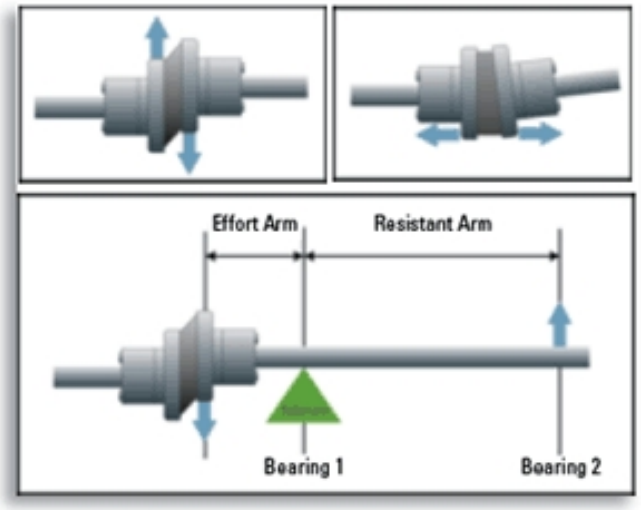


Fig 4. Misalignment creates forces at the coupling that are exerted on the shafts and, subsequently, on bearings.

	Angular Misalignment Mils per inch .001/1"		Offset Misalignment Mils .001"	
RPM	Excellent	Acceptable	Excellent	Acceptable
3600	0.3/1"	0.5/1"	1.0	2.0
1800	0.5/1"	0.7/1"	2.0	4.0
1200	0.7/1"	1.0/1"	3.0	6.0
900	1.0/1"	1.5/1"	4.0	8.0

Fig. 5. The tolerances we recommend are based on angle and offset values. You can choose to be more or less permissive.

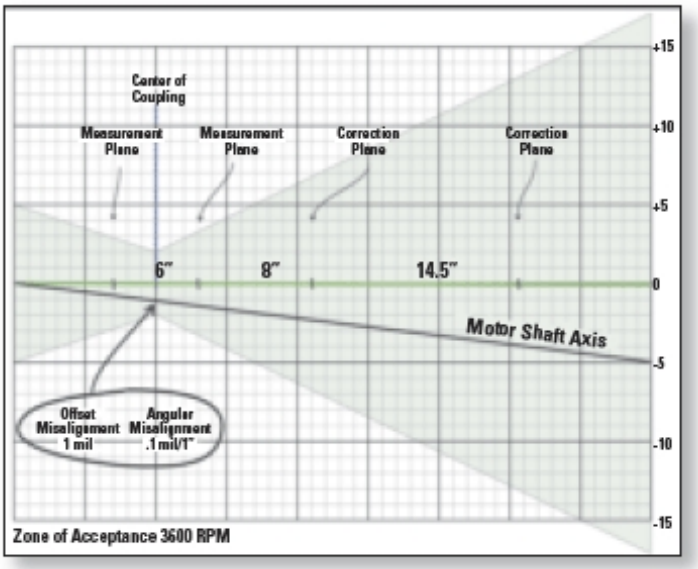
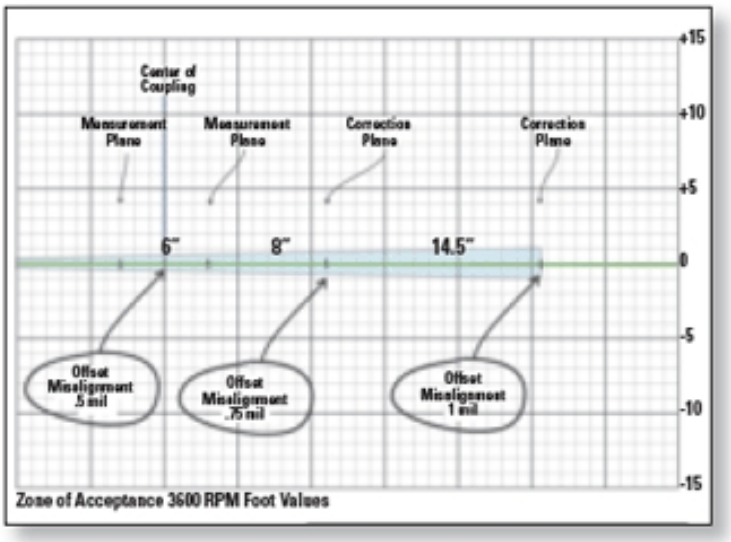


Fig. 6. This graph, showing a zone of acceptance for a 3600 RPM machine using angular and offset tolerances, reflects very good alignment.



Machine Speed	Maximum Offset At Machine Feet	Maximum Offset At Coupling Centerline
< or = 1800 RPM	0.002" (0.050 mm)	0.001" (0.025 mm)
> 1800 RPM	0.001" (0.025 mm)	0.0005" (0.013 mm)

Fig. 7. This graph is based on alignment using the foot value tolerances shown in the table. Small measurement errors will make these tolerances hard to satisfy.

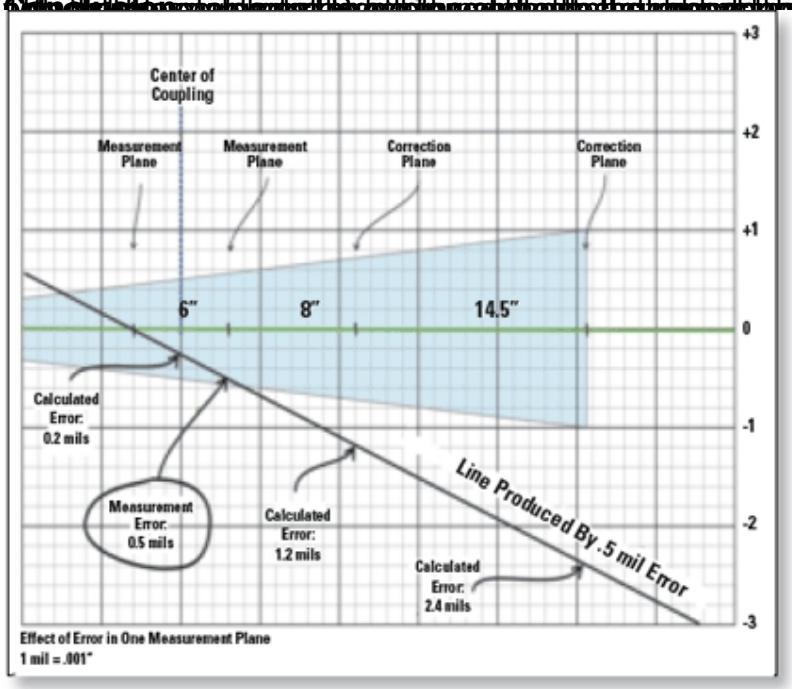


Fig. 8. As shown in this graph, the effect of a 0.5 mil measurement error in one measurement plane creates an angular error of 0.5 mil in 6" or 0.08 mil/1". When the offset tolerance is applied at the center of the coupling, the error is small, but when the tolerance is applied at the feet, the error is amplified.

Final thoughts

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