Product Service Bulletin
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Alignment Basics, Part One

Misalignment is one of the most common faults found in rotating equipment. Understanding how to properly diagnosis and correct for misalignment in plant equipment and how to deal with common pitfalls while out in the field is essential in doing the job right the first time.

The alignment of shaft centerlines on coupled machines is one of the most important aspects of machine installation. Contrary to popular opinion, flexible couplings will not always compensate for even moderate amounts of shaft misalignment. Misalignment is any condition in which the shaft centerlines are not in a straight line *during* operation.

Misalignment generates unnecessary forces. Precision alignment removes these forces resulting in reduced vibration and noise levels, minimized shaft bending and cyclic fatigue, reduced energy costs, and increased bearing, seal, and coupling life.

Shaft centerline misalignment can be classified as either angular or offset (also called parallel). Angular misalignment occurs when the shaft centerlines meet at an angle. Offset misalignment occurs when the shafts are parallel, but offset from each other. The misalignment may be vertical, horizontal, or a combination of the two. Most shaft misalignment is a combination of both angular and offset misalignment. Figure 1 graphically illustrates the alignment types.

Another type of misalignment

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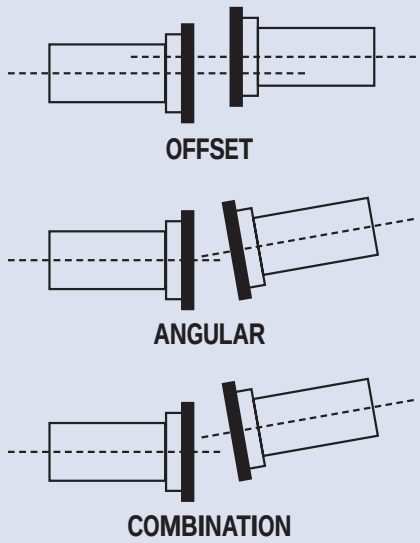
Figure 1: Types of Shaft Alignment



Ask the experts

Q: I received a letter telling me to send my invoices to a new address in Michigan. Why the change?

A: The letter you refer to applies only to Emerson Power Transmission (EPT) products such as gear products and modular motors. Invoices for US Electrical Motors warranty work (horizontal & vertical motors) are to be submitted to the same address as always:

US Electrical Motors
PO Box 36916
St. Louis, MO 63136
Attn: Product Service

To ensure prompt processing please be sure to submit your invoices to the correct location.

Have a question for the experts? Contact us at emersonmotorhelp @usmotors.com

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not associated with couplings is bearing misalignment. The centerlines of two coupled shafts can be properly aligned, but the bearings on one side of the coupling may be misaligned. Bearings can be misaligned if they are not mounted in the same plane; if they are not normal to the shaft, i.e. they are cocked relative to the shaft; or because of machine distortion due to soft foot, an uneven base, or thermal growth.

OFFSET MISALIGNMENT AND INBOARD BEARING LIFE

Coupling Type	Maximum offset for 3 levels of expected bearing life			Maximum coupling offset recommended by manufacturer
	90% life expectancy	80% life expectancy	50% life expectancy	
Link	3 mils (12% max)	5 mils (19% max)	20 mils (77% max)	26 mils
Elastomeric	8 mils (11% max)	21 mils (30% max)	70 mils (100% max)	70 mils
Grid	1 mil (8% max)	2 mils (17% max)	5 mils (42% max)	12 mils
Gear	5 mils (10% max)	10 mils (20% max)	35 mils (70% max)	50 mils

Economics of Misalignment

There are a number of cost benefits of precision alignment. It can help reduce plant operating costs by reducing energy costs. Precision alignment also results in increased maintenance savings through reduced parts consumption and reduced overtime. Finally, it can help decrease equipment downtime and increase product quality.

A recent study performed at the University of Tennessee found that even small amounts of misalignment could significantly reduce bearing life. The study found that if, on average, a motor was offset misaligned by 10% of the coupling manufacturer's allowable offset, there was a corresponding 10% reduction in inboard bearing life.

Furthermore, if a motor was offset misaligned by 70% of the coupling manufacturer's allowable offset, there was a corresponding 50% reduction in inboard bearing life *(Hines et al)*. The results of the study are summarized in the table at the top of this page.

Alignment Tolerances

Alignment tolerances have often been treated with a half-hearted "just get it close" attitude. But, alignment tolerances are actually the measurement of a job well done and they provide the definition of what close actually is.

There are two reasons to use tolerances. The key reason is to establish goals. If you do not have a goal, how do you know when the job is finished. If there is not a goal, there cannot be a quality alignment.

The second purpose of alignment tolerances is to establish accountability. Accountability is the evaluation of alignment quality. If there is no tolerance to compare an alignment to, how can the quality of the alignment be judged? Accountability can create competition, driving a mechanic to get the job done better.

Misalignment is one of the most common faults found in rotating equipment. Because of the frequency of occurrence, machines are often aligned without taking the time to properly diagnose the machine fault. Diagnosing misalignment in a machine can be difficult because the vibration, phase, and temperature characteristics are dependent on the type of coupling used. Misalignment leads to reduced bearing, seal and coupling life. Precision alignment reduces plant operating costs through reduced maintenance and energy costs as well as reduced equipment downtime.

Asset Optimization is possible with a balance of Technology, Expertise, and Work Processes which only Emerson Process Management offers for each category of plant assets: mechanical equipment, electrical systems, process equipment, and instruments and valves. Emerson's Machinery Health Management discipline plays an important role in Asset Optimization by increasing the performance and availability of mechanical equipment.

Next Month: Alignment Pitfalls and How To Identify Them.