Product Service Bulletin

Vol. 9, July 2003

US MOTORS

Ask the experts

Q: What causes misalignment?

A: Installation (human) errors, thermal growth, dynamic twist of bases under load, settling bases and/or foundations.

Machinery alignment is a process. The process begins with Pre-Shutdown and Pre-Measurement preparation. The pre-shutdown preparation should include an inspection for machinery problems. Any problem that can affect the quality of the alignment should be corrected before the alignment is attempted. This inspection should include:

Complete visual inspection of the machine including the foundation, baseplate, bolts, welds, etc.

Vibration and phase analysis of the machine.

Motor electrical data for later efficiency calculations.

Thermal temperature readings or infrared thermography on the machine.

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

Alignment Basics, Part Two

In theory, machine alignment is a very straightforward process. With some type of measuring device extended across the coupling, the shafts are rotated to several positions (at least three) to determine the relative position between them.

Since alignment is an iterative process (meaning that the misalignment should continuously decrease with each machine move), it is theoretically only a matter of sufficiently repeating alignment corrections until an acceptable solution is achieved. In fact, quality alignment is not dependent on the type of measurement system used. Any good dial indicator set or laser system should be sufficient to perform quality alignments.

Therefore, in heavy industrial applications, where the cost of downtown can be in excess of $10,000 per hour, the fundamental question for an alignment program is not simply "Can I successfully align the machine?" but rather "Which method will provide the fastest alignment solution so that I can start production again?"

Furthermore, since misalignment is often compounded by structural faults such as 'soft foot', piping strain, induced frame distortion, excessive bearing clearance, shaft rub, etc., it may not be possible to align the machine without first addressing these additional problems. These pitfalls can turn an otherwise simple alignment job into an all day affair - frequently with unsatisfactory results despite conscientious effort and a considerable investment in manpower and downtime.

For this reason, it is crucial for the personnel performing alignments to be aware of the kinds of structural faults that can complicate the alignment process and that they learn to recognize the tell-tale signs of bad measurements before they invest valuable downtime in an unproductive exercise.

COLLECTING VALID DATA

Some fairly simple yet powerful techniques can be applied to determine the validity of alignment readings before investing time executing a machine move that may be wrong. If using a dial indicator set, it is useful to apply the data validity rule to each set of readings. The data validity rule compares the

continued on back >

< continued from page one

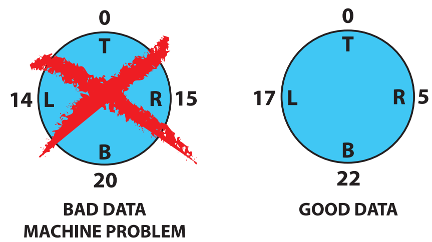
readings taken at the four cardinal positions: Top + Bottom = Left + Right. It provides a quick way to determine the validity of an alignment solution before moving the machine. This simple check is able to catch many set-up errors and mechanical faults such as:

- loose brackets
- sticking indicators
- indicators set too high or too low
- improperly recorded data values and/or signs
- sleeve bearing float
- surface irregularities or eccentricities
- excessive bearing clearance

Small deviations from the validity rule are to be expected. If the difference is more than 10%, it is possible that the coupling may be loose enough to provide excess torsional play ("backlash"). To reduce the effects of torsional play keep the coupling engaged while rotating the shafts from the driven machine in the normal direction of rotation.

If the error is greater that 20%, the cause should be determined. This could be a problem with the alignment fixture(s) or a concern with the machine being aligned. Alignment problems occur from loose fixtures or improper use of fixtures. Possible machine concerns include locked couplings, spalled bearings, machine binds, etc. If the data validity rule is not checked when such a problem exists, these potential machine faults will remain undetected and substantially complicate the alignment process. Even worse, the objective of increasing machine reliability through quality alignment will not be accomplished.

Figure 1: Examples of good and bad alignment data



When using a laser alignment system, the potential for user error is greatly reduced due to the automatic measurement and recording of readings. However, the data validity rule can still be very useful to identify structural faults such as excessive bearing clearance and other forms of structural looseness.

To apply the validity rule with a laser system, it is necessary to record **all four** cardinal readings (top, bottom, left, right) and plug them into the formula. If, however, the alignment solution is based on only three of the four cardinal readings, the user will not have the ability to check the validity of the solution.

In one such example involving a feed water pump in a power plant, an alignment was attempted using only three of the four cardinal measurement (top, left and right - the bottom reading was omitted). The machine was moved as indicated by the laser system but no improvement in the alignment condition was achieved. Numerous readings and machine moves were implemented but failed to result in any improvement in the alignment condition.

When the reading for the fourth position (on the bottom) was manually collected and the values were plugged into the equation, it was clear that the validity rule was being violated. Visual inspection of the machine train indicated that one of the feet on the gearbox had been bolted down with the wrong size bolt head - thereby substantially reducing the hold-down force at this foot. This allowed the foot to lift slightly during shaft rotation creating substantial error in the readings. After replacing it with the proper size bolt, the operator was able to align the machine in just a few moves. (Note: more advanced systems are currently available that will automatically apply the validity rule to the obtained readings and indicate whether acceptable levels for deviation have been exceeded.)

It is important to realize that otherwise straight-forward alignment jobs can become highly complex and yield unacceptable results if the technician does not address the quality of the alignment measurement and potential frame stress conditions (frame distortion, soft foot, and piping strain) during the pre-alignment check. These steps should all be conducted before the technician ever begins to move the machine.

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.

For more information on Emerson's Machinery Health Management, visit compsys.com.