

Qualify and Certify Staff for Shaft Alignment

Written by John Piotrowski, Turvac Inc.
Saturday, 01 March 1997 18:57

Companies should determine the skill level of personnel responsible for alignment, arrange for appropriate training for proficiency, and use qualification testing for certification. These examples show the need for certification in shaft alignment.

A maintenance technician at a chemical plant was asked to align a motor and a pump with a newly purchased laser shaft alignment system. Shaft position measurements were captured with the instrument. Corrections required to align the motor (assigned as the movable machine) with the pump indicated that the outboard end of the motor had to be lowered 85 mils and the inboard end of the motor had to be lowered 37 mils; there was no shim stock under the motor feet. After completely removing the motor, the technician began grinding away the baseplate. The motor was placed back on the base and shaft position measurements were captured again. Because too much metal had been ground away, the technician then added shims under the motor feet. Several side-to-side moves were made to bring the equipment into alignment.

A manufacturer of gas turbines was installing several large air compressors to expand the capacity of a system used to test jet engines. Requests for bids to install the 11,000 hp motors, gearboxes, and compressors were sent to several general contractors. Detailed specifications including instructions for installing foundations and sole plates and for correcting soft foot conditions were provided, along with rough alignment procedures and final hot and cold alignment procedures. The general contractor was told to subcontract the alignment work to companies specializing in machinery alignment. The specifications were sent to the subcontractors; however, several of the contractors submitted bids although they did not understand many of the detailed specifications. Toward the end of the project, the company discovered that the alignment work was not performed to the written specifications and payment was withheld from the contractors who performed the work.

A company that was in the process of becoming ISO 9000, 9001, and 9002 compliant requested information on certification testing for maintenance personnel who perform shaft alignment. Several employees had been certified in vibration analysis and thermography. The company wanted documentation that personnel were adept at finding and fixing problems.

A petroleum company decided to sell one of its facilities. Several prospective buyers were interested in retaining as many employees as possible. However, they wanted to retain only people who were adequately trained and were certified to do specific tasks. When asked to provide information on task certification of its employees, the petroleum company was unable to do so.

Qualify and Certify Staff for Shaft Alignment

Written by John Piotrowski, Turvac Inc.
Saturday, 01 March 1997 18:57

A steel company was having problems with a fairly complex multiple-element drive train. Misalignment was found to be the root cause of the failures. No one in the plant knew how to align the drive system. An alignment service company was contacted; although a technician said he could align the drive system in less than 4 hours, the job actually took several days to complete.

An electric utility company experienced several failures on a critical pump. Inhouse maintenance personnel had been using a laser shaft alignment system to measure the positions of the shafts. The pump was being driven by a variable speed hydraulic clutch. In the instruction manual, the clutch manufacturer stated that the clutch would rise upward 15 mils once it attained normal operating conditions. Maintenance personnel set the clutch 15 mils lower than the pump shaft assuming that the pump would not move from off-line to running conditions. A survey showed that the pump shaft rose upward far more than the clutch did, forcing the unit to run under severe misalignment conditions.

Equipment for vibration analysis and infrared thermography has improved dramatically over the past 20 years, and the number of people working in these areas has increased substantially. With a small investment, anyone can buy a personal computer and a vibration data collector or an infrared camera and be in business. However, the learning curve for this equipment is long and steep.

Over the past 5 years, there has been an effort to determine the skill level of people working in vibration analysis and infrared thermography through qualification and certification testing by several companies and institutions. Many companies are requiring their employees to become certified.

Certification for other tasks in the workplace such as correcting rotating machinery problems including balancing, shaft alignment, and tribology also has been discussed. With certification testing comes questions. Who has the authority to provide certification? What is the best way to determine if people are qualified to perform shaft alignment? How can trainees prove what they learn from training courses? And how qualified are contractors who are installing new rotating machinery?

Who to train and qualify

Many organizations feel that the responsibility for shaft alignment rests solely in the hands of tradespeople (mechanics, millwrights, pipefitters, and electricians). However, are tradespeople

Qualify and Certify Staff for Shaft Alignment

Written by John Piotrowski, Turvac Inc.
Saturday, 01 March 1997 18:57

responsible for the following tasks?

- Selecting training courses they feel they need and for sending themselves to the courses
- Researching types of shaft alignment measurement systems and purchasing a system that best fits the needs of their organization
- Telling a contractor that he is not installing rotating machinery correctly
- Hiring staff or contractors to help with the work overload
- Rebuilding a piece of rotating machinery that is malfunctioning because of excessive runout conditions
- Determining that a rotating machinery foundation or baseplate that has been removed and reinstalled has deteriorated excessively or been installed improperly
- Redesigning and reworking improperly installed piping that is putting excessive strain on the rotating machinery it is attached to
- Purchasing and installing piping supports, or designing a custom piping anchor on a CAD system, purchasing the materials, and installing the anchor
- Selecting a new flexible coupling design to replace one that fails often or does not work well
- Picking a pump as the movable machine and leaving the motor as the stationary machine
- Issuing work orders to check the alignment of all the rotating machinery every year
- Shutting a machine down on the basis of vibration and temperature data that indicate a misalignment or soft foot condition
- Determining which machinery might require a hot alignment check, selecting an off-line-to-running machinery movement measurement technique, installing the equipment on the machinery, measuring and analyzing data, and altering the cold alignment position on the basis of data collected
- Maintaining records of alignment work performed and saving records in the equipment files or a computer database
- Installing X-Y proximity probes on a machine supported in sliding type bearings to analyze the Lissajous orbit for signs of running misalignment.

Shaft alignment training should be mandatory for managers, engineers, technicians, front-line supervisors, and tradespeople to provide them with the minimum working knowledge needed to achieve accurate alignment and to know the process. Engineering and maintenance managers, rotating equipment and maintenance engineers, maintenance technicians, vibration specialists, foremen, and front-line supervisors, as well as the trades personnel, all should be trained and qualified to do their respective tasks.

Assessing and verifying knowledge and experience

Before qualification testing begins, shaft alignment knowledge can be assessed using a Field

Qualify and Certify Staff for Shaft Alignment

Written by John Piotrowski, Turvac Inc.
Saturday, 01 March 1997 18:57

Experience Evaluation form that queries employees' or contractors' knowledge and experience on specific types of machinery. Individuals can then be tested on specific tasks to determine if they are capable or if they need supplementary training to raise the level of proficiency.

The form can be used to determine required training for personnel installing, maintaining, or aligning rotating machinery. But how can experience and proficiency be verified?

Written or oral examinations can verify the knowledge level for each item in the form. One comprehensive test might encompass every facet of shaft alignment, or a series of tests can be given for discrete blocks of information. If the overall body of information is broken down into separate blocks, personnel with little or no experience can be tested incrementally as their level of knowledge grows. The accompanying section, "Test Requirements for Alignment Knowledge Assessment," outlines possible test subjects.

Written or oral exams can test knowledge but are inadequate to determine skill level in performing specific tasks. Perhaps the most effective means to verify knowledge and skill level is to have employees perform tasks on a simulator or directly on an operating rotating equipment drive system. However, using process machinery as a test platform may not be possible. Having simulation equipment available allows testing to occur at any time without affecting production or maintenance schedules. For accurate skills assessment, test equipment must simulate real life circumstances.

Qualification and certification testing in tasks such as vibration analysis, thermography, and shaft alignment is necessary. Establishing the requirements for qualification or certification can be accomplished by appraising the experience level of personnel through an evaluation form that addresses all aspects of the task. Skills of each individual can then be assessed and appropriate training can be administered. Written or oral exams and task simulation tests can be conducted to determine the true proficiency of personnel. **MT**

John Piotrowski is president of Turvac Inc., an alignment training and consulting company, 125 Settlemyre Rd., Oregonia, OH 45054; (513) 932-2771; e-mail turvac@your-net.com ; Internet <http://www.ncinter.net/~turvac/>

. He is the author of Shaft Alignment Handbook.

Qualify and Certify Staff for Shaft Alignment

Written by John Piotrowski, Turvac Inc.
Saturday, 01 March 1997 18:57

TEST REQUIREMENTS FOR ALIGNMENT KNOWLEDGE ASSESSMENT

Basic test

- Consequences of poor alignment on rotating machinery
- Detecting misalignment on running rotating machinery (vibration, infrared methods)
- Use and care of measuring tools and instruments (feeler gauges, dial indicators, optical encoders, proximity probes, laser/detector system, etc.)
- Finding and correcting excessive runout conditions
- Finding and correcting soft foot
- Finding and correcting excessive piping strain
- Foundation and baseplate design, installation, and care
- Concrete and grouting installation
- Alignment tolerances
- Rigid and flexible coupling design, installation, and care
- How to perform the reverse indicator method
- Basic mathematical or graphical/modeling principles for realignment
- How to determine effective alignment corrections using the reverse indicator technique
- Keeping records of alignment work.

Intermediate test

- How to perform the face and rim method
- How to determine effective alignment corrections using the face and rim technique
- How to perform the shaft to coupling spool method
- How to determine effective alignment corrections using the shaft to coupling spool technique
- How to perform the double radial method
- How to determine effective alignment corrections using the double radial technique
- How to perform the face-face method
- How to determine effective alignment corrections using the face-face technique
- Mathematical or graphical/modeling principles for all of the methods listed.

Advanced test

- How to align multiple-element drive trains
- How to align right angle drives
- The four categories for measuring OL2R machinery movement

Qualify and Certify Staff for Shaft Alignment

Written by John Piotrowski, Turvac Inc.

Saturday, 01 March 1997 18:57

- Calculating machine case thermal expansion
- Inside micrometer-tooling ball-angle measurement methods
- Proximity probes with water cooled stands technique
- Using optical alignment tooling for OL2R machinery movement
- Alignment bars with proximity probes OL2R method
- Using laser-detector systems to measure OL2R machinery movement
- Using the ball-rod-tubing connector system to measure OL2R machinery movement
- Using the vernier-strobe system to measure OL2R machinery movement
- Mathematical or graphical/modeling principles for all of the methods listed
- How to align rotating machinery to compensate for OL2R machinery movement.