Becoming a “Reliable Plant” and staying there requires keeping abreast of constantly changing and improving technologies and practices.

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In today’s leaner maintenance departments, companies rely heavily on the reliability of their machinery. While the practice of reliability engineering has been around for many years, it has never been focused on as much as it is now. In today’s maintenance world, reliability engineering positions—not to mention entire departments—have been created to put 100% of their time and effort toward the prevention of unscheduled machinery downtime and critical failures.

Even though the goal of a “Reliable Plant” remains much the same as it has for years, methods and practices for getting to that state are constantly changing and improving with the development of new technologies and practices. A case in point is proper shaft alignment of rotating machinery in the running condition, through the derivation and application of proper coupling target values.

With today’s laser alignment tools and proper training, alignment of machinery has become an easier task than in years past. However, in some cases, companies are finding that even while machines are within excellent alignment tolerances, they still have problems associated with misalignment. This often is a result of thermal growth issues with the machine, dynamic loads, downstream (or upstream) piping movement and other variables.

Many manufacturers supply their equipment with thermal expansion data and recommended alignment targets. The idea is to purposely misalign a machine when the alignment is done “cold,” or offline, so that when the machine reaches its normal running condition the machine is aligned. Compensating with target values is one step closer to proper alignment, but often these values are not as accurate as they were originally intended to be, due to flaws in the methods of their calculation.

Hypothetical applications

Two identical steam turbine-hot water pump machine trains are sold and supplied with factory-calculated target values. It is late October. One unit is installed in a Louisiana refinery at 90 F, the other in an identical plant in Washington State at 40 F. Both operate at the same temperature, but which machine will be in alignment when it reaches its normal running condition? Consider that the factory calculated the target values using an arbitrary cold temperature of 70 F. Because of the temperature differences, it is possible that both units may be out of alignment at running condition using the factory supplied alignment targets.

Location Ambient Temp at Time of Alignment	ΔTemp (°F) Running Temp (250 F) Ambient Temp	Length (inches) of Material Base to Centerline To Rotation	Coefficient of Thermal Expansion Cast Iron Pump (mils/inch/°F)	Thermal Growth at Machine Foot
Factory (70°F)	180	24	0.0059	45.9
Louisiana (90°F)	160	24	0.0059	40.8
Washington (40°F)	210	24	0.0059	53.5

Fig. 1. TLC calculations for one of the feet at each location based on the hypothetical example of steam turbine-hot water pump machine trains installed in Louisiana and Washington State.

Using the “TLC” thermal growth calculation method we can see how much the growth can differ depending on what the ambient temperature is when the alignment is performed. The TLC method is the product of the change in Temperature, the Length of material from base of machine to the centerline of rotation and the Coefficient of expansion for the material involved. Each support foot of each machine needs to be calculated. The calculations for one of the feet at each location are shown in Fig. 1.

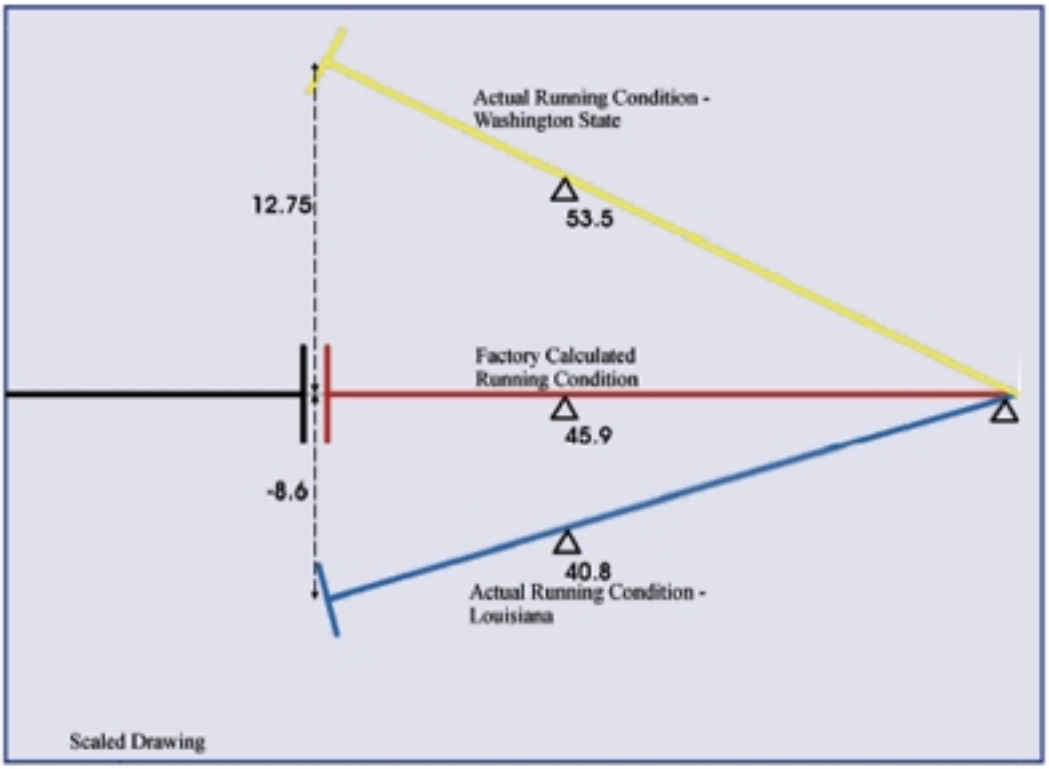

Fig. 2. In our hypothetical example, the thermal growth values calculated in Fig. 1 could lead to greater misalignment at the coupling center.

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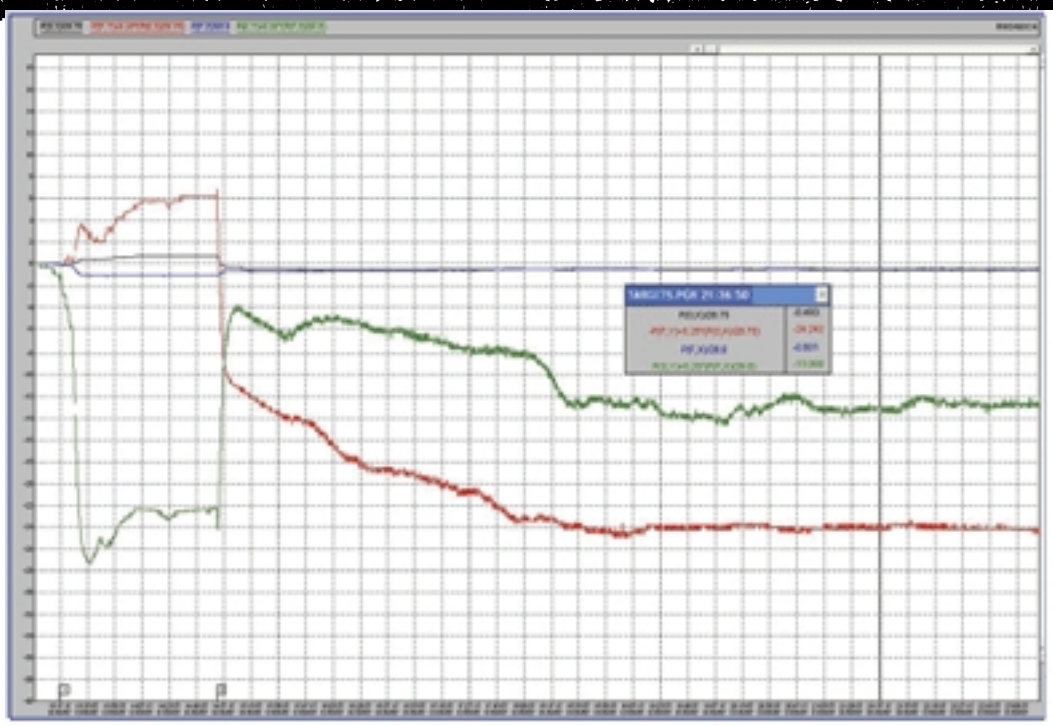

Fig. 3. WINPERMA® software trends, analyzes and archives data collected by the PERMALIGN® system.

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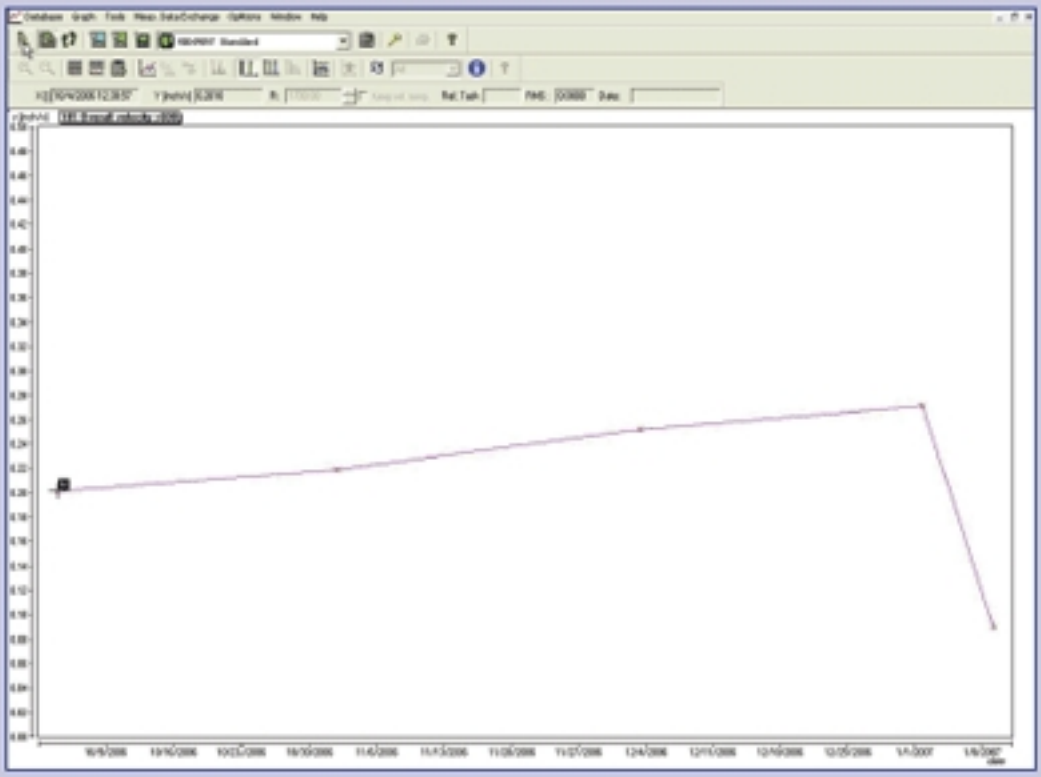

Fig. 4. A four-month trend of the overall velocity levels measured on the problem pump using the VIBXPERT® vibration data collector.

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