Written by Rodney Collier, Emerson Power Transmission Corp. Tuesday, 01 January 2002 16:52

Here are some tips to prevent often-seen installation and maintenance mistakes that lead to recurring downtime.

Too many companies have fallen victim to the shortcut of replacing failed power transmission components rather than analyzing the root cause of the failures.

For example, the operations manager for a supplier to the automotive industry was quite frustrated late one Friday afternoon. He demanded warranty for a failed gearbox that had lasted only two weeks. "The previous unit lasted 1½ years," he reported. "This downtime is costing our company \$10K per day." When asked what caused the previous unit to fail, he replied, "I'm not sure. All I know is that it failed and someone on third shift replaced it with another gearbox."

I told him that whatever changed in the drive that caused the first unit to fail had likelywreaked havoc on the current unit as well. An inspection of the internal components of the gearbox likely would have shown the gearbox was overloaded and that replacing it with the same size unit would likely result in another failure.

This article identifies four frequently occurring installation and maintenance errors involving power transmission equipment, and provides guidelines to avoid the costly equipment downtime typically associated with these errors.

Retension V-belt drives

The number one cause of V-belt failure is undertensioning. Undertensioned drives allow a belt to move or slip independently of the sheave. The resulting friction gives the belt's sidewalls a shiny or glazed appearance. Left unattended, this slippage creates heat that hardens the belt's rubber compound. The consequent flexing required of the belt and this new hardened condition causes cracks on the belt surface.

The belt may last a week or two, or it might make it a few months. But ultimately, the belt will fail prematurely and usually at an inopportune time. A slipping belt is easily identified by squealing on startup, excessive heat at the driver or driven sheave, black carbon dust underneath the

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drive, or glazed belt sidewalls.

The ideal tension for a belt is the least amount required to prevent it from slipping under peak load conditions. There are several methods of tensioning belts. Many installations are successful using a technician's experience or feel. However, the force deflection method is more accurate. Belt manufacturers and suppliers typically provide the force required to deflect a belt 1/64 in./in. of belt center distance.

While it is important to follow the manufacturers' recommendations for installation of new belts, the typical error is that the tension of a newly installed belt is not rechecked and adjusted after approximately one shift of operation. I recommend the belt tension should be checked after as little as 1 hr of operation. The need for retensioning is based on the fact that belts have a tendency to seat or find their home.

Paint removed from the grooves of new sheaves after only a few minutes of operation shortens the center distance slightly. Some belts may have "flashing" or excess material at certain spots which wears off and allows the belt to ride deeper in the groove, resulting in undertensioning. Additionally, as the belt warms up, it flexes easier leaving more slack in the drive. If belts are not retensioned after they have seated, slippage is imminent and premature failure is likely.

Align shafts to equipment specs

The often-repeated mistake is taking the approach that if the coupling halves fasten together, the drive is good to go. This is not necessarily true. This approach often works for rigid couplings but not for the widely used flexible types.

I recently worked with a client who was repeatedly breaking pump shafts. The problem turned out to be the result of misaligned shafts. The chosen coupling was flexible and relatively easy for mechanics to assemble. The only drawback was they had to slide the motor out of the way at every installation. The pump, on the other hand, could not tolerate misalignment nearly as well as the coupling. In fact, the bearing settings alone limit the amount of misalignment that most equipment can tolerate. Proper shaft alignment would have saved this company many hours of downtime, along with the associated labor and equipment costs.

Aligning drives to coupling capabilities rather than equipment capabilities often results in

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bending failure of the shaft(s). Preliminary indications of misaligned shafts are excessive heat at the face of the driver or driven equipment, oil seal leakage, and/or vibration.

The key is to ensure that shafts are aligned to within the equipment specifications rather than the coupling capabilities. I recommend achieving as near perfect angular and parallel alignment as possible^[] within reason. Dial indicators, for example, are often used for aligning shafts and are ideal for most applications. However, some critical applications may require more sophisticated tools such as laser alignment equipment. Regardless of the technique used, keep in mind that if ideal alignment is not achieved, it may be the equipment that suffers rather than the coupling.

No lubricants with tapered bore assemblies

One key benefit to using tapered bore products is that the design allows for easy disassembly should the need arise. However, all too frequently, installers apply an anti-friction lubricant to the tapered bore or the barrel of the bushing. Lubricants of any kind should never be used during installation of tapered bore products.

Assuming the installer is aware of recommended capscrew tightening torques and practices those guidelines, an overtorqued condition is likely because the friction between the mating parts has been reduced by the lubricant and the capscrews are tricked into a larger-than-recommended seated torque value. Under these conditions, the bushing is wedged deeper than desired into the bore, escalating the hoop stress directed at the hub. The result is typically seen in the form of fracture through the drilled and tapped holes of the hub.

Again, lubricants should never be used in tapered bore products. Torque the capscrews to recommended tightening torque and you will be able to disassemble the components by using the drilled and tapped back-off holes specifically designed into the components for ease of product removal.

Analyze gearbox failure

Gear reducers fail for a reason. Ideally, they are properly sized and maintained and live a long life, only failing as a result of having reached their expected life span. Unfortunately, many times this is not the case. Unpredictable overloading, worn accessory components, and changes in the application often present undesirable conditions for gear drives.

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The weak link of a gearbox is almost always the gearing, the bearings, or the shafting. Experience shows that often, it is the gearing that fails. Therefore, when a gearbox fails prematurely, I always ask a client what the condition of the gearing is. If the gearing is damaged or has broken teeth, it is a safe deduction that the unit has been subjected to loading beyond the mechanical limits of the gearbox. This is, of course, assuming the unit was properly lubricated. Replacement with another identical gearbox is likely to produce similar results if the load requirements are not lessened or the drive modified to within the mechanical limits of the gearbox.

Perhaps more is being asked of the drive in the form of more production and consequent load increases. Perhaps something has failed elsewhere in the drive train which causes more drag and requires the gearbox to work harder. Whatever the case, when challenged to replace a gearbox with failed gearing, evaluate the cause of failure closely before automatically replacing the gearbox with a like unit.

When working with clients in trying to solve problems arising from improper installation or maintenance of power transmission components, I am frequently reminded of a comment a friend made to me 10 years ago. He said, "Rod, there are mechanics and there are parts replacers." My challenge to you is to follow proper installation and maintenance techniques, analyze failures before replacing equipment, and enjoy minimum downtime. **MT**

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