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Cost-effective sheave maintenance

Good sheave alignment will increase efficiency by reducing premature wear or failure of belts, pulleys and bearings. This can be accomplished by several different alignment methods, such as the labor-intensive string and straightedge method (most common) or by laser. The latter, in the form of the DotLine Laser Pulley Alignment Tool (Fig. 1), is new to the sheave alignment field, but has proven itself in greatly reducing downtime and the manpower needed to do the alignment. Simultaneously, it achieves far greater accuracy. This results in great labor savings and increased production uptime.

A V-belt drive is a very efficient power transmission method (from 90 to 98%) and has traditionally been thought of as very forgiving; however, proper alignment and belt tension are extremely important and can make a huge difference in mean time between repair (MTBR). Good drive maintenance involves a number of steps, roughly half involve aligning the drive. These are, in order: removing old belts, inspecting all components for wear and damage, checking for bent shafts and correcting sheave runout, installing new belts, performing the alignment and tensioning the belts.

Your foremost concern should always be safety. *Never* allow loose neckties or long hair anywhere near belt-driven machinery, and make *certain* all equipment is locked out and tagged out.

Failure causes. Prior to beginning a sheave alignment, try to determine (if possible) the cause of your belt or sheave failure, and correct it to prevent unnecessary recurrence. The cause of failure could be associated with poor drive maintenance (improper belt tension, poor sheave alignment), environmental factors (sunlight, harsh temperature fluctuations), improper installation (wrong belts/sheaves, belts pried on by force), or operating factors (overload, shockload).

When embarking on belt drive maintenance, one often forgotten important step is to perform a close inspection of the belts and each sheave and its grooves. This inspection should include looking (and feeling) for cracks, chips or excessive groove wear, and checking for proper contact between the belts and the sheaves. To prevent premature or catastrophic failure, problems of this nature must be corrected.

Replacing belts only requires moving one sheave toward the opposing sheave to slacken the belts. Replace a belt with a new belt of the correct length, material and pitch angle. Never force a belt onto a sheave; this will damage the tensile member of the belt or the sheave itself. If aligning a multiple-belt drive, replace all of the belts together—not singly. New and used belts that are otherwise identical have greatly different operating and tensile characteristics. Only combine belts from the same manufacturer and preferably use a factory-matched set.

Fig. 1. The DotLine Laser Pulley Alignment Tool reduces downtime and manpower. *(Courtesy of Ludeca, Miami, Florida)*

Inspect the removed belt for any noticeable defect (cracking, gouges or crumbling) and signs of slippage (glazing). Notice *where* the belt is worn. This may be a good indication of what type of misalignment or other problem might be in play. It is appropriate to change a belt anytime undue wear is detected. When replacing a belt, make sure you replace it with one that has been properly stored. Belts should be stored in a cool, dry place with no exposure to direct sunlight or heater drafts. Do *not* hang belts from a single peg; this may damage the tensile member and distort the belt over time. Preferably hang them from two pegs. Better yet, pile them on shelves. Coil long belts and don't make the piles too big or heavy to avoid distorting the bottommost belts.

The next step is to measure sheave runout. There are two types of runout: rim (radial) and face (axial). Both must meet tolerance prior to actually performing final alignment corrections.

The tolerance for radial or rim runout on high-speed sheaves (1,800 rpm and higher) should not exceed 5 mils total indicated reading (TIR) on average and may be increased to up to 10 mils on slower sheaves. Tolerances for axial or face runout should not exceed 0.5 mils/in. of sheave diameter (TIR) for high speed sheaves and may be increased to up to 1 mil/in. for slow sheaves. Always follow the sheave or machine manufacturer's tighter tolerance recommendations, if given. Start by checking for radial

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runout. If unsatisfactory, check for shaft runout.

If excessive runout is also present on the shaft, it may be bent. If so, you must replace the shaft and check radial runout of the sheave again. If no runout on the shaft is detected, replace the sheave instead. If the sheave is mounted on a tapered shaft bushing, remember to inspect and clean the bushing both inside and out to ensure proper seating. Next check for face (axial) runout (wobble) and, if necessary, correct it by repositioning the sheave on its shaft. Once runouts are in tolerance, install new belts.

Place the new belts into the sheave grooves, reposition the sheaves to rough alignment and check that the belts are properly seated within their grooves.

Now for the alignment. Misalignment consists of three types: vertical angularity (twist), horizontal angularity and axial offset, all of which can coexist in any combination.

The most common sheave alignment method is the straightedge and string technique, wherein these must touch each sheave at two diametrically opposite positions simultaneously (totaling four contact points). The sheaves should be rotated half a turn and checked again. Since a string can bend around corners, you cannot easily differentiate between offset and horizontal angle when only three-point contact is made; nor will a straightedge or a string detect twist angle under certain conditions. This method is also very labor and time intensive.

A fan-type laser beam such as that produced by the DotLine Laser overcomes all of these problems. The DotLine Laser mounts magnetically to the face of sheaves as small as 2.5-in. diameter and projects a laser fan line onto three targets magnetically attached on the other pulley(s). All you need to do is ensure that the laser line lines up with the unit's targets. Using additional targets, other pulleys in the drive (such as inside or outside idlers) can all be aligned simultaneously.

Always correct vertical or twist angle first by shimming the driver. Then correct horizontal angularity by moving the driver with lateral jackscrews. Lastly, correct offset by moving the driver with axial jackscrews or by repositioning one of the pulleys on its shaft. (Be careful not to cock the pulley!). Since performing one alignment correction almost invariably affects the other alignment conditions, this process may have to be repeated several times. This is where a fan-line laser really pays off, since it allows monitoring all three alignment conditions simultaneously, as well as greatly increasing alignment accuracy. This makes the job easier and faster.

The next step, after the sheaves have been aligned, is proper belt tensioning. Incorrect tension (as well as misalignment) will adversely affect belt life and drive efficiency as a whole. Using a spring scale, press down on the belt 1⁄64 in./in. of span length, and observe the force required. If you are not sure of the belt span length, you may also use the center-to-center distance of the pulleys, which will be similar. Tension the belts until the force required for this deflection equals the belt manufacturer's maximum recommended force values for the specific belts you are using.

Also, make certain this force does not exceed the machinery's design loads. The force values for all belts should fall within 10% of each other. Using a matched set of belts and having a good alignment are essential in achieving this goal. It is tricky to move the driver to slacken or tighten the belts without changing the alignment! Here again, the DotLine Laser Pulley Alignment Tool is invaluable. All three of the alignment parameters can be monitored simultaneously for all sheaves while adjusting the tension.

The final step is to run the machines for about two hours to allow the belts to stretch and seat themselves properly in the grooves. The belts must then be retensioned to the recommended values. Now, run the machines at least 72 hr but not more than 10 days. Retension once again, this time to the manufacturer's recommended force values for used belts. ■

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