Written by Bill Hillman, Ludeca, Inc.
Tuesday, 27 July 2010 04:04

You might be surprised at how much energy is wasted when these systems operate poorly.

Properly maintained V-belt drives can be up to 97% efficient. Poorly operating belt drives can waste as much as 10% additional input power. Let's consider a scenario that ignores motor losses and only considers losses in the belt drive. With electricity costs of seven cents per kWh, a rotor operating three shifts per day, five days per week and requiring 50 horsepower from a belt drive would consume over $16,000 of power annually. An additional drop in efficiency of only 5% would result in increased costs of over $800 per year. In some industries, such belt drives may comprise more than 50% of the total drive population. This example clearly shows that big savings can be realized by properly maintaining them.

Problems that can cause loss of efficiency in belt drives include belt misalignment, heat, worn pulleys and improper belt tensioning.

Belt misalignment. . .

Belt-drive misalignment is a common cause of premature belt failure. Belt-drive performance is greatly reduced when misalignment causes increased belt wear and belt fatigue. Misaligned belts can fail quite rapidly due to the additional stresses imposed on the drive. Misaligned belts also increase machine vibration. The energy required to produce the vibration is wasted, adding to increased efficiency losses. Properly aligned belts will greatly increase both belt and pulley service life.

The industry standard for V-belt alignment requires that the belts be aligned to within 1/10 in. per ft. of distance between center of shafts and 1/16 in. for synchronous belts. For V-belts, this means that with a shaft-to-shaft center distance of 60 in., the misalignment can total ½ in. and still meet the standard. Modern belt-alignment tools allow for much greater precision than the standard requires. Uneven wear of belts and pulleys is an indication of misalignment problems—*which need to be corrected before replacing these components.*

Heat. . .

According to a Dayco and Gates reference, belt life is cut in half by every 35 F degree temperature rise above 85 F. Belt life should be 15,000 - 20,000 hours. This means that at three shifts per day, five days per week, a set of belts should last from 1.7 to 2.2 years. One study even predicts 25,000 hours at 85 F. Belt temperatures should be held below 140 F; above that point, belt life will drop to about 6500 hours.

Totally enclosed belt guards trap heat, making them a problem. Guards are for safety and to prevent debris from falling into belts and pulleys. Vent guards on the sides and near the top so heat can escape. Belt guards should conform to OSHA regulations. Keep belts as cool as possible.

Measure operating pulley groove temperature with an infrared thermometer or infrared camera to see if temperatures are higher than those suggested above. If they are, the belt is probably slipping—*which leads to the question of what should be done.* The typical response is: "Tighten the belts." That's incorrect. The right answer? "Address the problem causing the belts to slip." Potential problems include:

- The belts may need re-tensioning.
- The belts may be damaged.
- The sheaves may be excessively worn.
- The belts may be misaligned.
- The belts may not be matched in length.

Worn pulleys. . .

Worn sheaves may reduce belt life by as much as 50%. Use a sheave gage and check sheaves for wear. The total wear should not exceed 1/32 in. If sheaves are replaced every three belt changes and belt life is as stated above, sheaves should last 6.5 years. The top of the belt should not be below the outside diameter of the sheave. The belt should not contact the bottom of the pulley groove. (A shiny groove bottom is an indication of contact.)

Move pulleys in as close to bearings as possible, to reduce loads on bearings. Reducing the load on a bearing by half can increase bearing life by a factor of 8.
Larger sheaves can increase belt life. Increase both the driver and driven-pulley diameters by the same percentage, and speeds will remain the same. Larger pulleys reduce bearing loads because they allow for more contact area between the belt and pulley, permitting operation with less belt tension.

Improper belt tensioning. . .
Belt tension charts show the amount of tension that will allow a belt to deliver maximum horsepower—*which is usually much more tension than is required by the application*. Contact the belt manufacturer and provide drive information to get more accurate tension information for the applicable loads. The proper tension for a belt is the minimum tension at which the belt will not slip under the maximum load. Belts should not squeal on startup. If a belt is adjusted to proper tension and the drive squeals on startup, the drive is probably inappropriate for the application.

If belt drives are properly maintained and fail frequently, the drive may not be properly engineered. Call the belt manufacturer and provide drive information to determine proper application.

Belt-changing tips

- Don't pry belts off pulleys. Loosen motor-base bolts or the adjusting screw to release belt tension. Rolling belts on with a screwdriver may damage cords, causing the belt to be thrown off the pulley or turn over in the groove.
- Tighten pulley-bushing bolts in proper sequence to pre-vent axial runout on pulleys.
- Check and correct motor soft foot. Evidence of soft foot correction on belt drives is rare. Many craftspeople think motor shims are used only for shaft-to-shaft alignment. Soft foot conditions can also exist in belt-drive motors.
- Tension belts with a belt-tensioning tool. Run machine then re-tension. After 24 hours, re-tension belts again. Proper tension is the lowest tension at which the belt will not slip under maximum load. Over-tensioning shortens both belt and bearing life.
- Don't use belt dressings. Oil and grease shorten belt life.
- Check pulley runout with a dial indicator. Correct any runout problems before changing belts.
- Don't mix brands of belts, and don't mix new belts with old.
- Beware thick-sided pulleys when aligning belts as they may introduce error into the alignment. The goal is to align the belts, not the pulley faces. The best laser pulley-alignment tools offer optional magnetic targets that can be adjusted for different sheave-wall thicknesses.

UM

The Case for Laser Alignment:
A Personal Perspective

Many years ago, my wife gave me a battery-powered electric screwdriver as a gift. While I graciously accepted it, I didn't think I would ever use it. In fact, I wondered why anyone would want one!
I had more than a dozen regular screwdrivers in my toolbox; they had served me quite well over the years. I saw this new version as a gimmick for the gullible. How could I have been so wrong? The electric screwdriver soon became one of my favorite tools.

I went through a similar shift in thinking about laser belt-alignment tools. When I first heard about the technology, I wondered why I would want such a device when all I needed was a piece of string. Perhaps I'm just a slow learner. After trying out a laser belt-alignment tool, I realized that it was far superior to anything I had used previously for aligning pulleys and belts. The accuracy achieved, ease of use and speed of performing the alignment makes this tool a requirement for good belt-drive maintenance.

Belts are not aligned unless the shafts are parallel. Getting the shafts parallel can be difficult with strings and straight edges; a laser alignment tool makes the job quick and easy. An additional, more important advantage of the advanced laser belt-alignment tool is that I don't need anyone to help me align a drive. As I move a machine, the laser striking my targets on the opposing pulley allows me to see when I reach proper alignment—a one-man operation!
... BH

Bill Hillman is a technical contributor for LUDECA, INC., vendor of laser pulley-alignment tools. Telephone: (903) 407-9488 or (972) 429-3670; e-mail: billcmrp@yahoo.com