All You Ever Wanted To Know About Misalignment, But Were Afraid To Ask PA NOTE

Everyone has their own impressions about the effects of misalignment on belt drives. The fact is that misalignment will reduce belt life by increasing wear and increase the probability of belt turnover by decreasing stability.

This does not mean that misaligned drives will not "turn wheels". For some applications, misalignment is a necessary evil. In quarter turn drives, reduced belt life is an acceptable penalty to pay for the end result of power transmission in multiple planes. Here the user is aware of the effects of misalignment and can compensate for it by over-designing the drive and realizing that belt life will be reduced.

Here's the bottom line: "Any" degree of sheave misalignment will result in some reduction of belt life, which is not accounted for in the normal drive design procedure. As a general rule, sheave alignment on V-belt drives should be within 1/2 degree, or 1/10" per foot of center distance. SAE standards specify a maximum of 1/3 degree misalignment for any automotive V-belt. Misalignment of synchronous and Micro-V® belt drives should be less than 1/4 degree. For single V-belts, when the total drive misalignment approaches or exceeds 6 degrees, belt stability is threatened with an increased possibility of belt turnover.

Misalignment comes in two varieties: parallel and angular. Parallel misalignment is where the driveR and driveN shafts are parallel but the two sheaves lie in different planes. When the two shafts are not parallel the drive is angularly misaligned. A fleeting angle is the angle at which the belt enters and exits the sheave and equals the sum of the parallel and angular misalignment.

Belt kink, or sideways bending, is related to the fleeting angle and increases belt fatigue on a misaligned drive. The affects of belt kink are greater with belts having high modulus tensile cords such as fiberglass, steel, and Kevlar [aramid], because these cords cannot stretch to absorb the sideward stresses. In addition to belt kink, misalignment reduces belt life by increasing sidewall scouring against the sheave grooves. This accelerates belt and sheave groove wear and increases internal belt temperatures. Increased wear will also speed the decay of drive tension, further contributing to instability problems.

The affects of misalignment are greater for PowerBand® belts, Micro-V belts, flat belts, and synchronous belts. The increased stiffness of a PowerBand belt reduces its ability to withstand belt kink. Misalignment results in tracking problems with flat and synchronous belts. On drives with flanged pulleys, this means rapid belt wear. Misaligned drives without flanged pulleys won't have any wear problems - the belt won't be on the drive long enough to wear.

Angular misalignment causes its own special headaches with multiple V-belt, flat, and synchronous belt drives. Multiple V-belt drives will have a tension variation along the set of belts, which will further contribute to instability problems. Angular misalignment on flat and synchronous belt drives will increase the likelihood of edgecord failure caused by differential cord loading.

Misalignment can result from improper installation of the bushing in the sheave or the bushing on the shaft. This should be checked carefully on every new drive installation. Gates recommends that a straightedge be used to check alignment in each direction. In other words, lay the straightedge across the face of the driveN sheave and check that the driveR is aligned. Then lay the straightedge across driveR and check alignment of the driveN. This procedure will check for both angular and parallel misalignment. [Account for differences in the pulley edge thickness dimension.]

In the case where misalignment greater than 6 degrees is inherent in the application, deep groove sheaves should be used. They will offer support for the entire belt sidewall and minimize the possibility of instability problems.

Misalignment is a thorn in the paw of satisfactory drive performance. It is many times the not-so-obvious culprit in seemingly complex drive problems. Checking drive alignment should be a regular routine when troubleshooting a belt drive.

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