HOT AND COLD RUNNING BELTS

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Temperature has a big influence on the life of V-belts, especially in very hot or cold environments. But, there are things you can do to enhance belt performance despite temperature extremes.

Even though belt drives are properly designed, installed, and maintained, belt life diminishes when operated at extremely high or low ambient temperatures.

There are no well-defined temperature limits for satisfactory belt performance. As a rule of thumb, however, most belts give acceptable service within a range of -30 to between 130 and 160° F.

When drives operate at temperatures outside this range, users are often willing to accept decreased belt performance. This is unfortunate considering that, with a few changes, they can improve the performance and extend the life of such belts.

V-Belt Burnout

If an industrial belt is properly applied and maintained, it shouldn’t run at more than about 140 °F, assuming an ambient temperature of less than 110 °F. Higher temperatures cause the rubber properties to deteriorate, leading to premature failure.

Laboratory tests define more specifically the relationship between temperature and V-belt life. They show that, for every 36 °F increase in ambient temperature, the service life of V-belts is cut in half, Figure 1. These tests also show that for every 2 °F increase in ambient temperature, the internal temperature of a moving belt rises by only 1 °F (a 2:1 ratio). Thus, V-belt life is cut in half for east 18 °F increase in belt temperature.

Although it would seem that the ambient and internal belt temperature should be the same, the 2:1 ratio between ambient and belt temperature changes has been verified by repeated tests. The difference may be due to the effect of windage that helps to cool a moving belt.

Similar test results for V-ribbed and synchronous belts are not available. However, the 18 °F belt temperature relationship would be a good rule of thumb because it agrees with chemical reaction relationships and other rubber product tests.
Figure 1 - V-belt life gets shorter at elevated temperatures. These results are based on tests of 1/2-in. belts running at constant speed and tension and loaded to 12 hp.

Belt temperature can be checked in two ways. In the first method, stop the drive, then cautiously touch the belt. If it isn’t too hot, your hand can rest comfortably on the belt for at least a few seconds. If you can hold the belt for 5 seconds, the belt temperature is probably less than 140 °F.

Another, more accurate, method is to use either an infrared pyrometer or a needle pyrometer. The infrared device measures the surface temperature of a belt while it is running. The needle pyrometer reads the internal temperature of a stationary belt, Figure 2.
Heat Sources

Three primary causes of over-heating in belts are ambient conditions, belt slippage due to improper maintenance, and severe operating conditions. By far, the most common cause is belt slippage, followed by high ambient temperature.

Some belts have to run in a hot environment. For example, belt drives operate near high-temperatures kilns in brick manufacturing facilities, next to hot-running engines, or surrounded by totally enclosed, unventilated guards. In these situations, other drive components, such as electronics and motors probably won’t last long either.

If ambient conditions have been eliminated as the cause of overheating, belt slippage and severe operating conditions become the prime suspects.

Improper belt tension is an obvious cause of slippage, which generates unwanted heat. Less obvious causes include misalignment, worn sheaves, or foreign material such as dirt, oil, or water.

Unusually severe operating conditions or improperly designed drives also cause high belt temperatures. Examples of severe operating conditions include:

- Larger motors or engines than originally anticipated.
- Higher-speed motors with a corresponding reduction in sheave size, which increases belt bending.
- Higher loads than expected.
Take out the heat

When ambient temperature is too high, increase ventilation around the drive to dissipate heat. This can be done by using sheaves with specially designed fins that create air flow to cool the belts, Figure 3. External air sources, such as fans, are another option, but be sure the fan is not drawing hot air from a heat source and blowing it across the belt. And, don’t overlook something as simple as a well-ventilated drive guard, Figure 4. Simply letting the heat out sometimes dramatically lowers the temperature.

If the source of overheating is application-related, the problem may be corrected by redesigning the drive. One could, for example, add more belts to a drive to decrease the load per belt, use larger pulleys to reduce belt bending stress (a major factor in belt temperature), change to a different belt cross section, or use a notched belt.

If redesign is not possible, specially designed sheaves that have thin fins with large surface areas will radiate heat away from the belt.

New rubber compounds have been developed for automotive under-hood applications where smaller engine compartments and frontal areas restrict air flow, allowing temperatures to hit spikes of 300 °F. These highly compounded versions of HNBR and ACSM rubber belts cost two to three times as much as conventional belts. Because of the higher cost, consideration of these materials for the industrial sector would be limited to special applications such as ovens and kilns.
Effects of cold

As temperatures drop to low levels, the belt material, typically neoprene rubber, becomes stiffer until it reaches a brittle point at about -32 °F. Cracking, the major cause of belt failure due to cold, occurs below this temperature.

As long as a drive is running, heat generated by friction and bending warms the belt and keep it flexible at temperatures well below -32 °F.

Conversely, trying to immediately transmit a load through a cold belt upon start-up can crack the belt if it is too rigid to bend.

Other ways to avoid cold-temperature cracking are:

- Warm the drive enclosure or make a temporary enclosure and install a quick-heating unit.
- Remove the belt and store it in a warm place between uses.
- Keep idle time to a minimum and arrange for continuous operating periods.
- Apply minimum torque or no load when starting a drive that has been idle for a long time.
- Use larger pulleys to reduce the amount of belt bending.

V-belts made of an SBR-based compound operate at temperatures down to -65 °F in military vehicle applications. However, the upper temperature limit of these belts is reduced proportionately and is generally 140 °F or less.