



Synchronous Belts - Part II

PA NOTE

This is the second in a series of three PA Notes which is intended to increase understanding of synchronous belt drive design, construction, and operating characteristics. The following discussion will center on the application and operating characteristics of synchronous belts.

Applications

As discussed in the first PA Note, synchronous belts offer many advantages over both conventional belts and chain. Their unique construction and operating characteristics, in some cases, permit application where special drive requirements preclude the use of either belts or chain. Although they can satisfactorily be applied almost anywhere belts are used, they are primarily designed for shaft synchronization applications.

One example of a special drive requirement that lends itself to application of synchronous belts is where belt take-up adjustment for drive tensioning is limited, or where the drive is inaccessible making tension maintenance difficult. The required take-up allowances for tensioning synchronous belts are significantly less than those needed for V-belts. This is because the high modulus cord used in their construction is highly resistant to stretch, closer manufacturing tolerances on length are necessarily maintained, and belt seating in pulley grooves is minimal. There are also certain combinations of load/speed/size requirements that eliminate the possible application of other power transmission systems but are well suited to the operating characteristics of synchronous belts. Power tools and small household appliances are two examples.

Conversely, applications with the following drive characteristics are conducive to satisfactory synchronous belt operation:

1. We do not generally recommend synchronous belts for applications on drives with excessive or extreme shock loads. This is because the positive drive characteristic and high modulus cord material make synchronous belts less tolerant of severe shock than V-belts. The operating characteristics of non-synchronous belt drives enable them to absorb heavy shocks to some degree by allowing slippage and, to a lesser degree, through belt elongation. Also, the standard fiberglass cord has a high failure rate under compression loading, which is often associated with shock loads.
2. Synchronous belts are much more sensitive to misalignment than V-belts and should not be used on drives where misalignment is inherent to the drive operation. Misalignment leads to inconsistent belt wear and premature tensile failure. Tracking problems also result from drive misalignment.
3. We do not recommend the application of synchronous belts on fixed center (non-adjustable) drives for anything other than motion transfer (low or no torque) drives. Fixed center implies exact tolerances. Although length tolerances for synchronous belts are less than those for other belts, no belt can be manufactured to exact specifications. Pulley and drive geometry tolerances also contribute to the problems associated with fixed center drives. Some applications do use fixed centers but not without some difficulties.



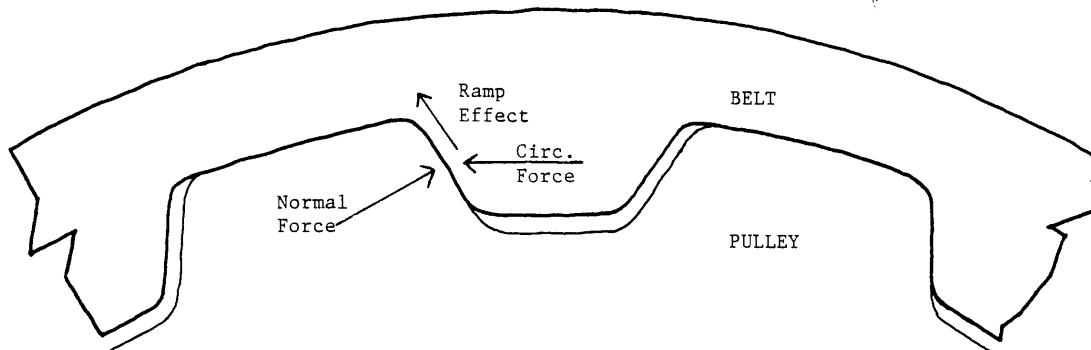
4. Synchronous belts should not be used in excessive debris environments. Debris can be more damaging to a synchronous belt drive than a V-belt drive, which has a tendency to remove debris from the sheave groove through drive operation. Large debris trapped between the belt and pulley will destroy the belt tensile cords or drive hardware. Small debris will become compacted in the pulley grooves forcing the belt to ride out away from the pulley and leading to belt failure by destroying the tensile member. In addition, exposure to oil and other lubricants should be minimized. Oil and petroleum distillates may alter belt polymers and adhesion systems.
5. Most importantly, synchronous belts should not be used to replace a satisfactory V-belt drive. The cost advantage of V-belts will many times eliminate a synchronous belt recommendation in a competitive environment.

Operating Tension

Many people are under the misconception that replacing a V-belt drive with a synchronous drive will reduce bearing loads on any application. Laboratory testing has shown that synchronous belts operate at tension ratios similar to V-belts. Consequently, the operating tensions (bearing loads) are the same as those for properly tensioned V-belts designed for operation under the same continuous load condition.

On applications with varying load requirements, this is not true. Synchronous belts will have lower average bearing loads in this case. In order to discuss this more thoroughly, we should first review the self-generated tension characteristics of synchronous belts.

The trapezoidal belt tooth forms an inclined plane that exerts force normal to the groove. The greatest part of this force is used to transmit the required load, but a small portion acts to force the belt away from the pulley. This is the source of the "self-generated" operating tension. It is easy to see that as the normal force of the belt tooth to pulley groove increases, the force pushing the belt away from the pulley also increases. Another way to look at this is: the tension generated in a synchronous belt drive is proportional to the load being transmitted. This concept is also true for the HTD and STPD profiles but to a lesser degree.





GatesFacts™ Technical Information Library

Gates Compass™ Power Transmission CD-ROM version 1.2

The Gates Rubber Company
Denver, Colorado USA



Thus, in variable load conditions, a synchronous belt drive may have lower average bearing loads than a V-belt drive. This is because, in a synchronous belt drive, tension is generated in proportion to the horsepower being transmitted, whereas with a V-belt, operating tension depends upon the imposed static tension installed for the peak horsepower load.

The required installation tensions are generally lower for synchronous belts than for V-belts. This reduces starting loads on some light duty applications.

In most cases, the use of a spring loaded idler is not recommended on synchronous belt applications. This stems from the fact that a synchronous belt will normally generate sufficient tension to overcome any reasonable force imposed by a spring loaded idler. The belt will ratchet in this situation because the effectiveness of the idler has been eliminated. Any spring force sufficient to impose artificially high belt tension will necessarily be excessive and will significantly reduce belt life. One exception to this is a motion transfer application.

Efficiency

As with other properly designed rubber belt drives, synchronous belt drives operate with very high efficiency. On most drives, synchronous belts may actually have slightly higher efficiency than other belts. Their positive drive characteristic eliminates creep and slippage losses, there are no friction creating joints as with chain, and the thin cross section keeps bending stresses to a minimum (also less heat generation). The slight advantage in efficiency must be balanced against higher initial costs when conducting a cost savings analysis.

Preview

The last PA Note in this series will cover general application parameters, maintenance and troubleshooting procedures, and a brief review of our Poly Chain® and Synchro-Power® Twin Tooth belts.