# Replace V-Belts with Cogged or Synchronous Belt Drives

## Suggested Actions

Conduct a survey of belt-driven equipment in your plant. Gather application and operating hour data. Then, determine the cost effectiveness of replacing existing V-belts with synchronous belts and sprockets. Consider synchronous belts for all new installations as the price premium is small due to the avoidance of conventional pulley costs. Install cogged belts where the retrofit of a synchronous belt is not cost effective.

## Centrifugal Fan and Pump Considerations

For centrifugal fans and pumps, which exhibit a strong relationship between operating speed and power, synchronous belt sprockets must be selected that take into account the absence of slippage. Operating costs could actually increase if slippage is reduced and a centrifugal load is driven at a slightly higher speed.

## Application Considerations

Synchronous belts are the most efficient choice. However, cogged belts may be a better choice when vibration damping is needed or shock loads cause abrupt torque changes that could shear a synchronous belt's teeth. Synchronous belts also make a whirring noise that might be objectionable in some applications.

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About one-third of the electric motors in the industrial and commercial sectors use belt drives. Belt drives provide flexibility in the positioning of the motor relative to the load. Pulleys (sheaves) of varying diameters allow the speed of the driven equipment to be increased or decreased. A properly designed belt transmission system provides high efficiency, low noise, does not require lubrication, and presents low maintenance requirements. However, certain types of belts are more efficient than others, offering potential energy cost savings.

The majority of belt drives use ***V-belts***. V-belts use a trapezoidal cross section to create a wedging action on the pulleys to increase friction and the belt's power transfer capability. Joined or multiple belts are specified for heavy loads. V-belt drives can have a peak efficiency of 95% to 98% at the time of installation. Efficiency is also dependent on pulley size, driven torque, under or over-belting, and V-belt design and construction. Efficiency deteriorates by as much as 5% (to a nominal efficiency of 93%) over time if slippage occurs because the belt is not periodically re-tensioned.

***Cogged belts*** have slots that run perpendicular to the belt's length. The slots reduce the belt's bending resistance. Cogged belts can be used with the same pulleys as equivalently rated V-belts. They run cooler, last longer, and have an efficiency that is about 2% higher than that of standard V-belts.

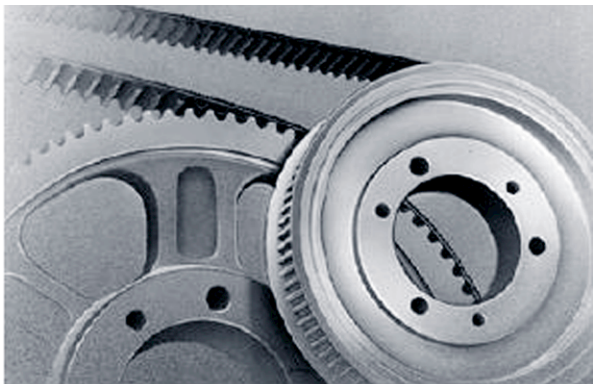
Photo Courtesy of Gates Rubber Company

***Synchronous belts*** (also called timing, positive-drive, or high-torque drive belts) are toothed and require the installation of mating toothed-drive sprockets. Synchronous belts offer an efficiency of about 98% and maintain that efficiency over a wide load range. In contrast, V-belts have a sharp reduction in efficiency at high torque due to increasing slippage. Synchronous belts require less maintenance and retensioning, operate in wet and oily environments, and run slip-free. But, synchronous belts are noisy, unsuitable for shock loads, and transfer vibrations.

## Example

A continuously operating, 100-hp, supply-air fan motor (93% efficient) operates at an average load of 75% while consuming 527,000 kWh annually. What are the annual energy and dollar savings if a 93% efficient ($E_1$) V-belt is replaced with a 98% efficient ($E_2$) synchronous belt? Electricity is priced at $0.05/kWh.

**Energy Savings** = Annual Energy Use x $\left(1 - \frac{E_1}{E_2}\right)$

= 527,000 kWh/year x $\left(1 - \frac{93}{98}\right)$ = **26,888 kWh/year**

**Annual Dollar Savings** = 26,888 kWh x $0.05/kWh = **$1,345**

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