ENERGY SAVINGS FROM SYNCHRONOUS BELTS

INTRODUCTION

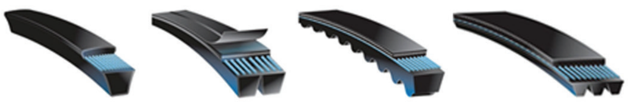
According to the U.S. Department of Energy, manufacturing operations in the U.S. spend $30 billion annually on the electricity powering motor-driven systems. Many of the 40 million electric motors in operation, which consume 70 percent of all electricity used in the plants, are powering systems not running at optimum efficiency, which results in higher costs.

Electric motors are common, and most of them use belt drives to transmit power. If these drives could improve efficiency by a mere 5%, the energy savings – and cost savings – would be significant. Fortunately, synchronous belt drives designed with energy efficiency in mind operate so efficiently that they enable up to 5% savings, reducing maintenance, cost, and downtime across applications.

COMPARING V-BELTS AND SYNCHRONOUS BELTS

ENERGY EFFICIENCY

Most of today's belt drives use standard V-belts, which have a V-shaped cross section, creating a wedging action on the pulleys.



Low acquisition costs, wide availability, and quiet performance make V-belts a popular power transmission solution.

V-belts are designed to generate friction between the belt sidewall and the groove surface of the metal; any slip results in torque loss and creates heat, which causes energy loss. The energy required to bend a belt around a sheave also results in energy loss.

Molded notch V-belts are more flexible and lose less energy when bent around a sheave and are the most efficient belt choice when a synchronous belt drive is not an option.

Synchronous belt drives are a more energy-efficient alternative to V-belt drives. A synchronous drive has positive engagement between the belt tooth and sprocket groove and generally runs cooler.

The synchronous belt's tooth profile has evolved over time from trapezoidal, to the rounded tooth of curvilinear, and finally to modified curvilinear, pictured above from left to right.

MAINTENANCE

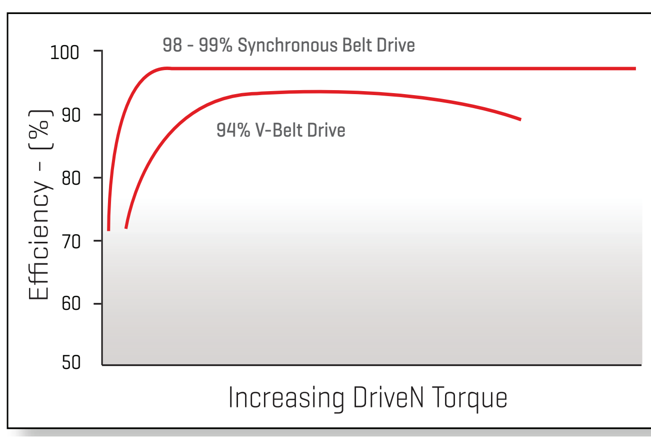
A positive tooth/groove engagement prevents a synchronous belt drive from slipping, while V-belt drives, no matter how well maintained, will exhibit some amount of slip. Slip occurs when the installation tension is insufficient to transmit the load. V-belts elongate and require retensioning on a regular basis whereas synchronous belts have minimal elongation and require no retensioning if properly installed, further reducing downtime and maintenance expense.

Although properly maintained V-belt drives can run as high as 95-98% efficient at the time of installation, this deteriorates as much as 5% during operation. Poorly maintained V-belt drives may be up to 10% less efficient.

BELT OPTIONS

Gates offers several options that save energy, resist heat and are low-maintenance. Synchronous belts, such as Gates PowerGrip® GT®3 and Poly Chain® GT® Carbon™ belt drive systems, remain at an energy efficiency of approximately 98%- 99% over the life of the belt.

When your drive requires a V-belt design, your belt choice can pay off. Gates Molded Notch V-Belts have a unique ethylene construction for higher heat resistance, longer service life, and up to 3% energy savings when replacing wrapped belts.



On average, a synchronous belt drive is 5% more efficient than a standard V-belt drive, eliminating excess energy consumption.

CALCULATE POTENTIAL ENERGY SAVINGS

Use the following formula to determine the kilowatt-hours saved when using synchronous belt drives rather than standard V-belt drives:

$$\text{Estimated Annual Savings in KWh} = \frac{(\text{Motor HP})(\text{Hrs/Yr})(.746)(.05)}{\text{Motor Efficiency}}$$

where the constant .746 is the conversion factor from hp to KW, and .05 is the 5% energy savings gained by converting.

Maintenance managers can leverage improved energy efficiency by converting V-belt drives to synchronous belt drives in one of two ways:

1. Maintaining current capacity while using less power, or
2. Meeting capacity demands using much less power.

For example, if the current airflow is satisfactory in an HVAC application, a synchronous belt drive would use less energy to do the job. If the needed airflow is less than is currently being delivered, a synchronous belt drive could be designed to provide consistent slower speed to maintain the air delivery over the life of the drive with even more significant energy savings.

Save Time and Money with Design Flex® Pro™ Software

Quickly design and compare two-point synchronous or V-belt drives that fit your parameters, and feel confident that your redesign is the most efficient option for your application.

Learn More & Download

LESS MAINTENANCE. MORE PRODUCTION.

V-belt drives and synchronous belt drives demand approximately the same amount of time for installation. A key difference between them, in terms of maintenance, is that synchronous belts do not require a run-in maintenance procedure or retensioning. Failure to perform these run-in procedures for V-belt drives may result in poor performance and/or premature belt failure – and a costly replacement.

A synchronous belt requires no retensioning, improves energy efficiency, and eliminates downtime. More uptime equates to more production, which leads to higher profit.

Quick Facts

- Machine drives, which are primarily electric motors, pumps, and fans, account for about half of the manufacturing sector's delivered electricity use.
- Industrial motor use consumes 25% of total electricity usage in the U.S.
- The majority of belt failures can be traced to environmental factors (debris, temperature, contaminants) and improper belt drive maintenance.
- Electricity costs make up about 96% of the total life-cycle cost of a motor.

A SHORT PAYBACK PERIOD

Factoring in energy savings, maintenance savings, and reduced downtime, payback from converting to synchronous belt drives is typically much less than one year.

Estimating potential energy savings and the payback period for a synchronous belt drive is simple:

Annual Energy Cost ($) = (Motor HP)(Hrs/Yr)(.746)(Cost per KWh) / Motor Efficiency

Annual Energy Savings ($) = (Energy Cost)(Efficiency Increase)

Payback Period = New Drive Cost / Annual Energy Savings

For example, if energy costs are $0.10 per KWh, the annual energy cost for a 40-HP motor running at 89% efficiency, 8,736 hours per year, totals $29,290.14. The annual energy savings is $1,464.51. If a new synchronous belt drive costs $342.83, the payback period is .23 years – fewer than three months.

When a V-belt drive is converted to a synchronous belt drive, savings continue to accrue year after year.

Gates® **CASE STUDY** **REICHHOLD, INC.**

V-BELT TO SYNCHRONOUS BELT CONVERSION YIELDS DRAMATIC COST SAVINGS IN PLANT'S HVAC SYSTEM OPERATION

Reichhold, Inc. is a global supplier to the composites and coatings industries, with 18 manufacturing facilities in 11 countries. The maintenance technician at the Durham, North Carolina facility approached a representative of Gates Corporation to survey the plant for potential energy savings. During the hot summer months, the plant spent approximately $80k per month in energy costs to operate its equipment.

The Gates representative analyzed 21 HVAC units with 30 hp motors, 44 fume hood exhaust fans with 5-10 hp motors and four cooling tower fan drives with 50 hp motors – all V-belt driven – using the belt drive selection tool Design Flex® Pro™.

HVAC UNIT ANALYSIS AND CONVERSION

The HVAC drive units were equipped with 4-strand V-belts, which required periodic retensioning and replacement every three months. The V-belt drive was replaced with a 14mm Gates Poly Chain® GT® Carbon™ belt drive, and performance was tracked.

Annual KWh usage fell into a range between 10,103 and 10,557 KWh per year, representing a yearly energy cost savings of $505 to $527 per unit. Converting all 21 units represents an energy cost savings of 21 x $505 = $10,608. In addition, the synchronous belt drive will run for years without retensioning or replacement, saving additional downtime and maintenance expense.

COOLING TOWER FAN DRIVE ANALYSIS AND CONVERSION

The Reichhold facility also included two 1,320-ton chillers with matching cooling towers. Each cooling tower had two fan drives fitted with V-belts. When one of the fan drives was converted to a 14mm Gates Poly Chain GT Carbon belt drive, the difference in performance was substantial. Estimated yearly cost savings for converting all four fans is $12,595, including reduced downtime and maintenance costs.

Before: Cooling tower fan with 5 strand V-belt drive.

After: Same unit with synchronous belt drive.

EXHAUST FAN DRIVE ANALYSIS AND CONVERSION

Although covered, the 44 fume hood exhaust fans on the Reichhold facility rooftop are subject to extreme seasonal temperature changes. 2-strand V-belts must be replaced every three months. The immediate result from conversion to an 8mm Poly Chain GT Carbon belt drive saw a 12.9% reduction in energy consumption. In addition, the annual cost of maintaining each V-belt was $250. Converting all 44 drives represents a maintenance cost savings of $11,000/year, in addition to the lower energy costs.

CONCLUSION

The maintenance and energy cost savings achieved by converting various V-belt drives to synchronous belt drives at the Reichhold facility totals over $34,000 per year.

Additional Resources

- To contact a Gates representative about drive conversions that increase efficiency and reduce energy costs, email gatespt@gates.com.
- For more information about energy efficiency, please visit www.gates.com/catalogs.
- For assistance designing your drives, contact Gates Product Application Engineers at ptpasupport@gates.com.