



Saving Energy With Synchronous Belts Put Some Teeth In Your Energy Savings

Julie I. Harrington
Automation
January 1991



Because of today's increasing energy costs, plant engineers are always looking for ways to increase efficiency. Higher efficiency means proportionately lower energy costs and, depending on the size of the operation, improving efficiency by just a few percent can produce significant dollar savings.

At the heart of many automated systems is a power transmission system, which frequently uses belts to transfer energy from a prime mover to a driven shaft. It is here that efficiency losses can occur, due to belt design or lack of maintenance. Fortunately, it is also here that substantial gains in efficiency can be obtained through the use of synchronous belts.

Belt Basics. Synchronous belts do not rely on friction or wedging for their drive power. Instead, they have teeth that are precisely molded to provide positive engagement between the belt and pulley or sprocket groove. Various tooth profiles are available to meet most drive requirements. Conventional or trapezoidal timing belts are available in several sizes and are rated from fractional to about 170 hp. They are best used in synchronizing applications.

High torque drive belts are available for applications that require greater load carrying capability. Special curvilinear tooth profiles, and other variations, distribute loads more evenly and make their use possible in applications rated as high as 1200 hp.



Advantages. Through comparative laboratory testing between V-belt and synchronous belt drives, it has been proven that in most situations synchronous drives are equal to or more efficient than properly maintained V-belt drives.

On high torque applications, synchronous belt efficiency increases and then remains relatively constant with increasing torque. At low speeds, synchronous belts generally carry more horsepower per inch of width than V-belts. V-belt efficiency decreases when torque overcomes static tension and the belt begins to slip.

Over-designed and under-designed V-belt drives tend to be less efficient than drives carrying the load they were originally intended to carry. However, synchronous belt efficiency remains relatively constant.

Improperly maintained or hard to maintain drives present an excellent application for synchronous belts. Properly installed and tensioned V-belt drives can be 95-98% efficient upon installation, and then deteriorate up to 5% during operation. Poorly maintained V-belt drives may be up to 10% less efficient because of stretch and slip. Conversely, synchronous belts can consistently maintain efficiencies as high as 98%.

Small diameters increase bending stresses, thus reducing efficiency. However, since energy losses due to bending are not as high with synchronous belts (because of their thinner cross-sections) their use may be advantageous.

Narrower or fewer belts tend to be more efficient in high-speed, low-torque situations. This is because energy is required to bring a mass up to speed. The higher the speed and the larger the mass, the more significant the energy loss due to inertia.

Energy Savings. Laboratory and field testing has shown that converting from V-belts to synchronous belts increases efficiency, on average, about 5%.

A more specific method would be to take amperage readings for each drive at the input end. The efficiency would then be determined from the difference in amperage readings of the two drives. When using this method, it is critical that driven rpm be identical for the systems being compared.

The most accurate method of determining energy saving is to perform an input-output test. This method measures input and output conditions of both drives, calculates the efficiency for each drive, and uses the difference to determine the energy savings. This is a very time consuming and complicated method. However, once the difference in efficiency has been determined, energy savings may be calculated by multiplying the average energy cost by the efficiency increase.

Synchronous belts can provide increased efficiency in many applications by minimizing torque and speed losses. High torque applications, over-designed and under-designed drives, improperly maintained drives, small diameters, and high speeds all provide excellent opportunities for increasing drive efficiency by using synchronous belts.