Guide to Selecting and Replacing Synchronous Belts

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Just as we now consider rotary dial phones archaic, so are many installed synchronous belt drives. That they continue to operate is testimony to their durability. But that should not prevent you from taking advantage of newer synchronous belt drive technology that can improve both equipment design and field installations.

Synchronous belt technology has taken a quantum leap forward since the invention of the timing belt in the 1940s. Synchronous belts now rival roller chain, gears, and other forms of power transmission in almost any application. Research into new compounds, additives, blending processes, jackets, tensile cord materials, and tooth profiles yields further advances every day, resulting in belt drives that pack more power into an ever smaller space.

This article will review some basics about synchronous belt drives and highlight some of the technological advancements that might make you rethink that new drive design or replacement drive.

Belt Replacement

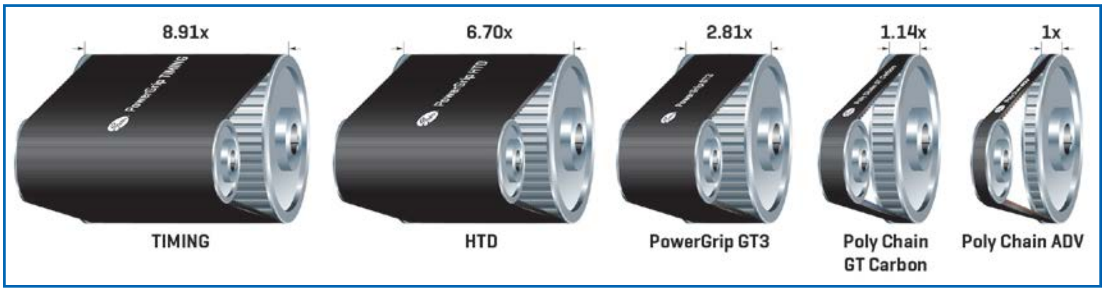
When replacing a synchronous belt on an existing drive, there's a natural tendency to simply swap out the belt for an identical new one. That could be a mistake for two reasons. The first is that belt wear might be the result of worn sprockets. A good rule of thumb is to replace sprockets after every third replacement belt has reached its maximum service life, or sooner if the sprockets show significant wear. Worn sprockets reduce belt life considerably.

However, there's a second and more compelling reason not just to swap out an old belt for a new one. Take a close look at the drive and the equipment on which it's installed. If you are running a traditional timing belt, for example, you have a range of other synchronous belt design options open to you. (See the image above and compare the size of the timing belt on the left to the latest synchronous drive on the right, which can outperform the timing belt.)

Decades ago it took wide belts and sprockets to handle load-carrying applications. The belt/sprocket width and weight of these drives, when attached to a speed reducer, often contributed to exceeding the specs for overhung load, placing a strain on bearings. Frequent bearing replacement and associated maintenance costs were the result.

Today's narrower, lighter synchronous drives can not only handle greater loads, but they also allow the sprockets to be placed on the shaft closer to the bearings, which reduces overhung load and extends bearing life.

What are some of the technological advancements that allow today's synchronous belt drives to become ever smaller and more powerful?



Each of the drives pictured has the same performance capabilities. The drive on the far right, however, uses the latest technology to greatly reduce size and weight.

Tooth Profiles

The first synchronous belts were designed with trapezoidal shaped teeth. The term "timing belt" is often applied to this tooth profile because it is used primarily for synchronizing, or timing, the movement between two shafts. Technological advancements in tooth design led to the curvilinear and modified curvilinear tooth profiles, each of which increased the load-carrying capacity of synchronous belts.

Today's modified curvilinear tooth profiles ensure smooth, quiet operation and precise registration for high precision positioning applications and high capacity power transmission drives.

Modified Curvilinear

Curvilinear

Timing

Belt Construction (Body Compounds and Jacketing Material)

Synchronous belts with the same tooth profile perform differently depending on their construction and who manufactures them. Engineering and design processes used to combine body compounds, jackets and tensile cord can vary greatly. Designers and users should be mindful of a belt's performance characteristics before specifying or replacing a belt on a piece of equipment.

Tensile Cord

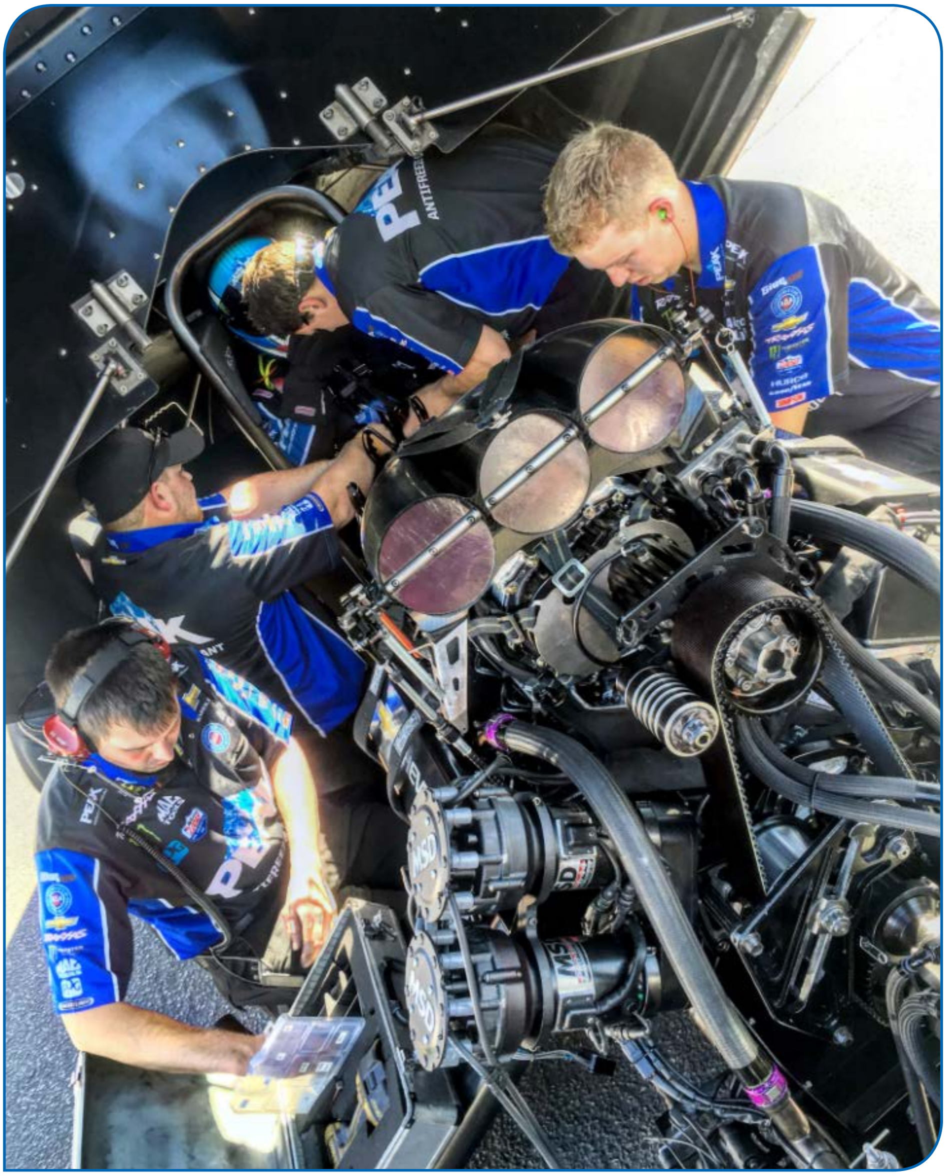
The tensile cord is the muscle of a synchronous belt, bearing most of the load for transmitting power. Steel was the first material used for tensile cords, replaced by fiberglass and aramid fibers, which offered additional strength and heat resistance. Today's newest, high-end belts use carbon fiber tensile cords, which offer the following characteristics and advantages:

- High power density for more compact drive designs
- High flex fatigue resistance
- High modulus (pitch stays constant regardless of load)
- High strength-to-weight ratio
- Superior environmental resistance (no degradation from water, oil and most contaminants)

Sprockets

Sprockets are a highly engineered component of synchronous belt drive designs. It takes both belt and sprockets working together in harmony to deliver a high performance belt drive system.

Considering that sprockets may operate at rim speeds up to 6,500 feet per minute and transmit loads as high as 1,200 hp, sprocket design and analysis is a critical component of drive performance and safety.



The blower on John Force's record-setting NHRA Funny Car is powered by a synchronous belt drive that helps the 8,000-horsepower dragster exceed 300 miles-per-hour in less than 4 seconds.

Application Criteria

Synchronous belt drives are well suited for applications with the following demands:

- Synchronizing power transmission between shafts
- High mechanical drive efficiency
- Compact drive layout
- Low maintenance
- Energy savings
- Clean running (no contamination from lubrication)
- High torque at both low and high speeds

Conclusion

When it comes time to replace a synchronous belt on an old drive, or design a new drive, stop a moment and consider the benefits of upgrading to the latest synchronous belt and sprocket technology. Today's narrower drive profiles offer high load-carrying capacity in a compact space while saving wear and tear on connected components. **PTE**

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