The Gates Rubber Company
Denver, Colorado USA

Synchronous Belts - Part I
PA NOTE

Use of synchronous belts has increased steadily since their introduction into the field of power transmission over 40 years ago. Gates latest marketing efforts have led to a greatly increased number of inquiries from the field. You'll be called upon more frequently to answer questions and design new synchronous belt drives. This is the first in a series of three PA Notes intended to increase understanding of synchronous belt drive design, construction, and operating characteristics which will assist in handling these problems.

This PA Note includes a general discussion covering the advantages of synchronous belts, available profiles, sizes, and constructions, and the availability of pulleys. Subsequent PA Notes will cover application and design procedures, operating characteristics, and suggestions for drive maintenance and troubleshooting.

History

The initial development of the synchronous belt was started around 1940 by the L. H. Gilmer Company. Progress was slowed by World War II but was completed and the first timing belt drive design catalog printed in 1949. Gilmer realized the need for a power transmission system to fill the void between chain and conventional rubber belts. Even then, he had a comprehensive understanding of the advantages this product offers to industrial and OEM consumers.

a. The positive drive characteristics provide exact synchronization eliminating speed loss inherent in other belt drives.
b. They allow positive drive characteristics at speeds much higher than those common to most chain drives.
c. When properly designed and installed, timing belt drives are less critical to tension maintenance than V or flat belt drives due to the positive drive characteristics and high modulus, low stretch tensile cord used in their construction.
d. They need no lubrication or oil encasement.
e. Their thinner cross sections reduce heat generation induced through bending stresses.
f. The positive engagement of belt teeth in pulley grooves makes synchronous belt drives less critical than V or flat belts to inadvertent exposure to drive lubricants such as oil or water, although extended exposure will result in premature belt degradation.
g. They are quieter than most chain drives.

Tooth Pitches and Profiles

The first synchronous belt product line included one trapezoidal tooth profile and pitch. This single belt size incorporated a variety of constructions designed to handle light and heavy duty or high and low speed application requirements.

The product has evolved since that time into a complex line of various pitches, profiles, and constructions. A wide range of pitches is now available to increase drive design flexibility to include a variety of load/speed conditions. Various tooth profiles have been developed to increase the basic horsepower capacity for a given belt size. Following is a complete list of the standard tooth profiles and pitches now available [Circa 1982]:

Conventional Trapezoidal Profile		HTD Profile	STPD Profile
MXL -	.080" Pitch	3 mm Pitch	2.5 mm Pitch
XL -	.200" Pitch	5 mm Pitch	4.5 mm Pitch
L -	.375" Pitch	8 mm Pitch	8.0 mm Pitch
H -	.500" Pitch	14 mm Pitch	14 mm Pitch
XH -	.875" Pitch	20 mm Pitch	
XXH -	1.25" Pitch		

The MXL cross section is now the RMA accepted standard mini-pitch belt system, replacing the previously used 40 DP belt (.0816"). The 40 DP system was initially developed as an alternative and compatible means of power transmission utilizing existing 40 diametric pitch gears. Hence the designation of 40 DP. The pitch and profile of these belts are very similar to MXL belts and distinguishing between the two is difficult without accurate measuring tools. The two systems are not compatible and components cannot be interchanged between them.

One easy way to detect the difference in profiles is to place a 40 DP belt on an MXL pulley or vice versa.

The HTD and STPD profiles were developed by Uniroyal [now Gates Rubber] and Goodyear, respectively, as high capacity cross sections. Both incorporate curvilinear (round) tooth profiles and have similar pitches, but the two systems are not compatible. Gates has no published drive design data for the STPD profile; drive designs using this cross section must be obtained through Gates Product Application Department.

Belt Construction

Construction is another variable which adds increased versatility to our line of synchronous belts. Our standard construction incorporates a premium oil and heat resistant neoprene stock, high modulus fiberglass tensile, and a nylon fabric tooth facing. All components are molded integrally to form a continuous belt.

The premium neoprene stock forms the teeth and protective overcord of the belt. In addition to the standard construction, special constructions are available to provide high oil resistance, static resistance, static conductance, and non-marking characteristics. Our static conductant belt construction will meet RMA standards as specified in RMA Bulletin No. 3, whereas our standard construction will not. The tensile cord is the muscle of the belt and the standard high modulus, low stretch fiberglass is excellent for a wide range of general applications. Available alternative cord materials are Kevlar [aramid] and steel with Kevlar being the preferred alternative from a marketing standpoint. All three materials are very high modulus cords with characteristic advantages and disadvantages associated with each. Kevlar [aramid] and steel, in general, have slightly higher ultimate strength. This does not directly translate into increased belt performance. Belt overall performance is optimized by a balance of factors such as fatigue life, environmental stability, strength, and the characteristics of the application (shock loading, ambient temperature). There is not a direct relationship between any two of these factors, i.e., a stronger belt will not necessarily have a greater fatigue life. Like a veteran basketball team for which the overall quality is based on the performance of the team as a whole and not the individual players. A reinforcing fiber must be selected according to how it performs in a certain belt on a certain application and not on a relative strength comparison.

If your customer has an application on which our standard construction belt is not performing acceptably, contact Product Application to discuss an appropriate alternative. Each troublesome drive must be looked at individually to determine the mode of belt failure, confirm proper design, and consider a possible alternative construction.

Pulleys and Sprockets

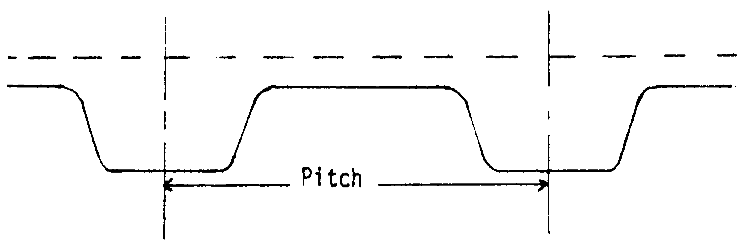
Cast iron pulleys for the trapezoidal profile, with the exception of the MXL and 40 DP pitches, as well as 8 mm and 14 mm HTD sprockets, are stock items and are readily available. All nonstandard pulleys and sprockets must be obtained from an appropriately equipped manufacturer. In the case of HTD sprockets, the manufacturer must be a licensed producer because of Uniroyal patent restrictions. Specific questions regarding availability should be directed to Denver Sales or Product Application.

Summary

It is the diversity of belt profile, size and construction which gives synchronous belts tremendous drive design versatility to accommodate a wide variety of applications. If a customer requires a belt type or construction not covered above, contact Product Application for our evaluation of production capabilities. Remember that a product development project or new tooling must be justified by the marketing potential of that product.

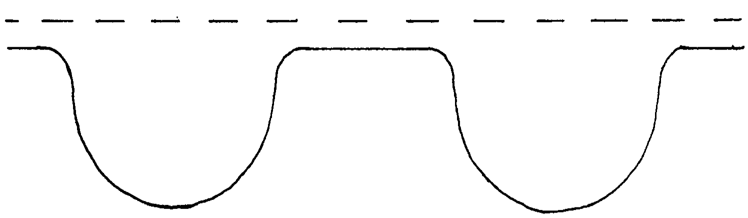
Preview

The next PA Note in this series will cover some of the operating characteristics peculiar to synchronous belts.



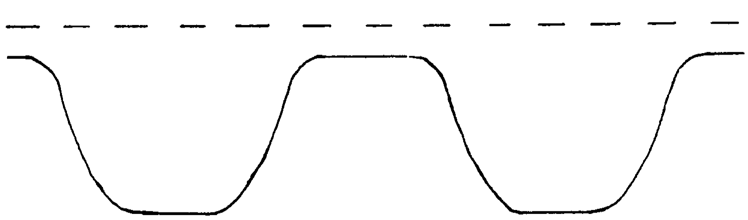
Conventional
Trapezoidal
Profile

MXL - .080" pitch
XL - .200" pitch
L - .375" pitch
H - .500" pitch
XH - .875" pitch
XXH -1.250" pitch



HTD
Profile

3mm pitch
5mm pitch
8mm pitch
14mm pitch



STPD
Profile

2.5mm pitch
4.5mm pitch
8mm pitch
14mm pitch