

Guide to V-Belt Selection and Replacement

Lance Lachney, Product Line Manager, V-Belt Drives, Gates Corporation

V-belts look like relatively benign and simple pieces of equipment. They're basically a glorified rubber band, right? Need a replacement? Just measure the top width and circumference, find another belt with the same dimensions, and slap it on the drive. There's only one problem: that approach is about as wrong as you can get.

Like their synchronous belt cousins, V-belts have undergone tremendous technological development since their invention by John Gates in 1917. New synthetic rubber compounds, cover materials, construction methods, tensile cord advancements, and cross-section profiles have led to an often confusing array of V-belts that are highly application specific and deliver vastly different levels of performance.

In this article we'll review some V-belt basics to help you make better sense of which belt to use in a given application to make your belt drives last longer, run more efficiently, and save you downtime and money.

Size Isn't Everything

Take a look at the accompanying chart (Figure 1). Each of these belts has a ½-inch top width and 50-inch circumference.

However, notice the differences in cord materials, body compounds, cover configurations, temperature ranges and application requirements. Despite their outward similarities, each of these belts is designed for a distinct

purpose. Using the wrong belt could cause equipment damage or pose serious safety issues. What is the right belt for the job? It depends on the application. Following are some environmental and application design criteria that will influence belt selection:

- Ambient temperature
- Oil resistance
- Ozone resistance
- Static conductivity
- Power capacity
- Pulsation or shock loading
- Small sheave diameters
- Backside idlers
- Misalignment tolerance
- Serpentine or quarter turn layout
- Minimal take-up
- Clutching
- High speeds
- Energy efficiency
- Dust and abrasives

As you can see, there are many factors to consider before choosing the right V-belt for the job.

Generally speaking, V-belts fall into these classifications:

- Heavy-duty
 - ◊ Industrial machinery
 - ◊ Continuous operation
 - ◊ Heavy loads and often harsh conditions
- Light-duty
 - ◊ Fractional horsepower applications
 - ◊ Intermittent usage
- Automotive

For this article, we'll confine our dis-

cussion to industrial heavy-duty and light-duty V-belts.

How V-Belts Work

Unlike flat belts, which rely solely on friction and can track and slip off pulleys, V-belts have sidewalls that fit into corresponding sheave grooves, providing additional surface area and greater stability. As belts operate, belt tension applies a wedging force perpendicular to their tops, pushing their sidewalls against the sides of the sheave grooves, which multiplies frictional forces that allow the drive to transmit higher loads. (Figure 2) How a V-belt fits into the groove of the sheave while operating under tension impacts its performance.

V-belts are made from rubber or synthetic rubber stocks, so they have the flexibility to bend around the sheaves in drive systems. Fabric materials of various kinds may cover the stock material to provide a layer of protection and reinforcement.

V-Belt Profiles (Cross Sections)

- V-belts are manufactured in various industry standard cross-sections, or profiles, including the following:
- Classical
- Narrow
- Metric
- Fractional Horsepower

The classical V-belt profile dates back to industry standards developed in the 1930s. Belts manufactured with this profile come in several sizes (A, B, C, D, E) and lengths (Figure 3), and are

Figure 1 V-belts with identical top widths and outside circumferences.

| Gates Part # | Gates Product | Top Width | O.C. | Tensile Cord | Compound | Cover | Temperature Range | Application Requirements |
|--------------|---------------|--------------|-----------------|--------------|-------------|------------|-------------------|---|
| AP48 | Predator® | 0.5" | 50" | Aramid | Chloroprene | Clutching | -30 to 180°F | Shock loading, high HP |
| AX48 | Tri-Power® | 0.5" | 50" | Polyester | Ethylene | Raw Edge | -60 to 250°F | Small diameters, high temperature environment |
| A48 | Hi-Power® II | 0.5" | 50" | Polyester | Diene | Flex-Weave | -30 to 140°F | Standard industrial power transmission |
| XPA1257 | Metric Power™ | 0.51" (13mm) | 50.20" [1275mm] | Polyester | Ethylene | Raw Edge | -60 to 250°F | Replacement for existing metric belt |
| 4L500K | PoweRated® | 0.5" | 50" | Aramid | Chloroprene | Clutching | -30 to 180°F | Lawn and Garden equipment |
| 4L500 | Truflex® | 0.5" | 50" | Polyester | Diene | Flex-Weave | -30 to 140°F | Fractional HP, light duty |

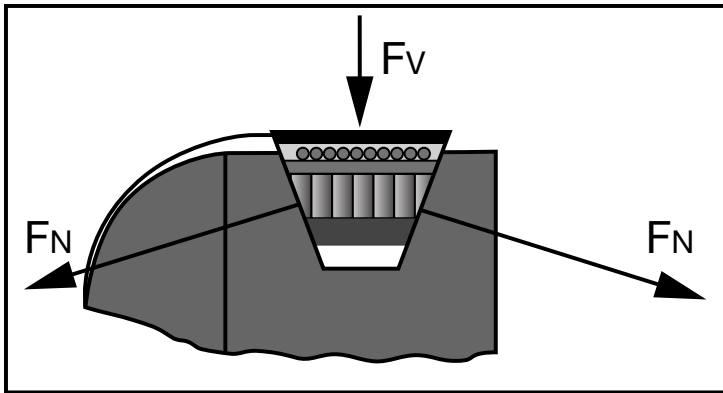


Figure 2 Vertical force (F_v) applied perpendicular to belt top creates high sidewall forces (F_n) to transmit higher loads.

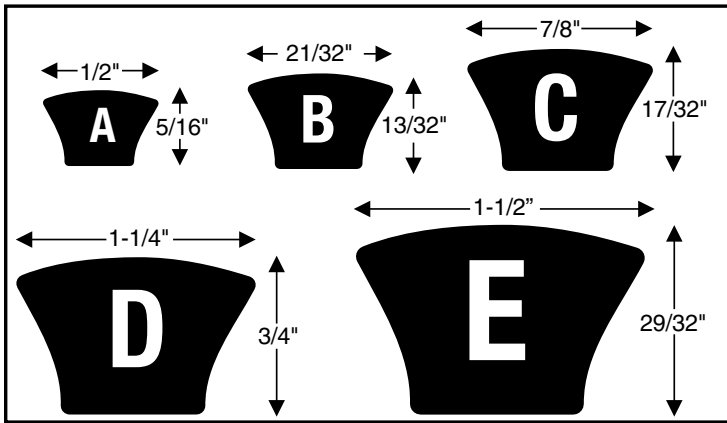


Figure 3 Classical V-Belt Profiles

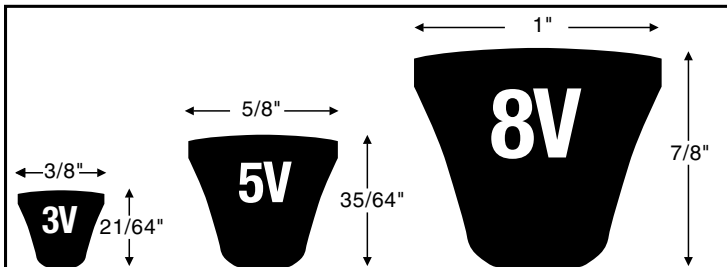


Figure 4 Narrow V-belt Profiles

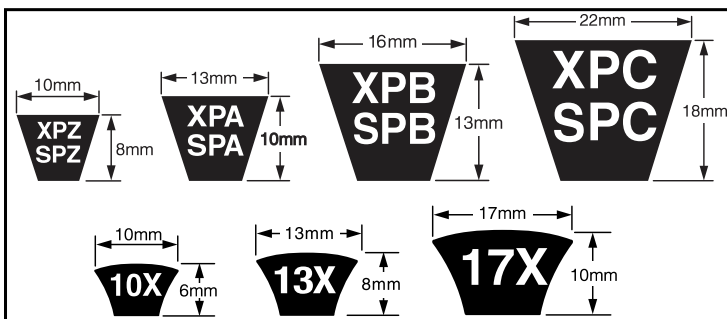


Figure 5 Metric V-belt Profiles

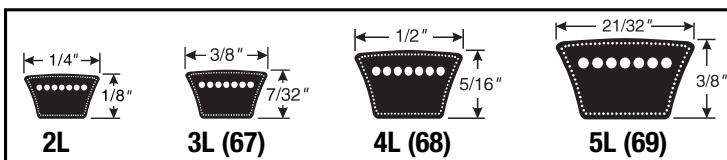


Figure 6 Fractional Horsepower V-belt Profiles



EXPANDING YOUR EXPECTATIONS

McInnes Rolled Rings continues to expand not only our facility, but also your expectations of what responsive service should be. We're committed to the delivery of quality products with the fastest shipping times in the industry.

Speed. Quality.
McInnes Rolled Rings.

McINNES
ROLLED RINGS

1.800.569.1420
1533 E 12TH STREET • ERIE, PA 16511
www.McInnesRolledRings.com

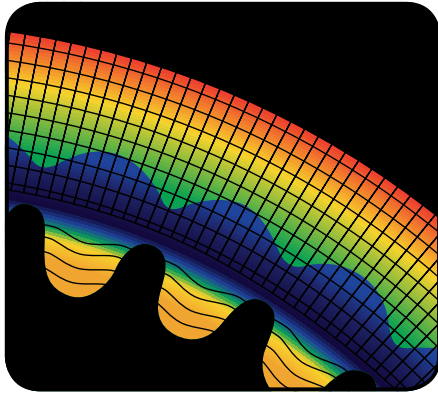


Figure 7 Bending stress (red area) is evenly distributed in a well-engineered notched V-belt, while the tensile cord (between red and yellow bands) remains well supported, all without sacrificing flexibility.

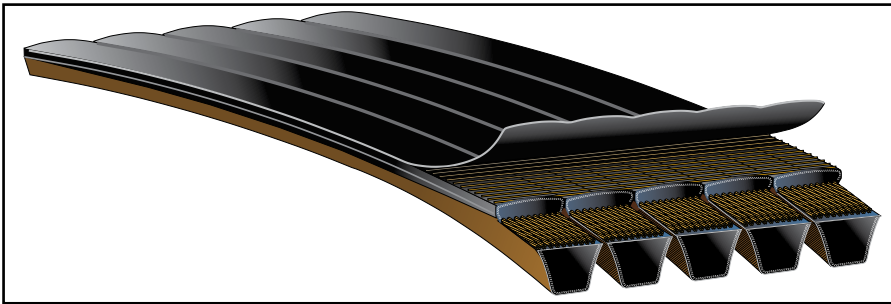


Figure 8 Joined V-belt

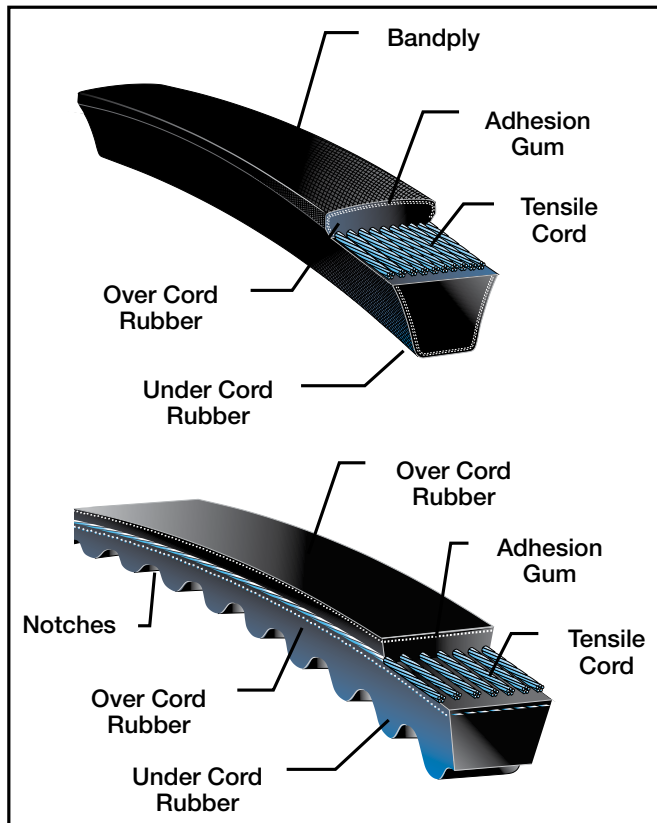


Figure 9 Anatomy of a V-belt.

widely used to replace V-belts in older, existing applications.

V-belts with a narrow profile (3V, 5V, 8V) have more steeply angled side-walls than classical V-belts (Figure 4), providing increased wedging action and higher load capacity (up to 3x that of comparable classical V-belts)..

Metric V-belts have profiles that adhere to international standards set by organizations such as ISO (International Organization for Standardization) and DIN (the German Institute for Standardization) (Figure 5). They are used to replace belts on industrial machinery manufactured in other parts of the world.

The fractional horsepower V-belt profile is designed for light-duty applications such as lawnmowers, snow blowers, attic or furnace fans, etc. These belts have a thinner cross-section and lighter gauge tensile cord (Figure 6), making them more flexible and able to bend around small sheaves.

Notched or Cogged V-Belts

All of the V-belt types noted above are typically available from manufacturers in “notched” or “cogged” versions. Notches reduce bending stress, allowing the belt to wrap more easily around small diameter pulleys and allowing better heat dissipation. Excessive heat is a major contributor to premature belt failure.

Engineering a notched belt is a balancing act between flexibility, tensile cord support, and stress distribution. Precisely shaped and spaced notches help to evenly distribute stress forces as the belt bends, thereby helping to prevent undercord cracking and extending belt life (Figure 7).

Joined V-Belts

For applications with vibrating or pulsating loads, especially with long center distances, joined V-belts may be the answer. A joined V-belt is, in essence, a number of single V-belts joined together with a continuous tie-band across the back (see Figure 8).

A joined V-belt increases lateral rigidity to reduce belt whip and maintain stability under shock loads. It also simplifies installation and tensioning compared with multiple single belts.

V-Belt Construction and Material

Figure 9 describes the constructional components of standard and notched V-belts. Each component has a vital role to play in how well V-belts perform and how long they last. Different materials and configurations can influence belt performance characteristics in specific applications.

The tensile cord is the load-carrying component of a V-belt. Most V-belts are made with polyester cords, although some belts are constructed with aramid or Kevlar® cords, which offer higher tensile strength, limit stretch, and can handle heavier shock loads. In a well-engineered V-belt, the tensile cords and rubber body of the belt are chemically bonded to form one unit, allowing for equal load distribution and longer belt life.

Tensile cords are supported by rubber stocks, both above (over cord) and beneath (under cord). Various synthetic rubber stocks are used by different manufacturers to provide heat resistance and reduce wear. Some high-performance synthetic rubber compounds, such as ethylene, significantly extend a belt's operating temperature range and resist hardening, cracking, and premature failure.

A well-engineered V-belt will have transverse rigidity, which means a high level of rigidity across its width so that the tensile cords will transfer the load equally. At the same time, the belt must be highly flexible along its length to reduce heat and bending stresses, which in a superior belt is accomplished by parallel alignment of fibers in the rubber compound.

Adhesion gum is the element that forms a strong chemical bond between the tensile cord and the rubber stock. It bonds the belt together so that it acts as a single unit. The gum also absorbs cord stresses and avoids cord pullout.

To protect the core of the belt from destruc-

tive environmental forces such as oil, grime and heat, as well as from general wear and tear, some V-belts have a fabric cover, or band ply. In a well-engineered belt, this flexible fabric is treated to form a chemical bond with the belt core materials, allowing it to withstand the stress of constant bending over time and prolonging cover life.

As described earlier, the notches in a notched V-belt are designed to increase belt flexibility and reduce bending stresses, especially on small sheaves.

Don't Forget Sheaves

Sheaves are essential V-belt drive components. As noted earlier, how well a V-belt fits into the sheave determines how much power the belt drive can transmit and how efficiently it operates. Proper fit is a function of both the belt and the metal sheave. A well-engineered belt and a well-machined, matching sheave provide the optimal combination.

Many users replace V-belts repeatedly without bothering to check the sheaves for wear. A worn, broken or damaged sheave decreases belt life. Sheave damage could result from incorrect installation, such as over-tightening the bushing bolts or prying the belt onto the sheave. Another cause

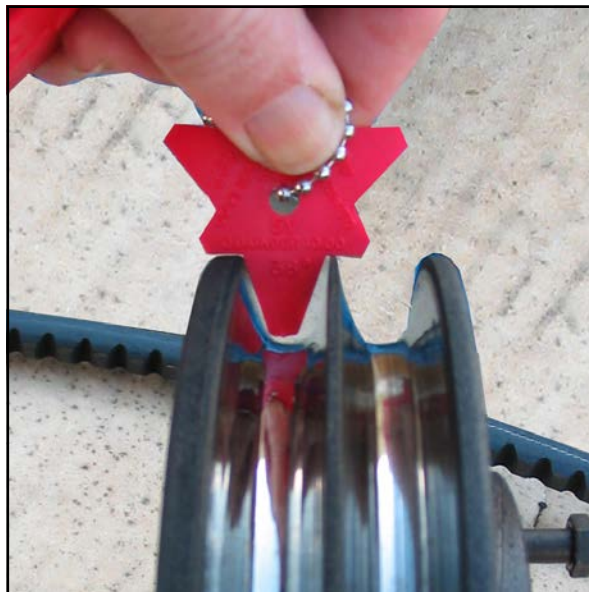


Figure 10 This photo depicts a highly worn sheave, which can cause belt sidewalls to harden and crack, or produce excessive wear on the belt's bottom surface and corners, leading to premature belt failure. In an unworn sheave, the gauge should fit snugly into the groove with no light shining through.

MOLON

MOTOR & COIL CORPORATION

CERTIFIED
ISO 9001-2015
ISO 13485









Motor Solutions Thru American Innovation

We don't leave the manufacturing and engineering of our products to other countries.

**AMERICAN
MANUFACTURER
EST. 1954**

VISIT OUR WEBSITE:
www.Molon.com

of sheave damage is debris falling into the drive, which can be prevented by installing a drive guard.

Signs of sheave wear include groove sidewall cupping and/or a polished groove sidewall with ridges. Use a sheave gauge (Figure 10) to detect excessive sheave groove wear, and replace sheaves immediately when worn.

For Related Articles Search

belts

at www.powertransmission.com

Upgrade V-Belts and Drives for Higher Performance and Savings

Advances in V-belt technology present users the opportunity to upgrade older drives and gain improvements in performance while saving time and money. For example, industry standard V-belts subject to extreme operating conditions, such as stifling heat inside a belt guard, can fail prematurely from heat cracks, stretching or excessive wear. Frequently retensioning and

replacing the belts leads to downtime, inefficiency and loss of productivity.

With today's new technologies, however, you can upgrade to notched V-belts made from an ethylene rubber material that can withstand temperature extremes from -70°F (-57°C) to $+250^{\circ}\text{F}$ ($+121^{\circ}\text{C}$), an 88% improvement over the temperature range for industry standard V-belts. These newer belts resist hardening to avoid cracking, offer improved flexibility, and run smoother in the sheaves to reduce vibration and extend the life of other drive components, such as shafts and bearings.

As another example, replacing an older, classical V-belt drive with a newer, narrow profile notched V-belt made with an ethylene elastomer and aramid fiber tensile cords can yield up to 3x greater load carrying capacity while reducing the weight and size of the drive, relieving stress on shafts, bearings and other components.

When it comes to V-belt drives with multi-groove sheaves, consider your options. If the sheaves are not worn, you can use fewer, higher-performance belts (leaving open grooves), or fill all the grooves with higher-performance belts to increase drive load capacity and extend belt life. If the sheaves are worn and need replacement, you can upgrade to a more compact (but equally powerful) drive to save weight and space, or keep the same drive configuration while increasing drive capacity.

Conclusion

From giant rock crushers to tiny sewing machines, V-belts have found their way into countless industrial applications. Today's V-belts are marvels of modern technology, reflecting the latest advances in mechanical and chemical engineering. The key thing to remember about V-belts, whether on a new drive or a replacement, is "know thy application." The right belt for the job, along with proper installation and maintenance, will provide you trouble-free service for the designed life of the drive. **PTE**

For more information

Gates Corporation
Phone: (303) 744-5800
PTPAsupport@gates.com
www.Gates.com/vbelts

PTC
MDA
ASIA

POWER TRANSMISSION AND CONTROL 2017

International Trade Fair for Electrical and Mechanical Power Transmission,
Fluid Power, Machine Parts, Fasteners and Springs, Bearings, Internal
Combustion Engines and Gas Turbines

31 October - 3 November 2017 Shanghai New Int'l Expo Centre
www.ptc-asia.com



For further information, please contact:

| | | |
|---|--|--|
| <p>Deutsche Messe AG MesseGelände, 30521 Hannover, Germany Contact: Meike Sauer / Julia Bress Website: www.messe.de</p> | <p>Tel: +49 511 89 34114 / +49 511 89 31118 Fax: +49 511 89 39681</p> | <p>Email: meike.sauer@messe.de julia.bress@messe.de</p> |
| <p>Hannover Milano Fairs Shanghai Ltd. Rm. 301 B5/Q Pudong Office Tower 193 Yinxiao Rd. Pudong Shanghai 201204, P.R. China Contact: Ms. Ally Huang / Ms. Sarah Shui / Ms. Lili Xu / Ms. Ivo Zhao / Ms. Sophia Bo / Ms. Sunny Sun</p> | <p>Tel: +86-21 5045 6700/252/225/264/215/322/251 Fax: +86-21 5045 9395 / 6886 2395</p> | <p>Email: ptc-asia@hmf-china.com Website: www.ptc-asia.com</p> |