Slashing Operating Costs Of Low-Profile Conveyors

Charles Mitchell, President,
Conveyor Technologies LTD.

(Editor's Note: Follow-up questions put to Tony Mitchell, Conveyor Technologies vice president of sales, immediately follow.)

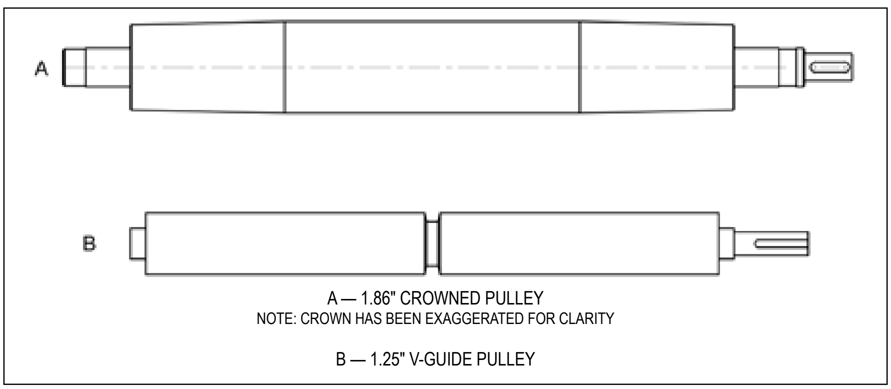

Figure 1—As pulley width increases, a 1.25"-diameter pulley will deflect nearly five times more than a 1.86"-diameter pulley; this effect is compounded when the pulley is weakened with a V-groove.

Figure 2—A tool-less, swing-up tail pulley provides one-minute belt exchange while retaining the tension setting. Calibrations on both sides permit rapid, precise balanced tension by which each increment represents the tension-setting-per-foot of conveyor length.

Introduction

Low-profile conveyors are ubiquitous in industry, serving key roles in the production and assembly of everything from cosmetics to snacks; beverages to electronics; and land transportation. Broadly speaking, we're talking about compact belt conveyors with one- to two-inch pulley diameters and maximum belt widths of 24 inches. Typically used in 24/7 applications in packaging, assembly, labeling, inspection and sorting, low-profile conveyors form critical production links where unplanned downtime or time-consuming maintenance is intolerable. Upstream equipment, such as ovens, bottlers, extruders and pasteurizers continue to churn out product, so line stoppages—planned or unplanned—must be minimized.

Certainly the most critical areas of low-profile conveyors that draw maintenance attention are the belt itself and the pulley/bearing system. Speed, load, accumulation and inclined operation increase forces on these components, as well as the drive system, highlighting problem areas such as belt tension. Belt manufacturers universally cite correct belt tension and crowned pulleys as keys to long belt life and consistent, slip-free performance with positive self-tracking. Incorrect belt tension is responsible for a high percentage of component-related failures and maintenance cost. Whether over- or under-tensioned, incorrect belt tension can cause a variety of problems, including bearing overload, mistracking, belt slippage and accelerated component deterioration.

What do Belting Manufacturers Recommend?

Correct tension varies, but typically it will be one mm of belt stretch per foot of conveyor length. However, with allowable manufacturing tolerances on belts, a belt will normally be a little longer or shorter than its stated size. To ensure correct tensioning, a simple system has been developed to allow maintenance people—and even novice operators—to set correct tension in seconds. The system uses the tail pulley to set tension; once all belt slack is taken up, tension is set via a scale on each side of the conveyor where each increment represents the tension-setting-per-foot of conveyor length. It seems counterintuitive, but a belt that is under-tensioned can actually elongate in use, which leads to many belts in good condition being discarded, due to a conveyor's limited tensioning capacity.

Again, following the recommendations of the world's major belt manufacturers, a crowned pulley with a correctly tensioned belt is the preferred way to achieve automatic belt centering. A crowned pulley produces dual, lateral opposing belt forces that balance each other when the belt is centered over the crown. If the belt moves off center, these lateral opposing forces become unbalanced, resulting in the "higher-force" side directing the belt back to its centered position. This action provides virtually wear-free centering. Crowned pulley systems also allow higher accelerations and speeds with much less belt and component wear.

Properly tensioned belts on crowned pulleys easily withstand moderate short-term lateral forces without major displacement from center. When side loads increase, a V-retainer on the underside of the belt can be added to limit off-center drift. The V-shaped profile rides in a groove cut into the pulleys (that reduces pulley rigidity), and a groove running the length of the conveyor bed. This approach allows the crowned pulley to quickly center the belt when the external force is removed, thus minimizing wear on the V-retainer. Belting manufacturers recommend that V-retainers should not be the primary belt tracking system, due to the high wear the V-profile incurs. If the lateral force is sufficient, the V-retainer will climb out of its groove and may damage the belt. An alternative is to use the V-retainer on the top edge-surface of the belt and have it guided and constrained from the top down by a rolling Delrin V-guide, located opposite the point where the belt experiences side forces. These guides keep the V-profile fully constrained and with reduced wear. A normal V-retainer alone offers no true "non-contact guiding" so it tends to drag against the sides of the groove and constantly wear. Another point to consider on a bottom-mounted V-retainer is that the weld used to attach it results in a slight high spot in the middle of the belt, which can be troublesome if the belt carries small products that are tip-over prone. Because of material incompatibilities, the V-profile cannot be used with certain types of belts, such as silicon-based, Teflon and polypropylene.

Pulley Diameter: Size Matters

Low-profile conveyor pulleys normally range from 1- to 2-inches in diameter, but this small range can produce a surprising difference in conveyor capacity and performance, as well as in belt, cleat and bearing life. Smaller-diameter pulleys may be needed for applications requiring a minimum height profile where speeds and loads are moderate. However, logic dictates that a smaller-diameter drive pulley will have a much greater tendency to

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deflect as the conveyor width increases (a 1.25" pulley without a V-groove will deflect nearly five times more than a 1.86" pulley with the same load). This creates an inherent "traction" disadvantage for load-carrying purposes and can negate the crowning effect (belt-centering capability) of the pulley. This is highly problematic in applications that involve reversing, wider conveyors and accumulating or inclined operation. Flexing a belt over a smaller diameter also accelerates the breakdown of the belt structure, leading to erratic operation and shorter life.

When scaled up in width, conveyors with small-diameter pulleys often cannot carry proportionally greater loads. For example, a conveyor with a pulley diameter of approximately 2 inches, with a correctly tensioned belt, will carry twice the load at a 24-inch width than it does at a 12-inch width. But this rule of thumb does not hold, as pulley diameters approach the 1.25-inch range (see chart).

Smaller pulley diameters—with their greater tendency to deflect—have limited ability to produce the proper belt tension needed to achieve automatic centering with a crowned pulley. The resulting loss of "traction" and self-centering are sometimes compensated for by lagging or knurling the pulley and substituting a longitudinal V-retainer—rather than a crowned pulley—for belt centering. Because the pulley must now have a V-groove in its center—as well as being knurled—its rigidity is further compromised. Indeed, belt manufacturers discourage knurled pulleys because they invariably abrade the belt underside and resist tracking—leading to a substantial reduction in belt life. Impacted debris in the pulley knurl, or worn knurling, can lead to belt slippage and mistracking, as well as accelerated belt, V-retainer and pulley knurl wear. Abrasion can occur without any load on the conveyor or increases of belt speed. Debris from this abrasion may be unacceptable in food, pharmaceutical or clean-room applications. And routine cleaning of the knurling is impractical because it requires stopping production and removing the belt.

Bearing life is also greatly affected by pulley diameter. A one-inch pulley must run at twice the rpm of a two-inch-diameter pulley to produce an identical belt speed. Small pulley diameters can result in smaller bearings with lower load capacity running at higher speeds, thus reducing service life. Ensuring that the bearing outer race cannot rotate in the bearing plate housing can improve bearing performance and avoid the need to replace worn bearing housings.

Drives are available in a wide variety of styles. One style that is gaining popularity is the external shaft-mounted design. This unit is compact, provides "perfect alignment" and eliminates all couplings, drive belts, chain, sprockets, guards and tensioning. These drives can be radially positioned in 30-degree increments. Mounting of this drive allows an exchange in less than five minutes when equipped with an optional plug connector.

If a conveyor is used for multiple applications that can be run at lower speeds, a variable speed drive may be desirable. This reduces wear and power consumption and provides optimum speed for each application.

The service manual for a conveyor can provide clues to potential failure issues; sections on preventive maintenance and troubleshooting can be enlightening. For example, does the manual recommend stocking spare pulleys, bearings and bearing plates, or disassembling and checking bearings during a belt change or cleaning knurled pulleys? Belt change time should be based on the conveyor in its operating position, not resting on a bench.

Manufacturers offer a broad range of options, such as cantilever stands, tool-less guide rail removal, belt support removal and belt release that can permit a tool-less, "one minute" belt change on a stand-mounted conveyor. These options should be reviewed with the manufacturer—especially if downtime is a critical factor.

Follow-Up Questions for Tony Mitchell, Conveyor Tech Vice President of Sales

PTE. Are there any advancements on the horizon in the material composition of drive belts that would enhance their durability?

TM. I am not aware of any new advancements in belting composition that would drastically impact the low-profile conveyor. Pulley diameter has a major influence on belt life since a larger pulley decreases belt fatigue and

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permits a heavier, broader belt selection. Conveyor Technologies Ltd. has customers running daily production without having replaced belts, pulleys, bearings and bearing housings in 10 years.

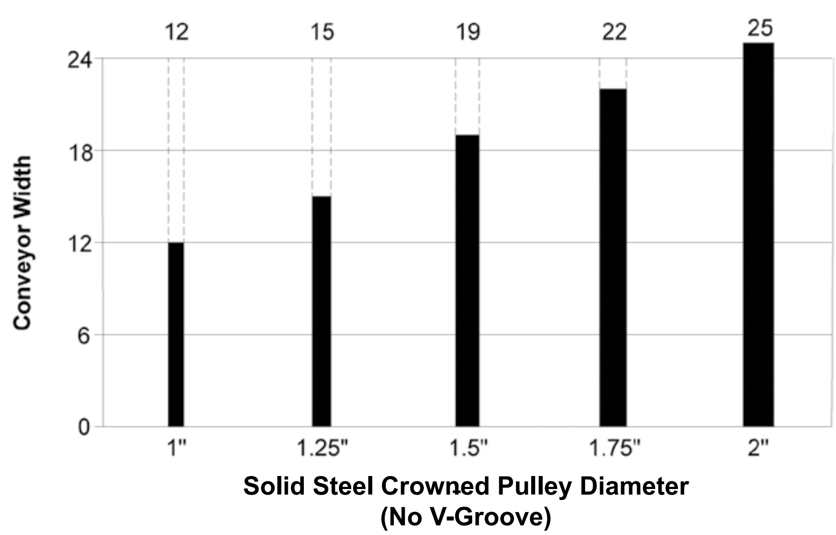
PTE. Why—unless it is simply continual human error—do conveyor system users have so much trouble in maintaining the proper tension for running their lines? Wouldn't on-the-job experience come into play?

TM. The primary reason that proper belt tension is such a major problem area is that until Conveyor Technologies Ltd. appeared, no one offered a precise method for tensioning that considered belt manufacturers' recommended tension value, conveyor length, manufacturing tolerance, or if stretching has occurred. (For example), a well-known low-profile conveyor manufacturer's service manual dealing with tensioning does not address these issues. Because the service manual does not define "proper tensioning," it is difficult to know if it has been achieved when their procedure is complete. Another major producer also assumes the belt length is correct and ignores the same issues. This system also does not provide assurance that the correct tension has been achieved. There is little wonder that conveyor users are often compelled to increase belt tension to achieve a functioning conveyor—and live with a higher maintenance cost.

PTE. If one-inch pulleys are so problematic vs. 2-inch pulleys, why do companies use them?

TM. With the advent of the Vee guide for belt tracking, most one-inch pulley designs converted to 1.25"–1.375"diameter. While this provided a slight reduction in pulley rpm, it does little to improve tensioning because of the Vee groove. This 1.25" diameter still retains a reduced belt and bearing life, along with a low-tension capability on wider

Table 1—Pulley Diameter vs. Recommended Maximum Conveyor Width Using 8-Class 8 N/mm Belting.



This chart—based on data from a leading belt manufacturer—illustrates how conveyor width can be limited by pulley diameter. This represents belting commonly utilized on low-profile conveyors. The belt rating is 8 N/mm, using a minimum recommended tension of 0.3 percent to ensure automatic belt tracking. The data provide a technical approach to pulley selection that will assist in achieving optimal performance of conveyor and belting—and lower operating cost. *(Caution: The belting manufacturer notes that use of a V-groove for restraining the belt will have a negative effect on chart values, thus voiding the chart data for this type of pulley.)*

units. Why these manufacturers hesitate to convert to 1.875"–2.00" diameters—which could have a positive effect on performance and component durability—is debatable. It would certainly have a negative effect on production costs and replacement part income. The benefit to the customer, however, in terms of maintenance costs and production down time, can be tremendous.

PTE. Is bearing *material quality* a contributing issue regarding their lifespan in these systems, or is it simply a size vs. outer race and plate housing issue?

TM. Because most low-profile conveyors require the belt top to be the highest surface, the pulley diameter controls the maximum bearing size. Consequently, the smaller the pulley diameter, the smaller the bearing.

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Baldor Grid-Lign Couplings

ELIMINATE PREVENTIVE MAINTENANCE

Baldor Electric Company introduces the Baldor-Dodge pre-lubricated Grid-Lign coupling, a maintenance-free, lubed-for-life design that eliminates the time and expense associated with preventive maintenance. Interchangeable with existing grids, hubs and covers, this product is easy to install with no mess, and eliminates unexpected down-time associated with improper coupling lubrication.

The unique, environmentally friendly design of the pre-lubricated Grid-Lign coupling features high-performance synthetic oil impregnated into a polymer shell that encapsulates the grid element. This polymer shell allows for efficient, long-lasting lubrication throughout the life of the coupling. The polymer acts as a reservoir for the oil that prevents contamination during installation and avoids the mess required with greasing a traditional grid design.

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The coupling not only includes the optimal amount of lubrication for the life of the element, but the synthetic oil used actually improves the lubricating performance of the grid segment during operation. Baldor-Dodge prelubricated Grid-Lign coupling components are interchangeable with competitive tapered-style grid couplings. Interchangeability includes use with complete vertically or horizontally split covers and half or full spacers.

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Nook

EXAMINES
FUTURE OF POSITION CONTROL

Nook Industries, a linear motion control systems and components manufacturer, has recently introduced its patent-pending Nook Sensor System (NSS). This system has been developed to provide precision position control for translating screw jack systems. With a highly accurate repeatability of up to + .004" (0.1 mm), the NSS is designed specifically for the ActionJac and is unique to the screw jack world in its simplicity of design, which features a custom aluminum stem cover. This cylindrical stem cover provides a housing shroud for select position and travel limit sensors, which are mounted with custom profiles and used to detect ring magnets fixed to the translating screw. A patented, state-of-the-art electronic magnetic circuit is the basis of operation for these sensors. The sensors on the NSS are manufactured using a polypropylene over-molding technology,

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which allows the sensor to be completely sealed into small sizes without compromising durability. An unlimited number of sensors can be added to meet a wide range of position sensing requirements as configurations with Nook's ActionJac are only restricted by the stem cover length. The cost efficient NSS replaces higher cost rotary limit switches as its simple aluminum stem housing design adds the functionality of position sensing versus traditional steel stem covers. The ease-of-use design can be incorporated to meet a myriad of industrial applications including; material handling, defense, aerospace, medical devices, stamping, conveying and sorting.

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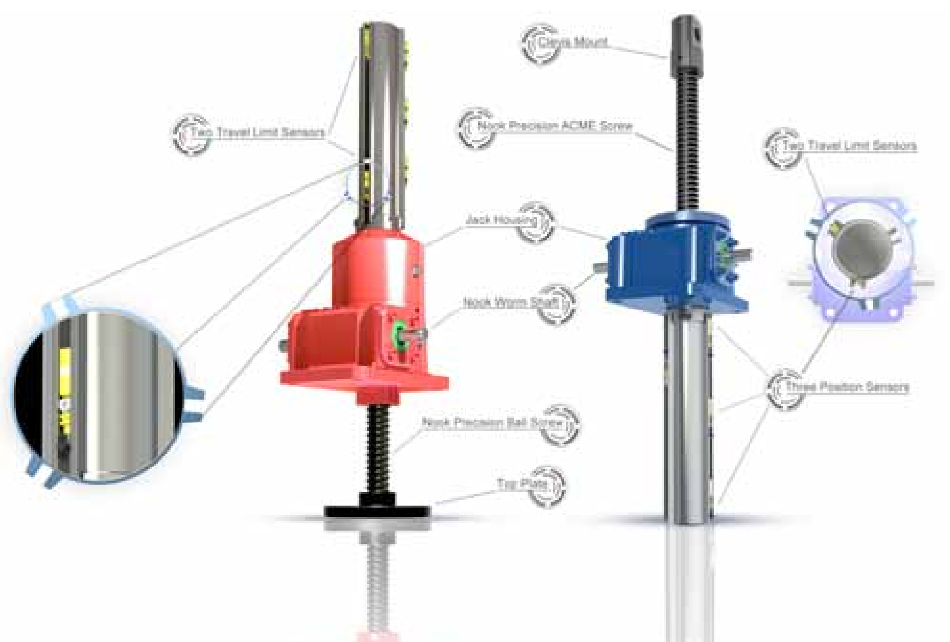

Gates

OFFERS BELT DRIVE SYSTEM SOLUTIONS

From system design and component selection to prototyping and delivery, design engineers are charged with ensuring efficiency, hitting cost targets and delivering systems that perform. In a recent project to design a human-powered boat that could withstand a 3,000-mile ocean crossing, Gates was called in to review the design and offer key component recommendations.

After devising a plan to pedal across the Atlantic and raise $250,000 for charity, two young engineers from the U.K. named Mark Byass and Mike Sayer enlisted a team of experts in boat design, fiber usage, ergonomics and hydrodynamics to design the watercraft. It's called Torpedalo.

Gates product application engineer Dan Parsons reviewed the designs and made key recommendations—eliminate

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the gearbox and use narrower belts in each of the two stages, making the system lighter, simpler and more efficient. Each stage of the synchronous belt drive is ~98 percent efficient, for a total estimated drive system efficiency of 96 percent. That means a smoother ride for the crew. This process was developed using *Gates Design Flex Pro* software, a design program that helps design engineers, maintenance engineers and power transmission distributors find solutions to fit the parameters of their belt drive systems. In addition to providing a fast, accurate way to design two-point drives from scratch, it allows you to:

- Determine proper belt installation tension
- Calculate belt pull
- Determine the belt horsepower capacity
- Show V-belt and synchronous belt options
- Estimate the energy savings of a synchronous belt drive compared to a V-belt drive

- Estimate the cost savings of replacing roller chain with a Poly Chain GT belt drive
- Compare noise levels of various Gates synchronous belt drives

Design Flex Web, the program's online counterpart, offers all of the functionality of *Design Flex Pro* plus easy access from your browser. For multi-point or complex serpentine belt drives, customers can utilize *Design IQ* software.

For more information:

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Stober

INTRODUCES HELICAL BEVEL GEAR UNIT

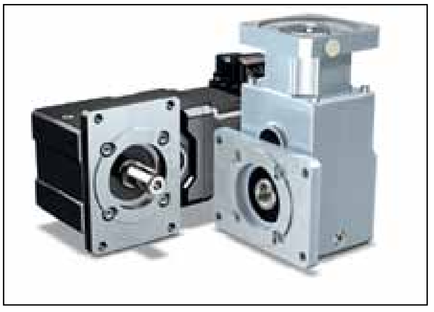
Stober Drives, Inc. has developed a new KL helical bevel gear unit, a compact right-angle drive that meets the packaging manufacturing industry's latest machine requirements. The space-saving gear reducer comes in sizes 1 and 2, and is suitable for packaging, filling, conveying, general automation and wash-down, said Stober product manager Adam Mellenkamp.

When compared with the conventional Stober K1 helical bevel gear unit version, the new KL1 supplies increased torque density of well over 100 percent. "Some packaging machines are very small, so we created the KL, which is the smallest size we have today," says Mellenkamp. "It's essentially a four-inch cube that fits in your hand."

Development of the KL is part of Stober's desire to make the manufacturing industry more efficient and productive—and green. "As we rebuild U.S. manufacturing and create jobs, productivity is the key to competing against low wage labor markets," said Peter Feil, vice president at Stober. "Highly productive and efficient equipment saves money, energy, materials, and time."

Helical gearing helps manufacturing go green by preventing breakdowns, saving energy and landfill space and greatly improving the bottom line in U.S. factories, he added.

"Going green in manufacturing is no longer an optional, feel-good choice," Feil said. "It is sound business



and our opportunity to regain our competitive edge in the global economy."

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