

Freedom of Movement: The Modular Roller Top Transfer and Diverting Station

ABSTRACT

The modular roller top belt was designed to solve a range of increasingly challenging transfer and diverting problems complicating operations in distribution centers, particularly retail e-commerce distribution. The transfer and diverting systems at work today are mechanically complex and costly, and were designed to handle relatively uniform, rigid cartons, not today's wider and more diverse range of package sizes, shapes and packaging materials and more complicated shipping logistics. The modular roller top station was developed to meet the industry's needs for diverting, transferring and sorting product. Using a matrix of freely rotating balls imbedded into a continuous flat belt, the rolling top belt station diverts and transfers products of any kind by using precise, controlled and impact-free motion on motorized conveyor lines.

The Simplicity, Flexibility and Precision of Motion Control

The modular roller top belt station is a completely new concept for transferring and diverting a wide variety of packages and packaging. With no auxiliary diverting equipment, its smooth and precise packaging positioning control minimizes packaging impact, and its multipurpose, modular design allows it to be positioned whenever and wherever it's needed within conveyors for any transfer or diverting application. Using motion control rather than force to divert objects is a sophisticated concept. But the engineering that makes it possible is a model of simplicity.



The high degree of motion control comes from the simplicity of the concept: use rotating spheres to convey packaging in any direction. Traditional horizontal conveyor rollers are unidirectional; spinning spheres make use of all 360 degrees of potential motion.



The roller top belt embeds a uniform array of independent, 1-inch, on-center spheres on the surface of a continuous, low-profile, gap-free interlocking plastic belt. The belt and spheres are powered by one or more activated running belts or a rotating disc underneath the station, using motorized drive rollers and controls. By using the motorized belts in different configurations and controlling their relative speeds, the modular roller top belt provides precise motion control, regardless of the size, shape or composition of the product. As a result, it can accelerate or decelerate objects, move any object to an angle vector at a given speed, or simply stop and rotate a product into a specific orientation. No other handling equipment is needed. The roller top belt uses a minimum of moving parts and has minimal power demands — while providing the flexibility and simplicity of a modular, easily configured and maintained system.

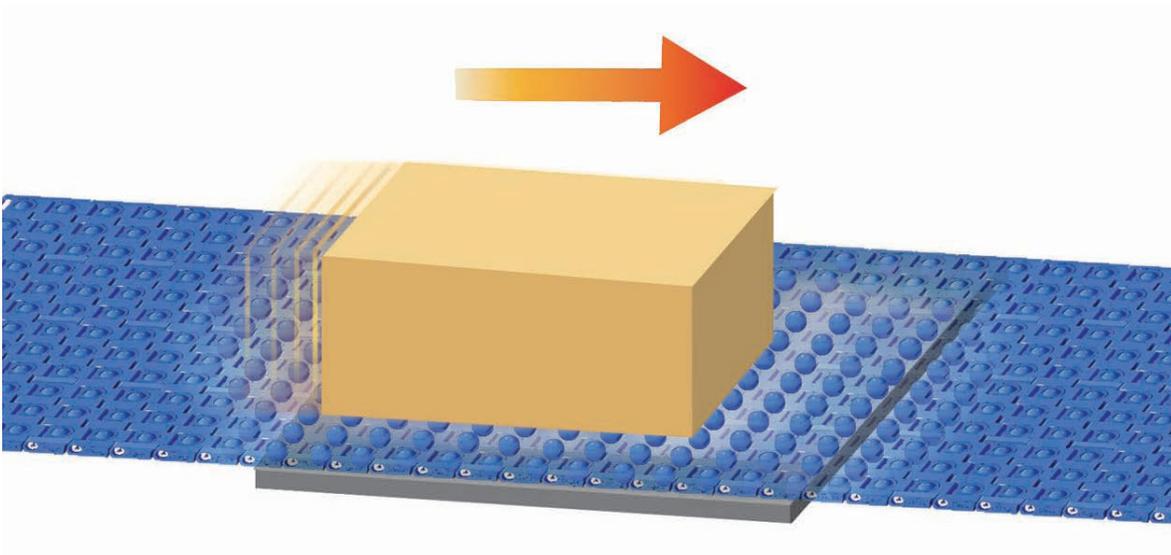


When first seen in operation, the motion control can be hypnotic. Packaging of all types, from standard cartons to small boxes, soft polybags or flat envelopes, seem to float into position on their own volition. Some packages roll onto the station and suddenly shoot forward at double speed to separate individual products. Others change angles autonomously, aiming toward different lanes on the belt. Some packages pause for a moment, rotate into position for bar code scanning, and then shoot back onto the line. Still more execute smooth 90-degree turns at full speed and fly straight onto another conveyor or station, without the rough handling and jolts of traditional lifts, and without the need for a pneumatic or Z-direction position feedback system.

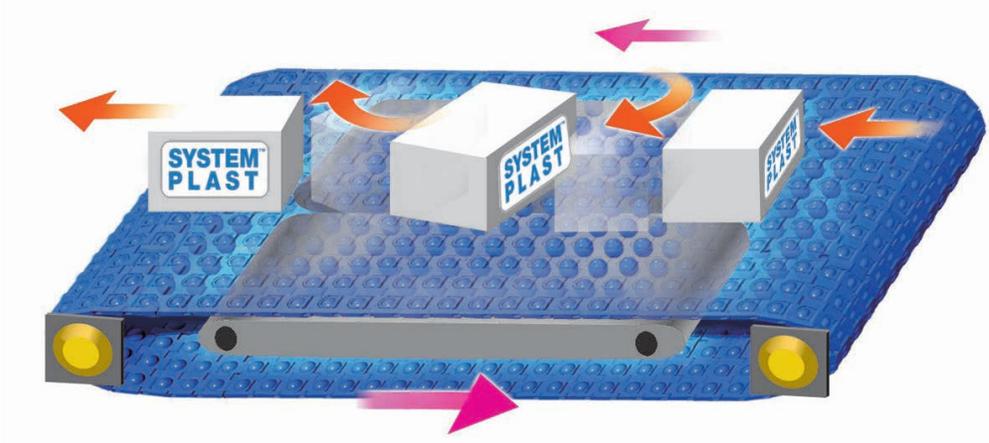
The modular roller top belt addresses the limitations and risks of existing transfer technologies while expanding a distributor's abilities to handle, precisely control, and transfer packaging of all sizes and materials. That is a significant expansion of material handling capabilities for industries, such as retail e-commerce, that now have to work with a greater diversity of products and packaging materials heading to many more destinations than ever before.

The Motion of the Spheres

By using different configurations of motorized roller belts or discs underneath the roller top belt, and controlling the relative speeds of the different belts, the modular station can be configured for specific transfer and diverting operations:



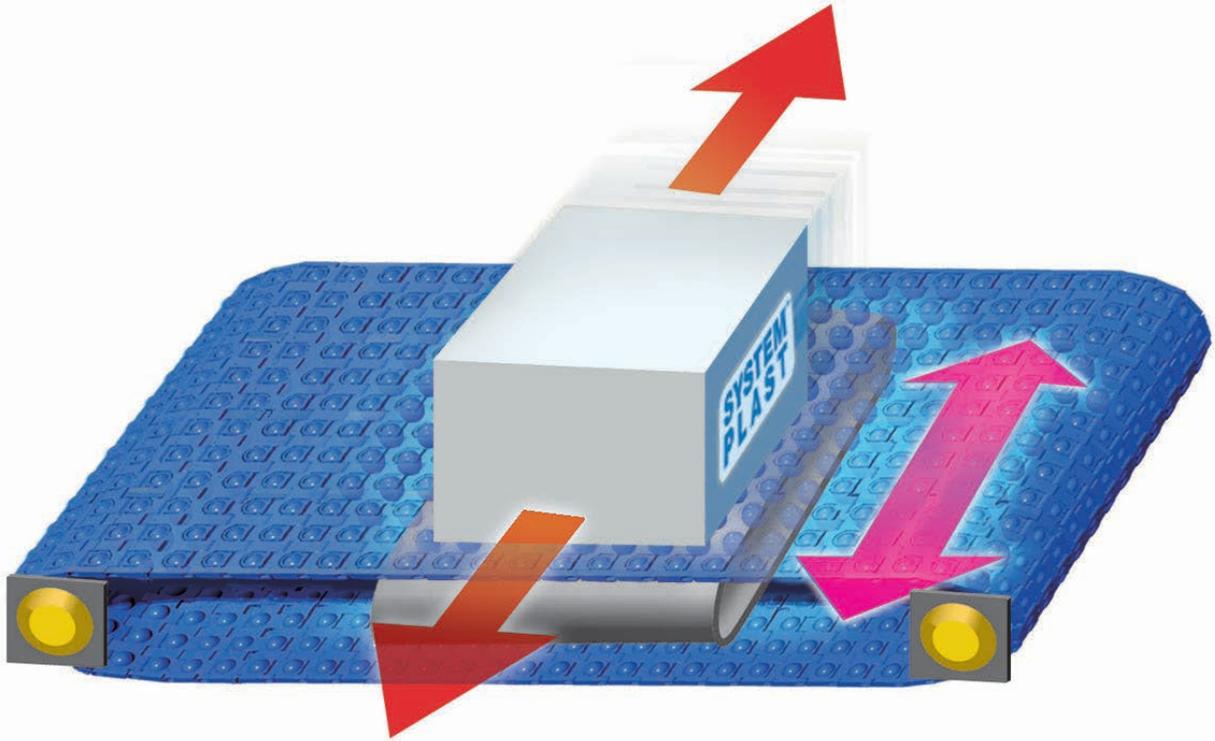
Double speed. When the belt and its roller top balls come in contact with the driver belt, the spheres rotate. The belt velocity plus the velocity of the rotating balls doubles the speed of the product on the line. This function is very useful in separating products from each other. And while the balls double the carrying speed, the belt itself doesn't accelerate, which extends belt life and reduces energy consumption.



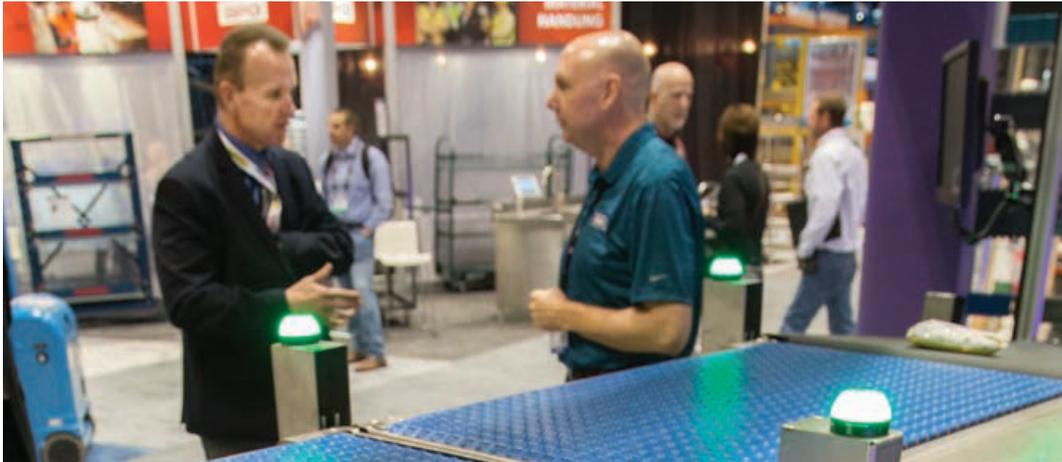
Re-orientating packages in motion. When the roller top sits on two parallel running belts running in different directions, packages in the middle of the belt will rotate as they move. This setup is ideal for applications when product orientation is important, such as the infeed to a palletizer, or automatically sorting packages into different lanes. By combining the speed of the belt and changing the speeds of the two belts underneath, the package can move in any direction with complete control of the vector angle, from a slight angle to a virtual U-turn.



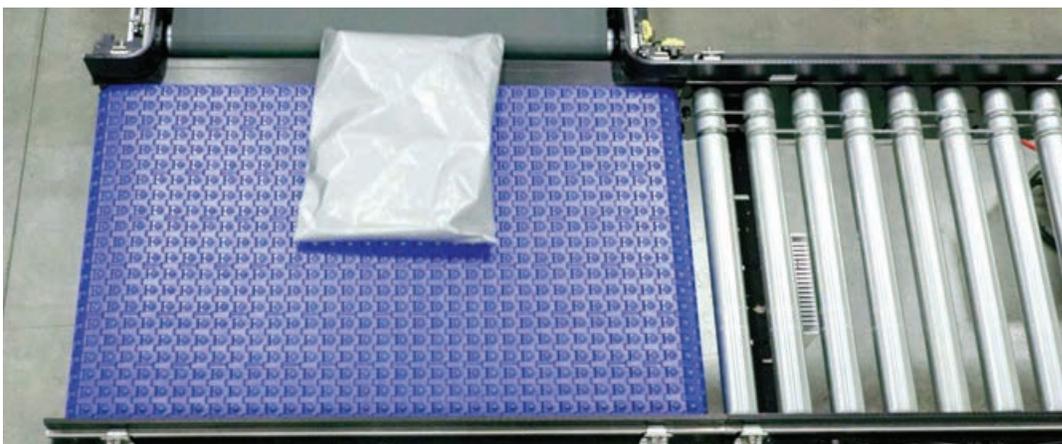
Stop and rotate. By positioning a rotating disc underneath the roller top belt, the belt can be stopped momentarily, the product positioned to any angle for processes such as bar code scanning or label reading and/or printing, and then propelled back onto the next conveyor.



Lateral motion. Until now, diverting packages laterally off the line was a rough and tumble process, as pneumatic lifters or pusher arms shove the package off the conveyor and line. With the modular roller top belt, this 90-degree swing is smooth and jolt free — no lifting, pushing, guide bars or contact. The lateral motion comes from a secondary activated belt positioned 90 degrees to the travel direction of the roller top belt. The spheres rolling over this second belt spin at right angles, instantly rolling the package straight off the conveyor at a 90-degree angle onto another conveyor or station, such as a reject conveyor. Alternately, the speed of the secondary activated belt can be adjusted to provide product repositioning for applications such as case packaging.



Sorting. By diverting products into designated lanes through motion control, a series of roller top belt stations can be placed end to end to create a medium-rate sorter. Material handling integrators can also customize the module for use as picking and packing stations. The package handling and motion control capabilities are up to the imagination of the systems integrator and the requirements of the job. Because the fundamental design is simple and modular, integrating a new station into the line and giving it a new job can often be accomplished within a few hours.

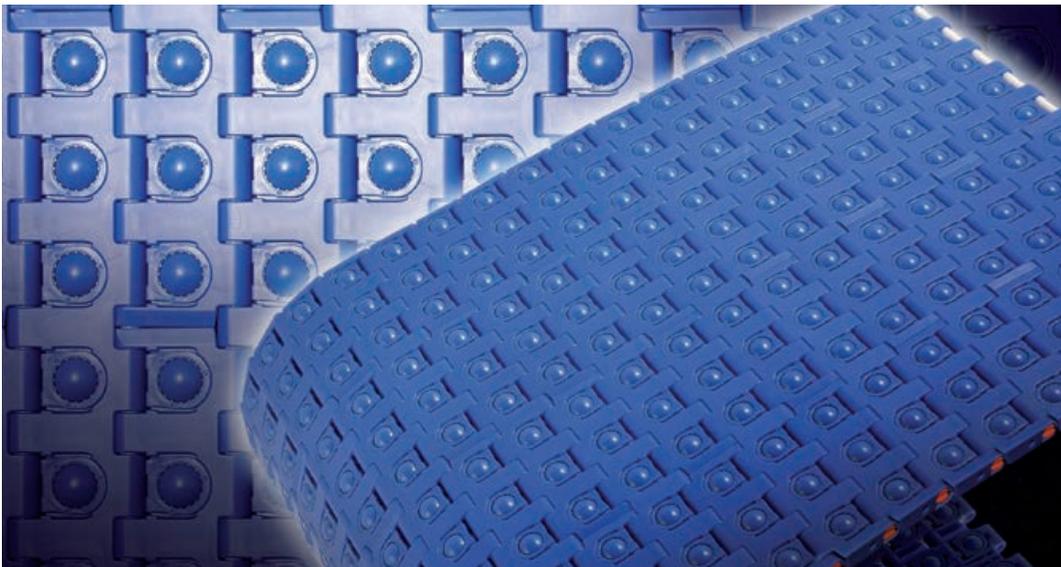


Adding Flexibility and Reducing Costs

The modular transfer and diverter station was explicitly designed for the increasingly complex needs of distribution centers as they process larger volumes of diverse packages to multiple distribution channels.

With the introduction of dimensional weight pricing in 2015, the installed base of conveyor systems designed to handle traditional rigid cartons was challenged by the need to convey much smaller, lighter and more malleable shipping containers, such as bubble mailers and polybags. This transition created choke points on conveyor systems at transferring, diverting and sorting stations, which were designed for rigid, fairly uniform packaging, and handled by mechanically complex, permanent single-function equipment, such as pneumatic lifters. Moving small packages or polybags required putting them into tubs for handling, then hand-sorting the materials at the end of a line: a time-consuming, labor-intensive extra step.

Transferring and diverting are relatively simple functions: you simply change the direction of a moving object. Replacing complicated componentry with a modular, easily installed system designed specifically to handle both traditional and new packaging would solve a range of challenges.



One barrier to handling small or soft packaging was the gaps between rollers at standard conveyor stations; products literally fell through the cracks. The solution was embedding the rotating spheres in a continuous, interlinked belt surface: flat and gap free. The belts and modules are designed in multiple widths to integrate into the full range of distributor conveyor systems.



MODSORT TRANSFER SIZES				
Size	Length, in.	Width, in.	Available Take Away Widths, in	Effective Zone Length, in
1	30	16	16, 22	24
2	30	22	22	24
3	36	16	16, 22, 28	30
4	36	22	22, 28	30
5	36	28	28	30
6	42	22	22, 28, 34	36
7	42	28	28, 34	36
8	42	34	34	36

Although designed for motorized driven roller (MDR) conveyor systems, integrators can also adapt the belts to support other conveyor systems. Roller top belt modules are currently optimized for medium-range conveyor systems to process up to 45 parts per minute, and support for faster systems is in development.

The Inherent Economy of Simplicity

Several of the development team’s basic design considerations turned out to have ancillary system benefits beyond precise motion control. The modular belts are made of interlinked and rugged blue acetal, imbedded with spheres made from tough and wear-resistant Polyamide. The result is high belt strength combined with low friction at a much lower weight than metal components. This low weight and friction contribute to a significantly lower power demand. Combined with their smaller, variable speed, run-on-demand motors, modular roller top belt systems can achieve energy savings between 50–60 percent compared to other conveyor transfer systems — in addition to the savings realized by eliminating the labor-intensive step of re-processing small or plastic packages conveyed in tubs.

Another benefit inherent in the belt design is worker safety. With no gaps or pinch points anywhere on the roller-free belt, workers have a much lower risk of injury.

Driven by a variable speed, run-on-demand, 24-volt DC motor, the module is not only energy efficient, but also allows for flexibility and simplicity in wiring and control, safe and quiet operation (>70 dBA), and minimal, easy maintenance. Its modular design allows the belts to be swapped out for repairs or replaced quickly. Motor controls support standalone programming, can interface with a programmable logic controller (PLC) in a customer's network, or be hardwired into a customer's preferred control system.



Further cost savings are achieved by simply eliminating the high cost of maintaining fixed lift, pneumatic or Z-direction position feedback systems. It is cheaper, simpler and faster to maintain a spare parts inventory of modular plastic belts that can be replaced in minutes rather than an inventory of pneumatic lifter and compressor systems and spare parts that require hours of downtime for repairs.

Modular roller top belts are available as turnkey units for new lines, or as a retrofit to replace existing systems. An integrator can install a module simply by removing the existing pneumatic or pusher system and putting the module in its place.

With the logic of its modular design and the simplicity and efficiency of its use of motion control to transfer, divert or channel products, the roller top belt offers distributors significant cost advantages — and multiple directions to increase throughput.



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