

# Drive & Control profile

## Rexroth Components Help Bell-Everman Develop Unique Linear Actuator



The ServoBelt combines Bosch Rexroth Ball Rail guides and aluminum framing with a belt-driven carriage, providing the speed and accuracy of a linear motor at a value comparable to belt-driven actuators.

Multiple technologies contribute to economical, high-precision linear actuator as alternative to linear motors

A new linear actuator called **ServoBelt™** developed by **Bell-Everman, Inc.** (Goleta, CA—[www.bell-everman.com](http://www.bell-everman.com)) provides the speed and accuracy of a linear motor at a value that's comparable to belt-driven actuators, thanks

to components supplied by drive and control specialist **Bosch Rexroth** (Charlotte, NC [www.boschrexroth-us.com/brl](http://www.boschrexroth-us.com/brl)).

Bell-Everman, a manufacturer specializing in high speed, high

### Challenge

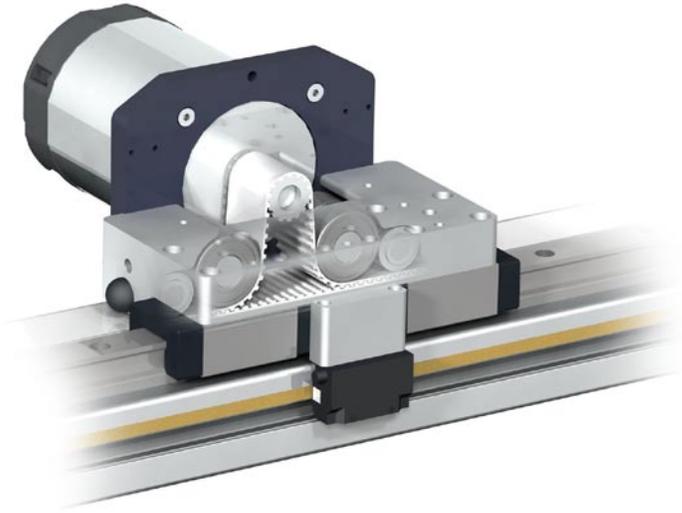
Create a precision, economical belt-drive linear actuator as a high-performance alternative to linear motor actuators

### Bosch Rexroth Solution

- Linear Ball Rail® system and aluminum structural framing
- Optional pneumatics, motors and robotic motion logic control for complete robotic solution

### Results

- Advantages of a linear motor system with less cost
- Acceleration in excess of 4g; speeds of 4 m/s standard, upgradeable to 10 m/s
- Repeatability four to five times better than conventional belt or rack drive
- Travel range from 0.15 meters to 50 meters without length limitation
- Interchangeable Ball Rails and blocks add versatility
- Aluminum extrusions provide ease of integration, with large selection of chassis cross-sections and mounting hardware



A moveable carriage powered by a servo motor and belt rides on Rexroth's linear rail and aluminum framing to achieve a standard range of travel from 0.15 meters to 50 meters with almost no length limitations beyond.

accuracy rotary, linear and multi-axis motion devices, developed the unique ServoBelt for large format automation applications. As a stage company—a company who makes linear and rotary motion devices that can be customized by OEMs or integrators—Bell-Everman saw a need for a high-precision, economical linear actuator for smaller companies that may buy only one or two machines, as well as OEMs who purchase multiple units. The company relies on Bosch Rexroth for reliable product support to achieve their goals for high performance actuators at a lower cost.

**Lowering Costs, Increasing Precision**

The ServoBelt is a fully customizable precision belt-drive axis used as an alternative option on large format machines (greater than two meter travel) driven by linear motors or rack and pinion

drives. It combines Rexroth [linear Ball Rails®](#) and [aluminum framing](#) as the building blocks for the system. A moveable carriage or block rides on the linear rail, which is mounted on a length of Rexroth aluminum framing. Servo motors drive a polyurethane steel reinforced T5 belt, which power the carriage. A static, bonded lower belt engages with the upper dynamic belt so that the active belting under tension is less than a few inches long. Stiffness, accuracy, and repeatability are greatly enhanced by the belt mechanism.

The ServoBelt, with its high open loop accuracy compared to conventional belt drives, was designed as an alternative to linear motor systems while approaching the value of a rack-and-pinion type drive—the only other way to conduct long travel applications without the higher cost of linear motors. The ServoBelt drive mimics

a linear motor by inhabiting the same force regime, but at a much lower dollar-per-inch cost. The ServoBelt technique offers much more drive-line rigidity than conventional belt drives and can substantially improve a machine's settling time.

Michael Everman, CTO of Bell-Everman says the ServoBelt linear actuator is ideal for long travel, an attribute typically associated with rack and pinions or linear motors, or in greater travel lengths unattainable by ball screws. It is especially suited for food and packaging applications, palletizing, material handling, textile cutting, biomedical handling, large format printing, water jets, plasma cutting, CNC wood routing and pick-and-place robotics.

Regarding performance, Everman said they were aiming high. “We’re using cost effective components and targeting accuracies that are usually attainable only with more expensive types of forcers—ball screws and linear motors,” he said. “From a performance standpoint, a key focus is on accuracy and



Rexroth interchangeable bearing rails and blocks add versatility without a loss in performance.

repeatability. And, we wanted all of the advantages of a linear motor system for far less cost.”

The bi-directional repeatability achieved by Bell-Everman is four to five times better than a conventional belt or rack drive ( $\pm 60\mu\text{m}$ ), with an astounding unidirectional repeatability of  $\pm 10\mu\text{m}$ . By using a linear encoder, it can match the repeatability of a linear motor. The ServoBelt can achieve a standard range of travel from 0.15 meters to 50 meters with almost no length limitations beyond. Acceleration is in excess of 4g while speeds up to 4 m/s with

standard grade bearings, and up to 10m/sec with a bearing upgrade can be achieved. Bell-Everman’s life test units are recording 40,000 out-and-back cycles per day, with at least 16 million stops and starts already tabulated.

#### Adaptability from Rexroth

Everman said that key components of the machine design come from Rexroth’s linear Ball Rails and aluminum framing.

“Their standard linear bearing rails are interchangeable so we can stock lengths of rails and bearing blocks and interchange

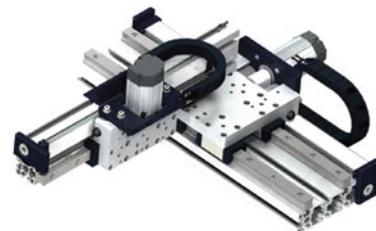
the blocks onto any rail and it will still have the performance specs we want,” he explained.

Using Rexroth linear Ball Rails allowed Bell-Everman to focus on overcoming their main hurdle – creating a belt that is rigid as opposed to having the flexibility of a “guitar string.” Everman said they experimented with a moving-motor belt drive predecessor design, but stiffness, although better than a conventional belt run, was an issue.

One notable attribute is that the chassis of the ServoBelt is based on easy-to-integrate Rexroth T-slot aluminum extrusions which can use a wide array of mounting hardware.

“Using the T-slot extrusions with our own belt carrier extrusion allows us to deliver standard stages in one to two weeks,” says Everman. “We can cut-to-length all of the major components,

The versatility of Rexroth linear Ball Rails and aluminum framing makes it easy to create subassemblies. Other Rexroth components such as motors, pneumatic grippers, valves, and a motion logic controller with robotic kinematics can be integrated to produce a complete robot.



with no long-travel machining operations,” he explained.

Everman added that multiple carriages can also be supplied for independent motion on the same axis and dual motor carriages are available to double Bell-Everman’s standard linear forces. The company can also integrate other Rexroth drive and control components such as [motors](#), [pneumatic grippers](#), [valves](#), and a [motion logic controller](#) with robotic kinematics to produce a completely integrated robot.

### Product Versatility Helps Expand Market

Everman said the ServoBelt appeals to smaller companies. “The versatility of Rexroth’s linear ball rails and aluminum framing makes it easy to create the subassemblies, which make them suitable for customers to buy in smaller quantities. With our design and the Rexroth components, assemblies can be constructed in unlimited lengths,” he said. “We have a product that is much easier to deliver as a one-off to customers who are experimenting with new machine designs. Having multiple independent carriage capability, without forcer cross-talk is a huge



Rexroth aluminum extrusions provide ease of integration and a wide array of mounting hardware allowing Bell-Everman to deliver standard stages in about one to two weeks.

plus. We’re slated to make stages with ten forcers on the same axis for an automated aircraft wing-fixturing system,” said Everman.

In addition to its versatility, the ServoBelt provides a sustainability advantage—increased energy efficiency versus a conventional belt. “When the driveline is stiffer, you spend less time trying to maintain position when the machine is shaking around due to other processes or other axes in motion,” said Everman. “It is definitely a

more efficient use of energy, so smaller motors can be used.”

Everman cites the quality of the Rexroth framing products, straightness, delivery times, and response to their needs as key factors in developing the ServoBelt.

“We designed our actuator with Rexroth products because they help us remain successful in a competitive industry,” said Everman. “We never have a problem with Rexroth quality. It always exceeds our expectations.”

**Rexroth**  
Bosch Group