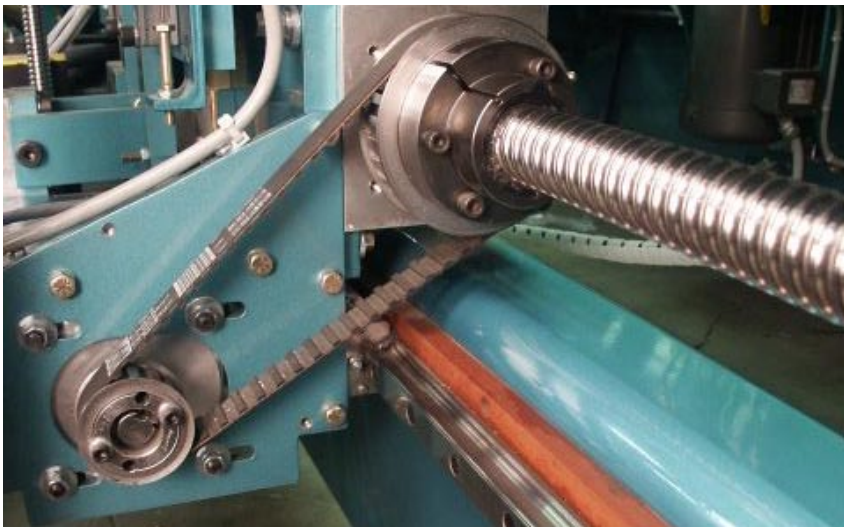
Drive & Control profile

# Door systems' successes hinge on advanced linear motion solutions



The geometrical design and extremely smooth surface finish of the Rexroth raceway results in lower friction during ball recirculation.

Since KVAL, Inc., opened its doors in Petaluma, California in 1947, the family-owned firm has been making innovative woodworking machinery for the door and window industry. A.A. Kvalheim, originally a cabinet maker in Norway, began the business by selling a panel saw using an ingenious traveling carriage to replace cumbersome conventional door-making jigs. Later his sons, Irv and Andy, and today his grandchildren continue the family tradition of innovation. Manufacturers of wood and fiberglass entry and architectural doors use KVAL automated equipment to rout and drill locks, hinges, and door lights. KVAL also makes automated hinge-and-door-frame assembly equipment for producing pre-hung doors.

"Our success is simple: our machinery is easy to use, durable and long-lasting and provides great customer value," says Jerry

## Challenge

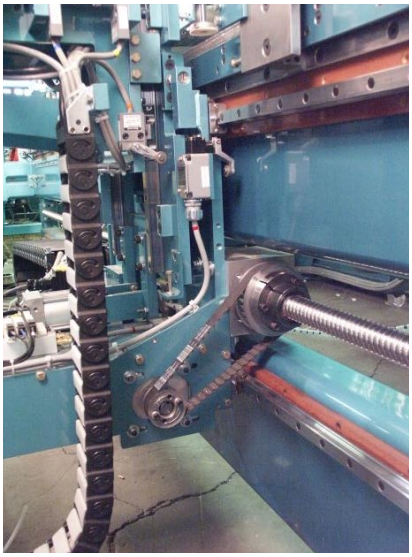
Create equipment that allows woodworking machinery to employ linear motion solutions that support the tool's weight, provide positioning accuracy and resist forces generated by drilling and routing.

## Bosch Rexroth Solution

- Rexroth Ball Rail® Systems
- Rexroth SEM-E-S precision ball screws

## Benefits

- Equipment life doubled
- Less friction
- 30% increased dynamic load capacity
- Enhanced serviceability
- Reduced maintenance and manufacturing costs
- Minimal machine downtime



A lubrication system and advanced floating seal improve the rail's service life.

Kvalheim, serving as the firm's president, with brother David, production manager, cousin Mark, purchasing manager, and brother-in-law Mark Smith, plant administrator.

"We have kept our focus on designing and building specialized wood-working equipment," says Jerry. "We couldn't do what we do without the quality and flexibility of Rexroth Ball Rail® Systems and ball screws. Almost every model of CNC and non-CNC equipment in our standard catalog of over 60 machines incorporates Rexroth linear motion products."

**Close collaboration**

Over the years, KVAL Engineers have standardized on several Rexroth products that meet some very demanding requirements.

The challenge is to create equipment that not only allows KVAL's customers to handle and machine doors without marring plastic-laminate or fine-veneer finishes, but also to perform a variety of routing and drilling operations without tear-out and chipping.

"It is unacceptable for the tool to ride on the workpiece," says Rick Trees, Rexroth's district sales manager. "Therefore, KVAL machinery employs linear motion solutions that support the tool's weight, resist forces generated by drilling and routing, and provide positioning accuracy."

As it turns out, Rexroth Ball Rail Systems excel at meeting the load capacity, service life, and running properties the application requires.

**Perfect profiled rails**

According to Trees, the rectangular shape of Rexroth profiled rails has the inherent geometry that provides the rigidity necessary for KVAL's larger machinery—some of which handles doors up to 4 x 10 feet and up to 200 pounds.

But it's the bearings in the runner block that must carry the load. In Rexroth runner blocks, recirculating balls contact a large surface area on the ball track—a design that can withstand a high load capacity. Furthermore, the geometrical design and extremely smooth surface finish of the Rexroth raceway result in lower friction during ball recirculation and allows a 30% increase in dynamic load capacity.

Beyond the friction-reducing track smoothness and precision that effectively doubles the equipment's life, serviceability is further enhanced by a lubrication system that provides 5 to10 million meters of maintenance-free travel. A foam insert in the runner block releases the lubrication to the balls over time This reduces lubrication related maintenance costs: labor, storage, and disposal along with time. There's a foam insert in the runner block that releases the lubrication to the balls over time.

"We've found that the lubrication system and advanced floating seal improves the rail's service life," says Kvalheim. "We can also use a field-installable front seal to help keep sawdust out. And because the blocks are prelubricated, we don't have to buy and add lubricant during assembly, which reduces manufacturing cost."

**Precision rails allow modular interchangeability**

Just as important as functionality for the end-user is flexibility for the machine builder. Rexroth linear guideways and runner blocks are machined with such high precision, especially in the ball track zone, that individual blocks and rails are interchangeable within their dimensional family.

"It's to our advantage to use stock carriages and purchase long rail lengths, then cut them to size as needed," Kvalheim says. "That's why it's great when rails and blocks are machined within tolerances that make them interchangeable.

With Rexroth, any set of blocks or rails within a given accuracy class will work together; so we do not have to order matched sets. In the field, this means runner blocks can simply be replaced without having to replace whole assemblies. Compared to the complexity of a complete assembly retrofit, block replacement is a tremendous cost savings and minimizes machine downtime."

A module called "The Face" is used to drill holes, while a field-installable front seal helps keep sawdust out.

**Ball screws for demanding systems**

There are several machines employed in a KVAL automated door-processing system. Architect DI-DM addresses the two faces, styling both sides simultaneously. In front of the DI, a module called "The Face" is used to drill holes. A standalone machine called "The Edge" processes the door ends (top and bottom). The DL-NCA (Door Light/Numerically Controlled) machine cuts window lights in doors. This machine uses 50 mm diameter ball screws, and a driven-nut product is under consideration to increase speed without the whipping that can occur in long ball screws.

"For this application, Rexroth ball screws with a driven nut are an ideal solution," explains Trees. "They can move the tool with rigidity and accuracy, but also with fast, low-friction, motion."

"Basically, the ball screw design is a marriage between ball-bearing and lead screw technologies," he continues. "Motion can be accomplished either by rotating the screw through the nut or rotating the nut around a fixed screw. To reduce friction between the nut and the screw's helix, recirculating ball bearings are incorporated into the nut."

For long traverse, high-speed applications encountered with the KVAL architectural door system, a nut-driven ball screw is ideal, because it minimizes the whipping motion that can occur when a long screw rotates at high speeds.

**Preloaded nuts**

KVAL uses Rexroth SEM-E-S precision ball screws with an adjustable split (preload) nut that exhibits an exceptional 150,000 Dn value. This capability allows a nut rotation speed from 3,750 to 6,000 RPM in the application to provide rapid, smooth motion for demanding production cycles.

"At these speeds, it's good to use preloaded screw assemblies to ensure maximum accuracy and repeatability," Trees explains. "These benefits are the result of preloaded bearings, which exhibit increased axial stiffness and zero backlash."

**Ball screw applicability and serviceability**

"For an equipment manufacturer, the adjustable preloaded nut also makes life easier," says Kvalheim. "We can stock nuts, then order long lengths of screw to be cut to length and end machined as needed. This improves our turnaround and flexibility."

In the field, the nuts can be simply replaced without having to order a whole new screw assembly. Interchangeability minimizes downtime and improves serviceability, as do contact molded seals that are used to keep out sawdust.

"Machine uptime reliability, flexibility, and precision are all critical issues to our customers," explains Jerry Kvalheim. "Just as interchangeability and serviceability are big issues to us. Rexroth linear-motion products have proven themselves on both our CNC and non-CNC machinery. Now, they are fundamental to our design habits. We don't think of them as being special or unique anymore—they are simply an essential part of how our machines operate to provide customer value."

Rexroth
Bosch Group



Bosch Rexroth Corporation
5150 Prairie Stone Parkway,
Hoffman Estates, IL USA 60192-3707
Telephone (847) 645-3600
www.boschrexroth-us.com