

# Drive & Control profile

## Rexroth helps friction welder put a new spin on welding plastic parts



Eagle Technologies used a Rexroth drive and control platform to reduce components while improving output, durability and safety functionality on its power plastics welding machine.

Eagle Technologies' power welder uses Rexroth drive, control and linear motion technology to give washing machine parts manufacturer greater reliability, reduced waste and less downtime

The traditional image of welding involves large pieces of metal and sparks flying as the welder applies the torch. However, welding small plastic parts involves joining them by pressure and friction in a precisely controlled automated process. One of the most challenging of these welding tasks is the production of fluid-filled plastic balance rings,

used in balancing the wash load in a washing machine.

Most balance rings begin life as two donut-shaped plastic pieces (about two feet in diameter), one of which is held in place while the other half is spun and pressed downward onto it. The compression force and friction melts the plastic to exactly

### Challenge:

- Reduce waste, improve welds
- Reduce expense, downtime from component failure
- Increase flexibility for part changeover
- Maximize operator safety

### Rexroth Solution:

- IndraMotion MLD platform with integrated motion logic control
- IndraDrive digital intelligent servo drives with Safety on Board and Safe Motion functionality
- Synchronous IndraDyn servo motor with absolute Hiperface encoder
- SERCOS III Ethernet
- Durable Ball Screw and Ball Rail® assemblies
- VCP Series touchscreen HMI

### Results:

- Reduced waste/scrap material by 15 percent
- Longer motor life
- Fewer machine components, less build-out time
- Less machine flexing, more accuracy
- Easier machine programming and changeover
- More uptime, efficiency and throughput
- Maximized operator safety

the right extent, forming a leak-proof weld. The spin stops at precisely the right spot so that slots for plastic baffle insertions and mounting holes for fasteners line up perfectly between the two halves—within a margin for error of less than one degree of rotation and less than two millimeters along the circumference. Using specialized power welding machines, fabricators for appliance manufacturers can turn out thousands of balance rings a day using this process, producing each one in less than 30 seconds.

At least, that's the plan. In actual practice, however, problems can arise. One major appliance part fabricator recently found itself experiencing an unacceptably high level of wasted materials and scrapped parts (about 15 percent) due to leaky welds, misaligned slots or even collapse when too much pressure caused excessive melting. Even worse, the low speed and high torque required for optimum results was putting enormous strain on motors, particularly since safety concerns required the power to the motors to be dropped out each time the operator reached into the machine—four or five times per minute. The parts fabricator estimated that motors for power plastic welders had to be rewired once per year on average, causing significant expense and downtime. Finally, any changes in a manufacturer's balance ring design resulted in the machine's motion controller having to be painstakingly reprogrammed. To stay competitive, changes had to be made.

### **Enter the Eagle: Bosch Rexroth and Eagle Technologies**

Based on prior experience with other machines, the parts fabricator

turned to machine designer and builder Eagle Technologies ([www.eagletechnologies.com](http://www.eagletechnologies.com)) for a solution. Eagle, along with local automation distributor Morrell Inc. ([www.morrellinc.com](http://www.morrellinc.com)) chose a drive, control and linear motion package from Bosch Rexroth Corporation ([www.boschrexroth-us.com](http://www.boschrexroth-us.com)) as the most flexible and cost-effective solution for dealing with the unique challenges involved. Eagle's combination of Rexroth intelligent servo drives, built-in safety functionality, motion logic control, motors, operator interface and linear motion components promised to meet each machine design challenge.

#### **Power with precise control**

Eagle's approach began with the Rexroth [IndraMotion MLD](#) servo control platform, a [SERCOS III](#) Ethernet-based system that integrates the machine's motion logic control directly in the drive without the need for separate PLC. The IndraMotion MLD serves as the heart of the new spin welder, providing a compact combination of motion and PLC functions in a single automation platform. The motion logic controller works with Rexroth's [IndraDrive](#) digital intelligent servo drives and [IndraDyn S](#) synchronous servo motor to drive the spin welder's three-stage planetary gearbox. This permits controllable low-speed, high-torque spin motion.

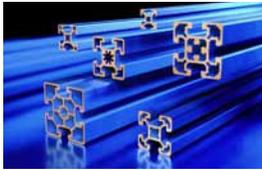
The spinning welding head, driven by the Rexroth IndraDrive and servo motor combination, moves up and down on a set of Rexroth Precision [Ball Screws](#) and [Ball Rails®](#) that are mechanically coupled to the two shafts with individual timing belts. The accurate control and reliability of the Rexroth Ball Screws and Ball Rails allow for powerful welding

compression while avoiding flexing—eliminating yet another cause of leaky welds and wasted parts.

The powerful torque and compression generated by the Rexroth components are precisely controlled by the IndraDrive unit. This allows the machine to line up slots and baffles in the ideal "clock" position required to make the two ring halves match. The force exerted by the downward compression can be calculated and controlled to exacting standards, melting the plastic to the precise degree required for a tight weld. Finally, the controller in the drive allows constant monitoring of motor speed, drive temperature, energy use and many other key factors.

#### **Ease of operation**

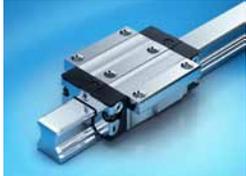
Rexroth's user-friendly [VCP-series human machine interface \(HMI\)](#) allows operators to apply a full menu of parameters for each welding operation: motion, positioning, force, power usage and more. Adjusting to different parts requirements is accomplished through the HMI touchscreen instead of having to reconfigure the entire machine. The HMI allows multiple recipes to be stored with easy access to profile changes required for switching over products. Morrell was able to use both ladder logic and structured text to program the machine. The programming language complies with IEC-61131 standards. In addition, a software oscilloscope enables rapid fine-tuning of motor and drive performance and monitoring of bus voltage, regenerative load, running torque and other parameters.



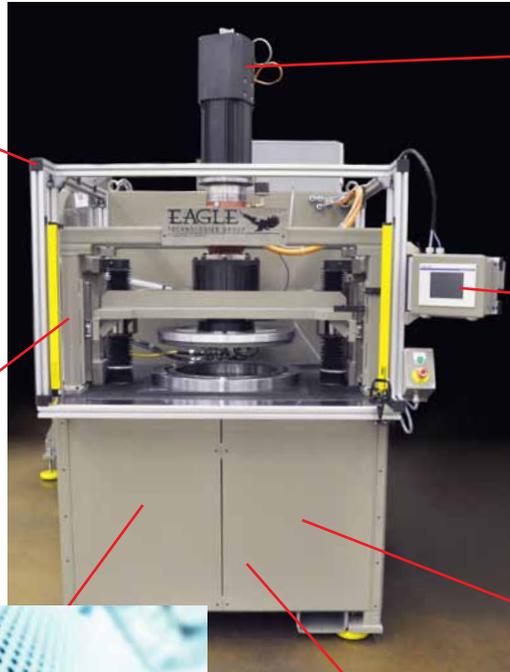
Rexroth aluminum structural framing



Rexroth precision Ball Screws and Ball Rails®



Rexroth Safety on Board with Safe Motion functionality



Rexroth IndraDyn synchronous servo motor



Rexroth VCP touchscreen HMI



Rexroth IndraMotion MLD integrated motion logic platform and IndraDrive digital intelligent servo drives



SERCOS III industrial Ethernet communication

With the Rexroth drive and control package operators can control every motion, speed and dimension parameter with a high degree of precision and consistency, resulting in precise welds for washing machine balance rings.

### Maximum operator safety without strain on motors

One of the most important challenges faced by Eagle Technologies was to ensure safety in a machine whose operator must frequently reach inside the weld area to make adjustments and remove parts. The need to stop the entire machine (a sudden drop of 480 volts AC) when the operator reaches inside had been a key factor in frequent motor burnouts. But Rexroth offered an alternative that avoids this problem, based on their unique and innovative drive-based [Safety on Board](#) and [Safe Motion](#) concepts.

Rexroth's Safety on Board relies on programmable safety-based logic,

eliminating the need for lock-out/tag-out machine stoppages that place strain on motors. Integrated safety functionality is embedded *in the servo drives*, supporting safe motion functions without the need for external safety hardware. This reduces complexity, increases speed of response and protects the spin welder's operators—while producing less motor wear and tear.

Operator protection is therefore built right into the machine's automation, starting with the light curtain that separates the operator from the weld area. Rexroth servo drives respond to signals from the light curtain through dual, redundant safety channels that put the machine into

one of two "pause" modes, Controlled Stop 1 or Controlled Stop 2, where power is still fed to the machine but motion is stopped. This protects operators performing various tasks, after which the equipment is easily restarted without having to reset the entire machine.

### Efficient PLC integration and use of space

Rexroth's integration of motion logic into the drive itself offers big improvements over the earlier machine; saving space and reducing design and build time for Eagle Technologies. The ability to integrate motion logic control in one component was also an advantage Rexroth offered

over competitive systems, as was the power and torque of its motors.

“Usually a weld machine design starts with a PLC and then the designer builds out from there,” says Earle Cooper, project manager for Eagle Technologies. “Rexroth’s IndraMotion MLD lets us start with control of two axes already built into the servo drive, so we could focus on a wide range array of options for creating different types of welds and parts.”

During the design phase of this new welder platform, Morrell Inc. worked with the end-user to determine the power requirements and the production parameters involved. Morrell specialists also provided all training for the end-user’s controls engineers after the machine install.

### **Perfect match for production needs and performance**

With the new Eagle power welder the end-user realized an immediate improvement in the efficiency and productivity of their balance ring

production. Scrap material dropped from 15 percent to less than one percent, which translates into a productivity gain because so many fewer parts are discarded due to leaks, improper welds or damage. The IndraMotion MLD, providing consistent control of motion and clock position, is a large reason for this, but the machine is also more mechanically sound and less prone to flexing during the weld. The machine’s HMI makes it easy for operators to “capture” the parameters of a perfect weld and spin profile, then repeat it time after time. This includes final positional rotation control to less than one degree, which maximizes product quality. It’s also easy to reprogram the machine to accommodate changes in parts or weld specifications. These improvements have been realized without compromising productivity (the total time to finish each balance ring is less than 20 seconds) or operator safety (the safety system conforms to EN954-1 Category 3 safe and supports new ISO 13849 standards).

Best of all, the problem of motor wear, burnout and failure has been virtually eliminated because Rexroth motors and drives are designed to work together, with drives that can be paused instead of shut down when an operator reaches inside the machine. This allows high compression forces, high torque, rapid acceleration/ deceleration and low rpm to co-exist peacefully.

“We still don’t know exactly how much longer the motors are lasting than before,” says Cooper, “because none of them have required any repairs.”

After more than a year in operation at a major appliance parts fabricator, the Eagle power welder has passed every test with flying colors. By turning to Rexroth products and Morrell’s value-added services, Eagle Technologies provided its end-user with better quality, reliability and throughput—in a machine that’s versatile enough for any large diameter plastic parts welding.

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