White Paper

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The Growing Role of Electromechanical Actuators in Automotive Manufacturing

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The Growing Role of Electromechanical Actuators in Automotive Manufacturing

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Maintaining a competitive edge in the global marketplace requires manufacturers to continually search for new processes and technologies that increase production quantity, quality, and flexibility. Nowhere is this more apparent than in the automotive industry where shorter time-to-market cycles and ongoing cost containment are critical to enhancing shareholder value in the face of ever-increasing global competition. To meet these and other challenges, automotive manufacturing engineers and operations managers are taking a closer look at process automation across all phases of production, searching for incremental gains in productivity, quality, and reliability. A recent area of focus throughout the automotive industry is converting older fluid power (pneumatic and hydraulic) actuators to clean, flexible, and efficient electromechanical actuators.

Electromechanical Actuators – Lean, Clean & Green

Fluid power technology has been a proven, de-facto standard throughout the automotive industry for decades. Consequently, the technology is well understood, easily applied, and readily available from a plethora of sources. It is not without its flaws, however. Chronic leaks, frequent adjustments due to changes in temperature and humidity in the environment, and limitations in overall flexibility and precision prevent manufacturers from achieving potential process improvement goals. While this technology has improved significantly over the years, the inherent performance limitations, inefficiencies, and maintenance headaches remain.

In contrast, modern electromechanical actuators marry precise and programmable servo controls and motors with rugged and reliable mechanical screw mechanisms. Free from fluid power's noisy pumps and compressors, (as well as complex spider webs of hoses, fittings, and valves), electromechanical systems offer simple installation, repeatable and programmable motion, lower overall energy consumption, and a long, maintenance-free service life. These advantages, coupled with advancements in mechanical screw technology that offer a force density approaching that of a hydraulic cylinder, creates a compelling business case to "go electric".

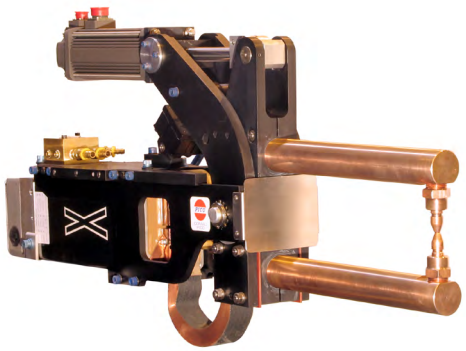
Application Solutions for Automotive Manufacturing

Fluid power actuators are ubiquitous today across all automotive manufacturing processes, and each one is a potential candidate for migration to electric. However, some applications are more critical or present more of a process bottleneck than others. In general, the following types of applications will benefit the most, and therefore offer the shortest payback, from conversion to electric:

- Robotic Spot Welding
- Assembly Pressing
- Robotic Dispensing
- Clamping & Fixturing

Robotic Spot Welding. Joining sections of stamped sheet metal parts to form the car frame requires hundreds of spot welds, and weld accuracy and consistency are critically important to ensure high quality and therefore passenger safety. Weld quantity and quality requirements are driving most automotive manufacturers to invest heavily in automating the spot welding process. Mounting spot welding guns on the end of a robotic arm not only increases the quality of each weld, it also eliminates the human hazards associated with the manual welding process.

Traditionally, pneumatic cylinders were utilized to actuate the weld gun and apply the specified amount of force during the weld cycle. While these actuators were relatively inexpensive and easy to install, the compressibility of air and its susceptibility to drift with changes in air temperature and humidity contributed to inconsistent and unacceptable weld quality. In addition, the pneumatic systems required frequent maintenance to repair inevitable leaks, and adjustments were required each time there was a model changeover.



The advent of integrating an electric motor and a mechanical screw in a package similar in form factor to the pneumatic actuator is a significant step forward for robotic spot welding. The resulting integrated electromechanical actuator not only offers significantly better control of the gun clamping force, thus significantly improving both the weld quality and repeatability, but also enables push button changeover between car models and eliminates much of the maintenance and repair required by the pneumatic-based solution.

Assembly Pressing. Component part and full vehicle manufacturing relies on numerous presses to both form and assemble components. In the automotive space, the applications for high force pressing are nearly endless: axle-bearing installation, transmission assembly, stamping and forming body parts, and hydroforming seat panels, to name a few. For many years, hydraulic presses have dominated these applications because of their high force density. This high force capacity allows for more parts to be formed or assembled in one operation, leading to increased throughput for manufacturers.

Hydraulic technology is not without its limitations however, fluid power systems are slow, inefficient, and require complex fluid handling systems, and considerable maintenance. As new electric actuator technology approaches the force density of hydraulics, many plant managers are turning to presses with electric solutions to reduce energy consumption, maintenance requirements, and overall system cost.

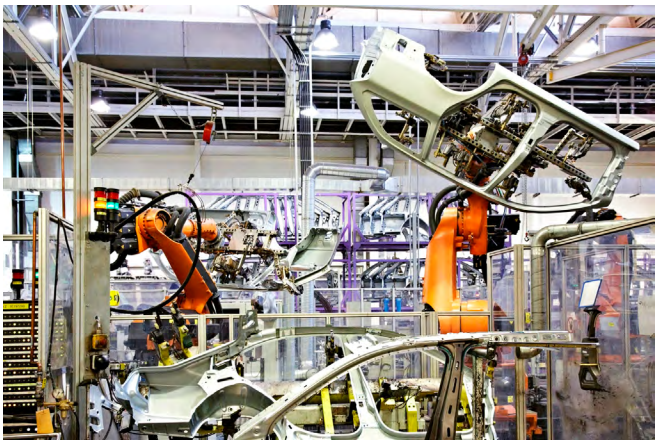
In many cases, a switch from a hydraulic to an electric actuator can further increase throughput and lower costs by, increasing speed, reducing downtime, and improving energy efficiency. A recent success story can be found at a tier 1 supplier focused on steering wheel production for a major automotive

manufacturer. The tier 1 supplier changed actuators on its mold presses from hydraulic to electromechanical actuators and achieved an increased throughput of nearly 85%! With the numerous other pressing applications available in the automotive space, the opportunity for these remarkable improvements are endless.

Robotic Dispensing. Another very common process in the automotive industry is fluid dispensing. Precision metering of adhesives, sealants, grease, and lubricants is of utmost importance for maintaining proper gasket adhesion or mechanical part lubrication. Traditionally, pneumatic powered actuators pumped viscous fluids, but with part fallout and excessive wasted fluid, designers are realizing that greater precision of flow control offer many benefits in automotive manufacturing.

To ensure that dispense-metering manufacturers are achieving the quality that they and their customers require, dispense-metering manufacturers are shifting to electromechanical actuator solutions. Using the position feedback control, integral to servo-controlled actuators, volumetric flow rates are optimized based upon the position of the dispensing head. With precise metering, car manufacturers achieve robust quality control and can minimize costs by not over-dispensing high-cost fluids. Based on these improvements, it is easy to see why dispense-system manufacturers are turning to electric solutions, resulting in win-win results for them and their customers.

Clamping & Fixturing. In an automotive body shop, there are thousands of automated clamps. Similar to dispensing systems, pneumatic actuators actuate the majority of clamps. This allows for fast actuating clamping and fixturing, but lacks the control and flexibility that automotive manufacturers require from their production lines. With the desire to increase flexibility and control total cost, programmability and minimal maintenance requirements top the list of desirable features of clamping and fixturing systems. As the vehicle mix per line increases, electric actuators are proving highly effective in clamping applications.



By programming the speed and force of the clamping mechanism, line builders can develop universal production lines to build numerous vehicle models on the same line. Electrically-actuated clamps are easily programmable to accommodate line changeovers. Unlike pneumatic clamps, electric clamps control acceleration and deceleration rates, allowing for quick moves to get the clamp into position and slower clamping modes to prevent crashing tooling into the production part. By introducing electric solutions into their facilities, manufacturers reap the benefits of consistent quality parts and line flexibility to increase throughput and reduce total cost.

The table below lists several additional processes and applications that benefit by leveraging the advantages of electromechanical actuators.

Process	Typical Application	Electric Actuator Benefits
Fastening/ Joining	Door panel installation	Force repeatability
		Flexibility and precision to cope with varying designs and material
Honing	Cylinder bores on engine blocks	High acceleration rates (up to 3g)
		Precise velocity control
		High system stiffness
		Results in better surface finish
Leak testing	Simulate bolt force to pressure test transmission cavities	Force repeatability
		High system efficiency
Painting	Final body paint dispensing	Precise flow control
		Pressure monitoring
Punching	Placing locations for parking sensors, cameras, door hinges, etc.	Precise position control
		High system stiffness

Conclusion

Staying ahead of the technology curve and embracing change is critical to maintaining a competitive advantage. Identifying and prioritizing applications that best leverage the advantages offered by electromechanical actuation is a key factor in meeting delivery, quality, and cost expectations of customers. Compared to traditional fluid power, implementing electric actuator solutions today will result in significantly reduced maintenance costs and associated downtime, superior process control, lower energy consumption, and ultimately a lower cost of ownership.