

design The Advantages of Modern Electric Actuators

FAQs

FREQUENTLY ASKED QUESTIONS

Q: What are reasons one might have for choosing electric actuators over hydraulic actuators?

A: Hydraulic actuators have some advantages in certain cases. They have a high power density, low component acquisition cost, moderate to high stiffness, high speed, and are a commonly used technology with several commercial outlets. However, in certain situations, hydraulic actuators can be less beneficial to a system. They have a moderate accuracy and repeatability without the additional help of extra tuning equipment. They also have intricate and complex installation and maintenance due to hydraulic pumps and tubing. Additionally, they have a high installation cost, low energy efficiency, large environmental impacts, and limited scalability and modularity. These are the cases where electric actuators offer a better solution.

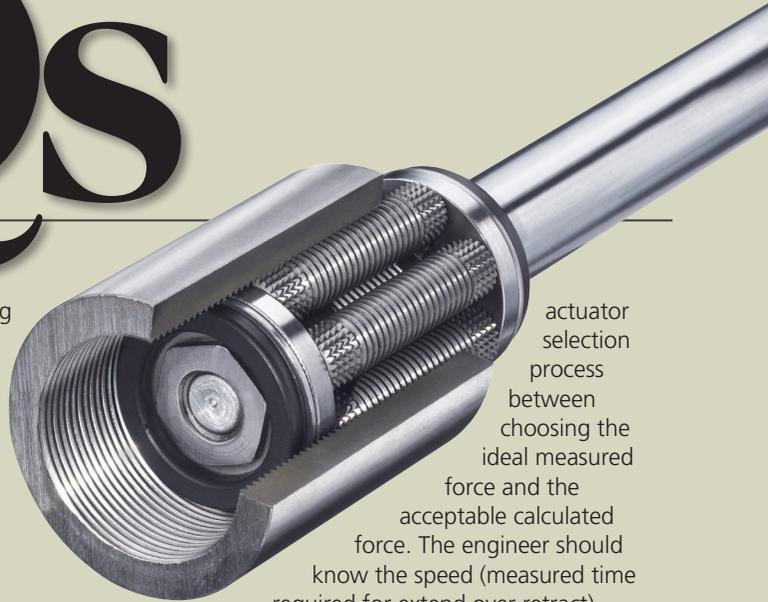
Q: What are the primary benefits of using an electric actuator system over hydraulics?

A: Electric actuators offer high speed and force, are flexible and easily programmable for a variety of load conditions, have high accuracy and repeatability, are efficient, simple to install, require little maintenance, and are environmentally friendly. By not using a hydraulic system, the user can eliminate oil leaks, reduce pollution, and improve worker safety. Other environmental benefits of electric actuation include: higher energy efficiency/lower energy consumption; quieter operation/lower noise levels; and near zero power consumption when not operating (hydraulic system

pumps operating during idle periods consume substantial energy). Additionally, there is no disposal of hydraulic fluids (upon normal maintenance or repair, hydraulic fluids need to be disposed of properly). Electric actuators are also a non-toxic solution especially in the food industry.

Q: What are the challenges encountered with replacing a hydraulic system and what should you be looking for in the conversion process?

A: There are certain conversion challenges that occur when converting from hydraulic actuator systems to electric ones. If the system has more than one hydraulic actuator, the approach of a piecemeal conversion may be a more difficult process as compared to converting all machine axes at the same time. If you have harsh loading conditions, you should consider bumpers or adjusting the motion profile to alleviate impact shock loads and high vibration. Converting properly from one actuating method to another requires understanding how to properly size the new actuator. The actual stroke length should be measured and considerations toward mounting should be taken. For a simple estimate of required force, the piston diameter multiplied by the pump pressure should guide your electric



actuator selection process between choosing the ideal measured force and the acceptable calculated force. The engineer should know the speed (measured time required for extend over retract), how many cycles per minute, hour, and day, number of shifts or days per week the actuator is used, and the operational environment. The operational environment will include the temperature, dust, liquid, and hazard conditions.

Q: What advancements in electric actuation have improved current processes?

A: Advances in electromechanical actuation include the pairing of a rotary servo motor coupled with rotary-to-linear mechanical transmission such as a roller screw. Roller screws have nuts running along a threaded rod that are geared with respect to each other and a nut housing much like a planetary gearbox. They provide more contact points than a ball screw, which means the applied force can be distributed over a larger surface area, resulting in lower stress levels and longer life. Rollers connect the nut with the screw, creating synchronized movement without recirculation allowing for higher rotational and linear speeds in applications where substantial force is required. There is also less vibration and noise at higher speeds due to the absence of recirculating balls. The high load capacity of roller screws allows

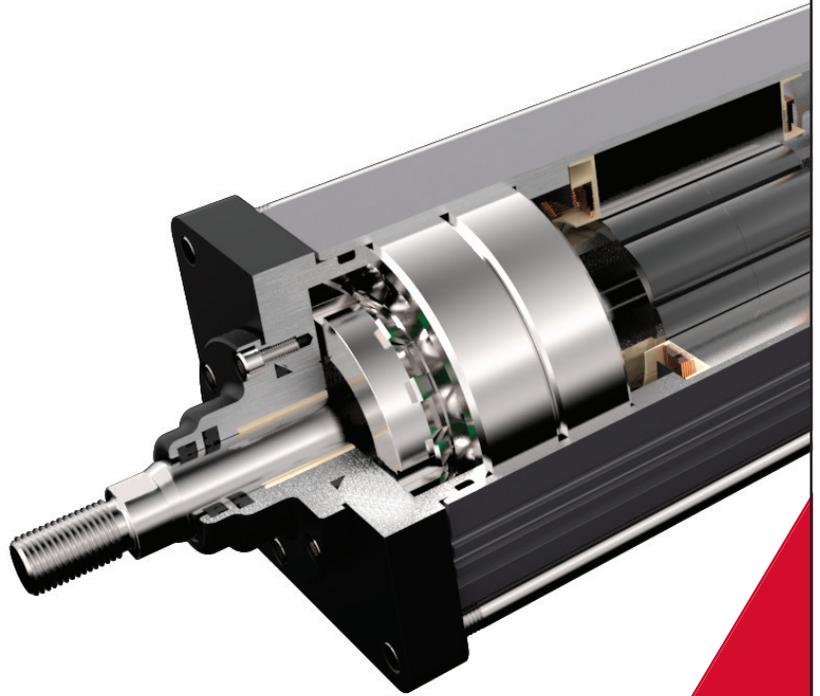
a smaller, more lightweight package than a ball screw — and to further optimize weight and package size, newer models of electric actuators combine the roller screw and the servo motor into one unit. The integration of the motor creates a smaller package size and reduces the number of components. Direct driving of the roller screw mechanism eliminates backlash due to couplings and drive trains resulting in higher dynamic response and better performance.

Along with the pairing of servo motors and roller screws, advances in brushless motors with feedback devices provide higher accuracy and repeatability. Traditional electric actuators typically use single or three-phase induction motors as their driving force. The problem with this design is when the actuator needs to change directions or start and stop, the operation is limited by motor temperature rise and therefore has limited duty cycles. Using a continuous-duty-cycle brushless dc motor along with the pairing of roller screws helps solve this limitation. The feedback device allows for very precise control of both the position and speed of the actuator output rod.

Q: What current industries are using electric actuators to their benefit?

A: Several industries are utilizing electric actuators for their systems. For example, they are used in the automotive manufacturing world and robotic end tooling like weld guns, bearing presses, and powering position arms. Food processing equipment uses electric actuators for volumetric filling, cubing, and conveying and indexing product. The oil and gas industries are using electric actuators to replace hydraulic and pneumatic actuators due to their environmental benefits and more flexible and precise control. Both hydraulics and pneumatics have the potential for leakage, creating possible hazardous conditions (i.e., contamination or ignitable gas where methane is commonly used as the pneumatic fluid in the oil field). Electric actuators are increasingly being used to address all these concerns. ■

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