Hydraulic actuator replacement: accurately sizing an electric upgrade

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Achieving equivalent forces to hydraulic designs, electric linear actuators are more precise and reliable, and they're also less expensive to run. When upgrading to an electric linear actuator, accurate sizing of the existing application is crucial to achieve the most efficient and cost-effective specification.

Gerard Bush, engineer at INMOCO, explains the advantages of an electric actuator upgrade and how to achieve the most accurate sizing.

For nearly all applications, electric linear actuators are a preferable choice compared to their hydraulic counterparts. Today, electric linear actuators from a brand like Tolomatic are available in bore sizes up to 127mm (5") and can exert up to 222.4kN (50,000lbf) of force. As a result, they can handle force demands across virtually all applications, ranging from metal presses to cranes, except for those requiring the very highest force, where hydraulic designs still have an advantage.

However, when considering retrofitting an application, or upgrading a machine design, reluctance to switch from hydraulic to electric is often a result of the perceived time and cost of the update. Long term though, it's nearly always less expensive, and a time saving, to make the change to electric.

The demand for regular maintenance, and the risk of leaks, are inherent to hydraulic systems, whereas their electric counterparts are almost maintenance free. The high reliability of electric designs also results in significantly less downtime, which optimises application productivity. What's more, electric actuators are less expensive to run; while hydraulic systems only achieve around 50% efficiency, electric systems typically operate at 75-80%.

Lower cost, improved performance

The improvements in precision and repeatable accuracy also mean that electric actuators can deliver a boost in throughput as well as production quality. The motion capabilities of an electric design enable real-time management over force, position, velocity, as well as acceleration and deceleration. This level of control also expands the functionality of what a machine can do.

However, when converting an existing machine or design to electric actuators, accurate sizing is crucial. When conservative estimates are applied in place of confidence in accurate sizing, this usually delivers an oversized and overpriced actuator. The system pressure method of actuator sizing falls into this category, taking the area of the cylinder multiplied by the rated system pressure.

To achieve accurate sizing, calculating the true peak and continuous working force of the hydraulic cylinder is the optimum approach. This means identifying, as closely as possible, the forces acting on each side of the piston, then calculating the effective area of the rod side by subtracting the rod area from the full bore area. Finally, ensure that the actuator can deliver the required application force by considering the difference in force between the two sides.

Accurate sizing

Recording the values of the application while in operation will achieve the most accurate data, and this requires a load cell or an electric actuator installed in the application. This method may not be possible with existing machines, so a practical alternative is to measure hydraulic pressures in the cylinder while the process is in operation.

The closer the measurement is taken to the point of work, the more accurate the measurement, and this means measuring the pressure at the cylinder, however, this area may be the least accessible. An alternative is to measure pressure between the valve and cylinder, as pressure-compensated flow controls and needle valves or other inline

accessories downstream of the control valve may have an influence on pressure. It's also possible to measure the pressure at the valve, and while this is the most common for conversion applications, it's the furthest distance from the work point. This can increase the error in actual versus measured pressures. However, even a pressure estimation within 15 percent of the actual force will provide a reasonable level of accuracy compared to the system pressure method.

Support in specification

It's also important to measure the return pressure. Usually, there will be minimal back pressure in the return lines, but some systems can have high return pressure between the cylinder and the valve that will impact the output force of the cylinder. The most accurate force calculations will also determine the dynamics on both the piston end and the rod end of the cylinder. When back pressure is applied to the rod end of a cylinder during an extend move, this will also offset some of the force applied to the piston end of the cylinder, and this must also be accounted for.

Tolomatic provides a range of electric actuators ideally suited to hydraulic replacement applications, such as the RSX extreme force actuator rated to 222kN force, through to the RSH hygienic actuators designed with IP69K protection for clean-in-place (CIP) applications. INMOCO supports Tolomatic products in the UK and can assist with hydraulic replacement projects including accurate electric linear actuator sizing.

Image Captions:

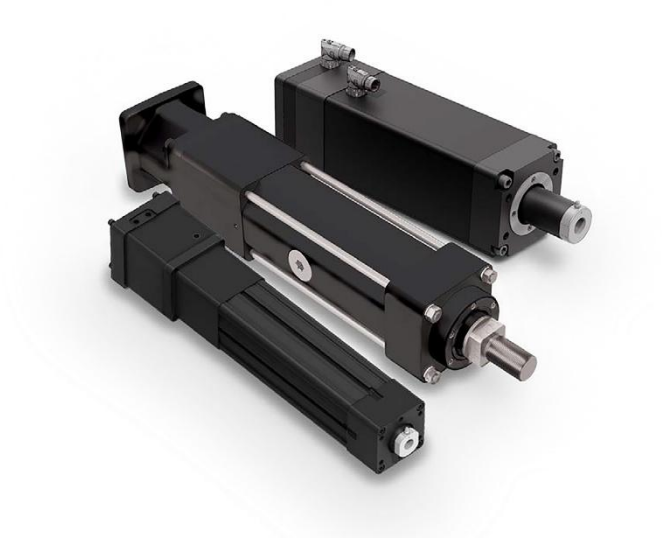

Image 1: Tolomatic Electric linear actuators

About INMOCO

Established in 1987, INMOCO now offers an extensive range of motion control equipment including: compact servo amplifiers, position controllers, stepper motors, PLC controllers, linear motors, sensors, electric actuators and gearheads. INMOCO's product portfolio is supported by extensive applications and technical expertise, in addition to customer-specified electro-mechanical development and sub- assembly services; including calibrating and testing in a class 10,000 clean room facility.

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