Electro-Mechanical vs Pneumatic Actuators

Weighing the options between the use of electro-mechanical or pneumatic actuators in machine and systems design.

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In machine and industrial systems design, there are numerous areas in which design engineers have to make a decision about whether to use pneumatic or electro-mechanical devices. In this "Design Decisions" viewpoint from Exlar, a provider of electro-mechanical devices, the advantages of electro-mechanical actuators are explored in comparison to pneumatic options.

Exlar believes that system design requirements for handling multiple positions, higher levels of positioning accuracy and flexibility in changing positions are among the key elements offered by an electro-mechanical solution that make them preferred to pneumatic solutions for many design applications.

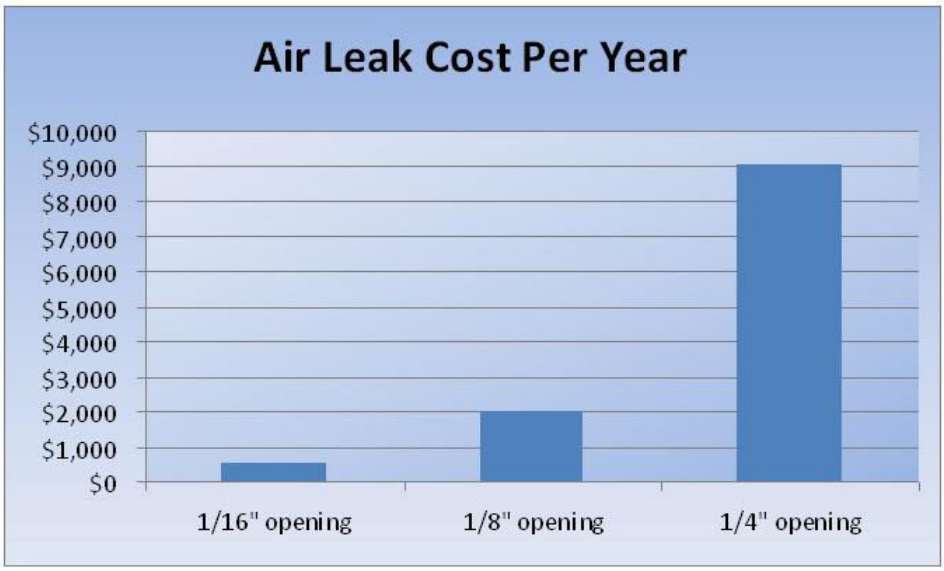
Another significant factor in favor of electro-mechanical devices is the higher cost of operation for pneumatic products. The cost savings provided by an electro-mechanical actuator system in place of pneumatics becomes very apparent when comparing direct energy costs. To illustrate, following is a comparison of a horizontal point-to-point move with 15 inches of stroke and 35 lbs of tooling weight to be cycled 30 times per minute with a duty cycle of 50 percent.

With an electro-mechanical cylinder, the move time of 0.5 seconds can be achieved using a motion profile with 0.1 second acceleration, 0.3 seconds at constant velocity and 0.1 second deceleration. The maximum velocity of this profile is 37.5 inches per second. With the efficiency of an electric system, the power required for the electro-mechanical actuator to perform this application has an energy cost, at $0.07 per kwh, of approximately $165 per year.

Using a pneumatic cylinder with a load of 35 lbs and the required maximum speed of 37.5 inch/sec, a pneumatic cylinder with a diameter of 2 inches is used with an assumed air pressure of 85 psi. The cylinder volume in combination with the cycle rate, at 85 psi results in air consumption that equates to an annual energy cost of over $1,100! The energy cost to operate the electric cylinder is only %15 of the cost of the pneumatic cylinder.

Other Considerations -
The Real Cost of Air

In addition to operational costs, another advantage electro-mechanical cylinders have over pneumatic cylinders is the energy cost wasted by air leaks. The chart below shows up to $9,000 lost per year with a simple air leak of .25 inch in diameter. Annual cost in U.S. dollars of an air leak emanating from various sized openings. Source: Exlar



Installed Cost

When comparing installed system cost over time, the component cost differences between a pneumatic and electric system are recovered through energy savings in as little as five months in typical systems. The energy cost savings in subsequent months are approximated in the chart below.

Energy cost savings comparison of pneumatic and electro-mechanical actuators over varied lengths of time. Source: Exlar

From 2004 to 2007 the price per kWh for industrial large-scale consumers increased approximately 40 percent and indicators point to a doubling of energy costs by 2014. This is another major driving force behind machine builders' preferences to move to electro-mechanical solutions

Electro-mechanical devices can also be considered greener when it comes to overall CO^2 reduction. With 85 percent of energy production in the United States coming from fossil fuels, studies by groups like the Fraunhofer Institute indicate that the CO^2 emissions from fossil fuel power plants can be 33 times less when powered by an electro-mechanical solution in place of a pneumatic solution.