



Cost Reduction at Linear Movements

Replacement of Pneumatic Cylinders with Linear Actuators

If more than two positions are needed, synchronization is required or dynamic or lifetime of pneumatic cylinders are not good enough, machine builders move more and more to electro mechanical solutions.

Due to the high cost of operation of pneumatic products the use of electro mechanical actuators even gets more reasonable also in simple point-to-point applications with two end positions only. This is mainly the case when the duty cycles are always the same and pneumatic cylinders must be sized quite big due to high speed and load requirements.

Comparison of costs of Pneumatic Cylinders against Electro Mechanical Solutions

By using a real example, costs are calculated for a pneumatic solution and an electro mechanical solution. It is a simple horizontal point-to-point movement with 400mm of stroke and 15kg of tooling weight that should be moved with 30 cycles per minute with a duty cycle of 50%.

Electro Mechanical Cylinder: The required positioning time of 500msec will be fulfilled with a maximum acceleration of 10m/sec^2 and a maximum speed of 1m/sec . In a trapezoidal profile the acceleration time of 100msec is effective work for the actuator. This is beside the friction only $1/5^{\text{th}}$ of the total positioning time. Beside that it is possible to convert the generated kinetic energy during the deceleration process back in to electrical energy. Due to that, the job can be done with a continuous power less than 100W and energy cost less than 100€ per year.

Pneumatic Cylinder: Due to the load of 15kg and the required maximum speed of 1m/sec a pneumatic cylinder with a diameter of 50mm must be used. Unlike an electro mechanical actuator the energy (compressed air) must be served during the whole positioning time. In addition to that the kinetic energy is absorbed by dampers and cannot be regenerated. The cylinder volume in combination with the cycle rate gives a total need of 24000m^3 of compressed air at 6 bars. These are energy costs of more than 3000€ per year.

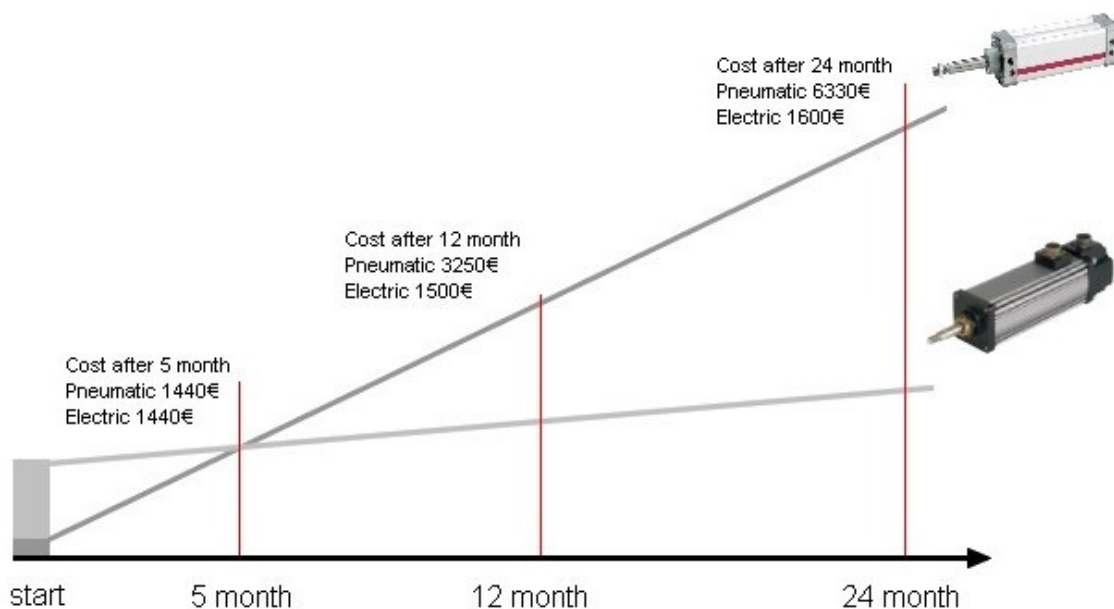
Full-Cost Pricing: Evaluations of energy cost show that initial cost carry less and less weight when calculating the full-cost pricing. In our example energy costs of pneumatic cylinders



exceed the investment cost of electro mechanical solutions after certain weeks already. After analyzing the investment and energy cost in our case by using an electro mechanical against a pneumatic solution it results a cost reduction of 1750€ after 12 month and 4650€ after 24 month. Following European Union studies the **Energy Efficiency of pneumatic cylinders** is about 5%. Only for supply and preparation of compressed air in the European Union 80TWh are needed. This is the power of seven and a half nuclear power plants.

Increased Energy Cost: From 2004 to 2007 the price per kWh for industrial large-scale consumers raised about 40% and experts expect a doubling of energy costs in the coming five years. This makes more industries changing their minds and move to more energy saving technologies. The investment costs will lose its influence when designing machines.

CO₂-Reduction: Two third of energy production in Europe is done by fossil fuels. Following studies of the Fraunhofer Institute the CO₂ emission of gas power plants is 515g CO₂/kWh and 980g CO₂/kWh in coal power plants. This would result an emission of 12 tons per pneumatic cylinder in one year. Comparing these values with a modern mid-size car (120g/km) this would be a driven distance of 100000 km per year, with an electro mechanical solution a distance of 3000 km per year.



If you have more questions please do not hesitate to contact us at the above written address.