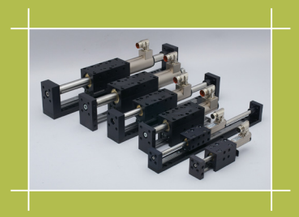

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INDUSTRIAL LINEAR MOTORS

LinMot industrial linear motors are a design element that offer decisive advantages over typical elements such as pneumatic cylinders, servomotors with spindles and belts, or mechanical solutions such as cam discs or crank designs.

- **TECHNOLOGY**

  Since the power transmission has no gearboxes or spindles to wear out, even extremely dynamic motions can be achieved with a long operational life.

- **Linear Direct Drive**
- **No mechanical play**
- **Protection class IP67 or IP69K**
- **Low energy costs**

- **FLEXIBILITY**

  Position, speed, acceleration and force can be precisely specified. Travel profiles are saved as curves and can be synchronized with rotary or linear motions.

- **Freely positionable**
- **Highly dynamic**
- **Long service life**

- **AVAILABILITY**

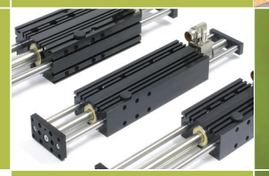
  LinMot linear motors are standardized products that are available in over 40 countries and more than 80 sales locations.

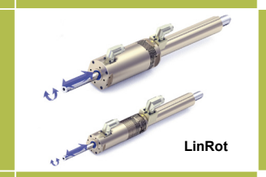
- **Standardized catalog products**
- **Global support**
- **Long service life**

01/2012

Cost optimization for linear motion

REPLACEMENT FOR PNEUMATICS
INDUSTRIAL LINEAR MOTORS





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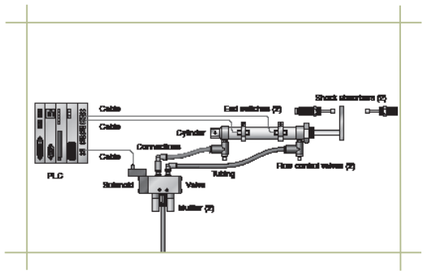
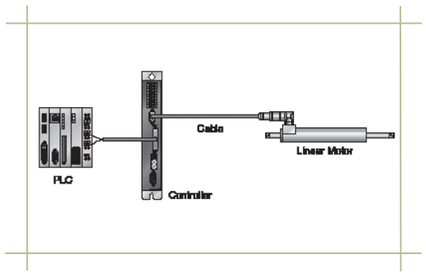
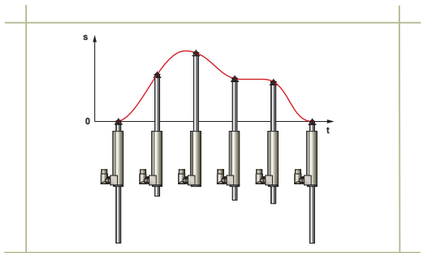
Due to high operating costs, pneumatic cylinders are increasingly being replaced with industrial linear motors

Industrial linear motors reduce the number of components required and greatly increase system flexibility







Replacing pneumatics

GREATER FLEXIBILITY AND DYNAMICS

Especially when more than two positions are required, when positions need to be changed by software, when motions are synchronized to a main drive, or when the dynamics and service life of a pneumatic cylinder are simply not sufficient, designers gladly turn to linear direct drives from LinMot.

SIMPLE START-UP

By integrating the control of position, speed, acceleration, and force, commissioning is made much easier. Motion parameters are calculated when the project is laid out, and can be adopted directly during commissioning.

IMPROVED PROCESS STABILITY

Unlike pneumatic cylinders, where only the end positions are checked, the position of a linear motor is constantly controlled and monitored. This leads to much greater process stability, because very small deviations can be detected when needed.

REPLACEMENT PAYS OFF EVEN FOR SIMPLE MOTIONS

Due to high operating costs for pneumatics, the use of industrial linear motors pays off to an increasing degree, even for simple point-to-point motions with only two end positions.

This is especially true when motions are performed regularly in cyclical operations, and pneumatic cylinders need to be oversized due to speed and load conditions. In this case, the energy and maintenance costs exceed the investment costs within a few weeks (see example, right).

SIMILAR CONFIGURATION MAKES REPLACEMENT EASY

Industrial linear motors have a cylindrical form factor and similar dimensions to pneumatic cylinders. For this reason, they are commonly used as replacements for pneumatic actuators in existing and new designs.

ADVANTAGES OF INDUSTRIAL LINEAR MOTORS

- Freely positionable
- Adjustable speed
- Adjustable acceleration
- Programmable force
- Extremely dynamic
- Monitored motions
- Gentle motions
- Synchronization capability
- Long Service Life
- Low maintenance costs
- Hygiene (no air)
- Low energy costs

Task Description:
In a pick & place application, a 15 kg load is run at 30 cycles per minute with a 400 mm stroke

Cost Comparison

LINEAR MOTOR SOLUTION

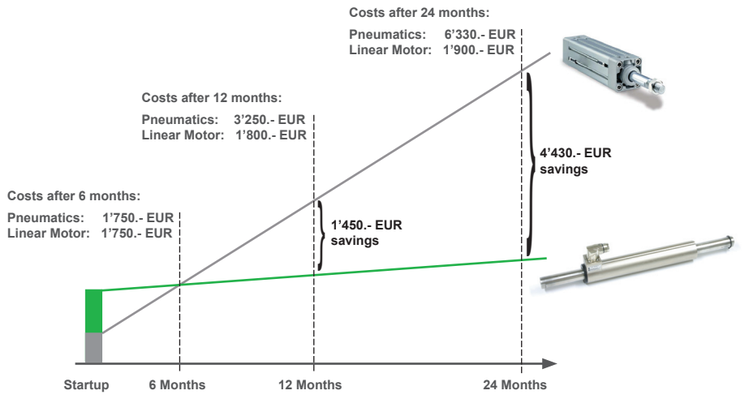
The required positioning time of 50 ms for the task given above is achieved with an acceleration of 10 m/s2 and a travel speed of 1 m/s. The acceleration time, during which the linear motor does useful work, is 100 ms. This means that the effective motor losses (other than friction) occur during only one-fifth of the positioning time. The kinetic energy from braking is also converted into electrical energy and stored in the servo controller, so that it is available again for the next cycle. The task can thus be accomplished with less than 100 W power consumption, and annual energy costs of less than 100 EUR (0.12 EUR/kWh).

PNEUMATIC CYLINDER SOLUTION

Due to the load mass of 15 kg, and the required maximum speed of 1 m/s, the pneumatic cylinder must have a piston diameter of 50 mm. In contrast to the linear motor, the energy (compressed air) must be fed in throughout the entire motion. The kinetic energy from braking must also be absorbed by shock absorbers, and cannot be stored intermediately for the next motion. Based on the cylinder volume and cycle time, the annual air consumption is 24'000m^3 of compressed air at 6 bar. The energy cost is over 3000 EUR per year (0.13 EUR/m^3 at 6Bar).

TOTAL COST CALCULATION

Calculating the energy costs shows that the investment costs become less and less significant to the overall costs for applications with cyclical motions. The energy costs in our example exceed the investment costs for the pneumatic cylinder after just three weeks. As energy costs rise in the future, the investment costs will become less and less relevant. The significantly longer service life, compared to pneumatic cylinders, means lower maintenance costs whenever industrial linear motors are used.



Analysis of the investment and energy costs in this application example shows that the savings from the use of an industrial linear motor, compared to the use of a pneumatic cylinder, are 1450 EUR and 4430 EUR at 12 and 24 months of service respectivelys.

ENERGY CONSUMPTION FOR PNEUMATICS

The energy efficincy of pneumatic drives is about 5%, according to EU studies. In Europe, 80 TWh of energy is required every year just for compressed air preparation. This is equivalent to the output of 7.5 nuclear power plants.

RISING ENERGY PRICES

From 2004 to 2007, the price of electricity for large-scale industrial consumers in Europe rose by 40% within three years. Experst predict that electricity will double in price in the next 5 years. This inevitably leads to rising demand for energy-saving machines and systems.

CO_2 OUTPUT

More than 63% of world wide consumed electricity is still produced from fossil fuels (EU 55%, US 72%, Germany 64%, Italy 80%). According to a study by the Fraunhofer Institute, the CO2 emissions in coal power plants are 980 g per kWh of energy produced. In gas power plants they are 515 g CO2/kWh. For our task descritpion, this means annual CO2 emissions of 12 tons per pneumatic cylinder.

TWO AND A HALF TIMES AROUND THE WORLD

Comparing the CO2 ouptut of the pneumatic cylinder to the emissions from a modern passenger car (120 g/km), this would be the same as driving 100,000 km a year. If, however, the application is solved with an industrial linear motor, the driving equivalent of the CO2 emissions is only a distance of 3000 km.