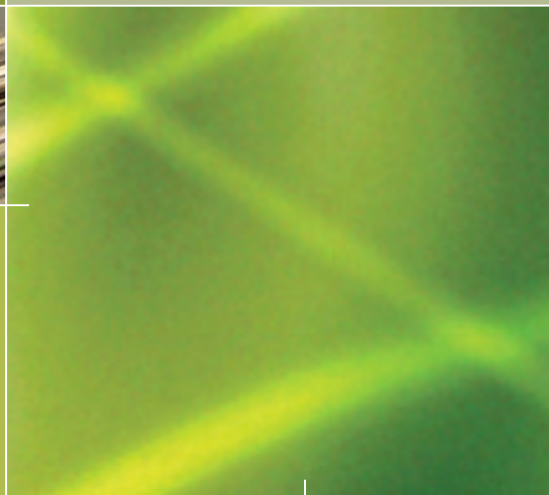


## Cost optimization for linear motion

REPLACEMENT FOR PNEUMATICS  
INDUSTRIAL LINEAR MOTORS



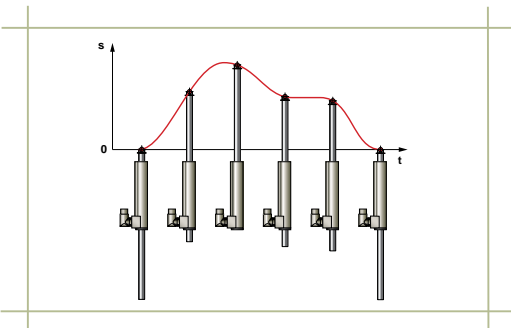
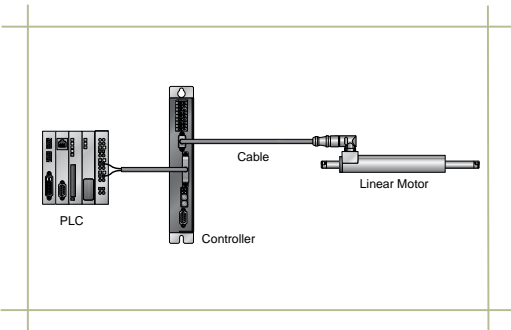
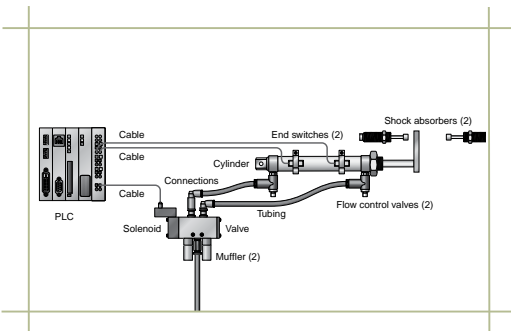
**LinMot®**

INDUSTRIAL LINEAR MOTORS  
[www.LinMot.com](http://www.LinMot.com)

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.

### 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

### 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.

## 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

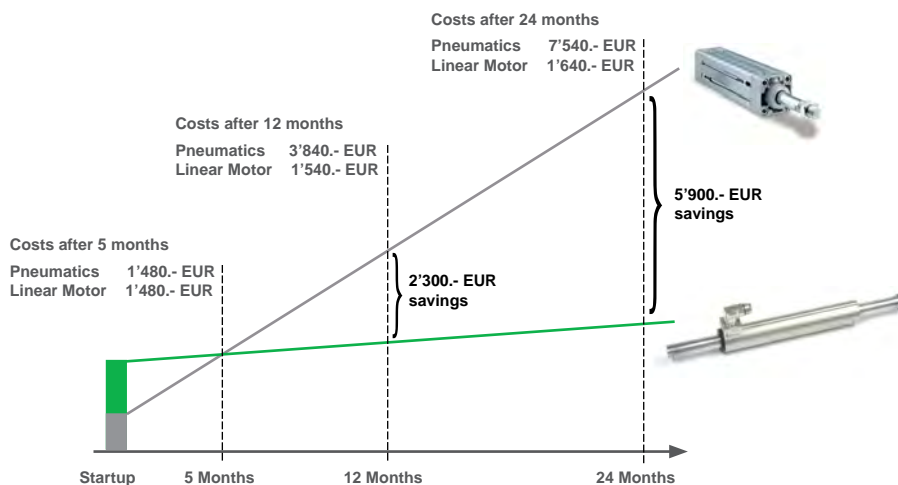
The required positioning time of 50 ms for the task given above is achieved with an acceleration of 10 m/s<sup>2</sup> and a travel speed of 1 m/s. The acceleration time, during which the linear motor does useful work, is 100 ms. This means that the effective motor losses (other than friction) occur 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 in continuous operation 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 149'000 Nm<sup>3</sup> of compressed air. The total energy cost is over 3'700.- EUR per year (Pneumatic manufacturers calculate with 0.025 EUR/Nm<sup>3</sup> 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 2'300.- EUR and 5'900.- EUR at 12 and 24 months of service respectively.

## ENERGY CONSUMPTION FOR PNEUMATICS

The energy efficiency 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 2011, the price of electricity for large-scale industrial consumers in Europe rose by over 65% within seven years. Experst predict that electricity will double in price in the next few years. This inevitably leads to rising demand for energy-saving machines and systems.

## CO<sub>2</sub> OUTPUT

More than two thirds 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 CO<sub>2</sub> emissions in coal power plants are 980 g per kWh of energy produced. In gas power plants they are 515 g CO<sub>2</sub>/kWh. For our task description, this means annual CO<sub>2</sub> emissions of over 12 tons per pneumatic cylinder.

## TWO AND A HALF TIMES AROUND THE WORLD

Comparing the CO<sub>2</sub> output 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 CO<sub>2</sub> emissions is only a distance of 3000 km.



**INDUSTRIAL LINEAR MOTORS**

NTI AG  
LinMot & MagSpring  
Haerdlistrasse 15  
CH-8957 Spreitenbach

Phone: +41 (0)56 419 91 91 | Fax: +41 (0)56 419 91 92

office@LinMot.com  
www.LinMot.com

## 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 up to 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