Linear drives

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INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

Overview of linear drives

- basic division of drives,
- descriptions of individual systems,
- comparison of systems,
- advantages and disadvantages.

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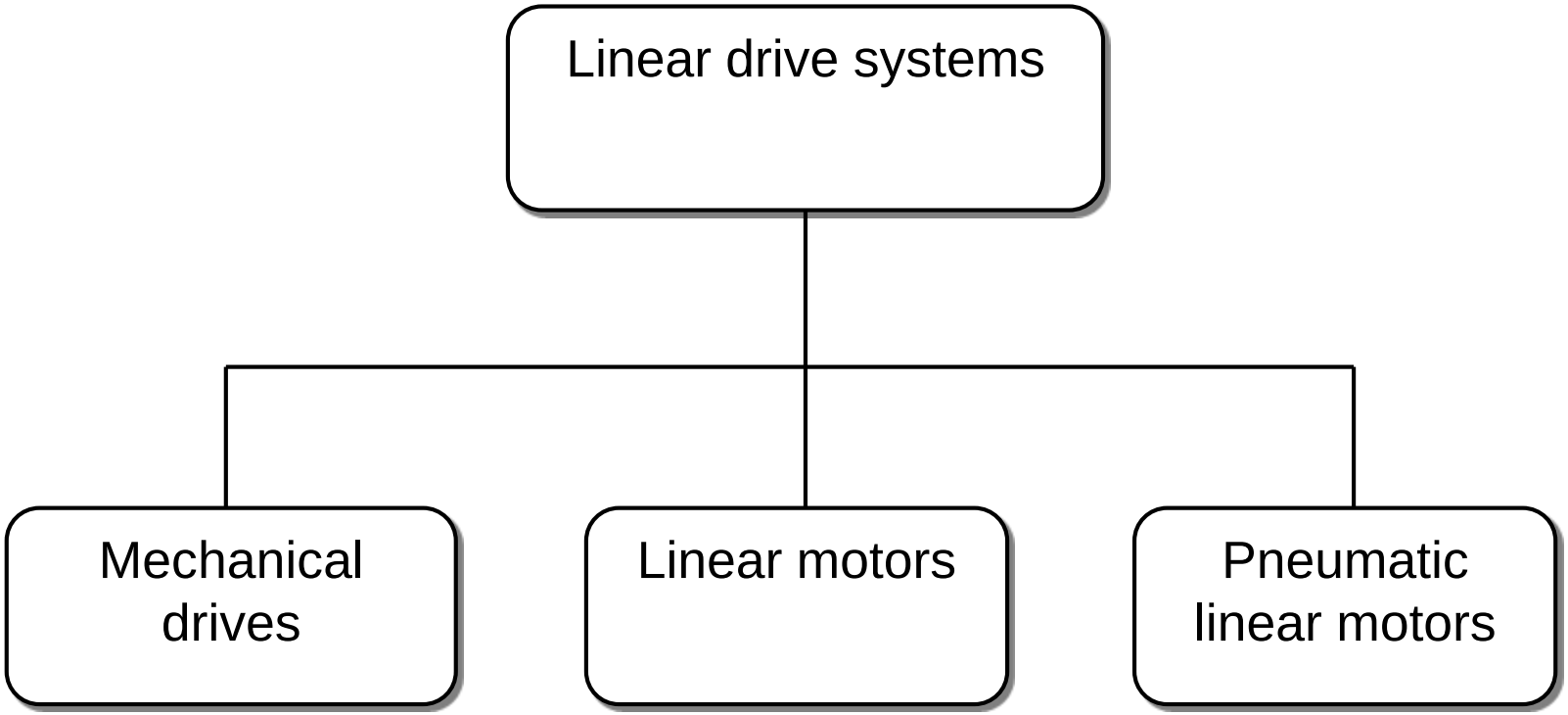
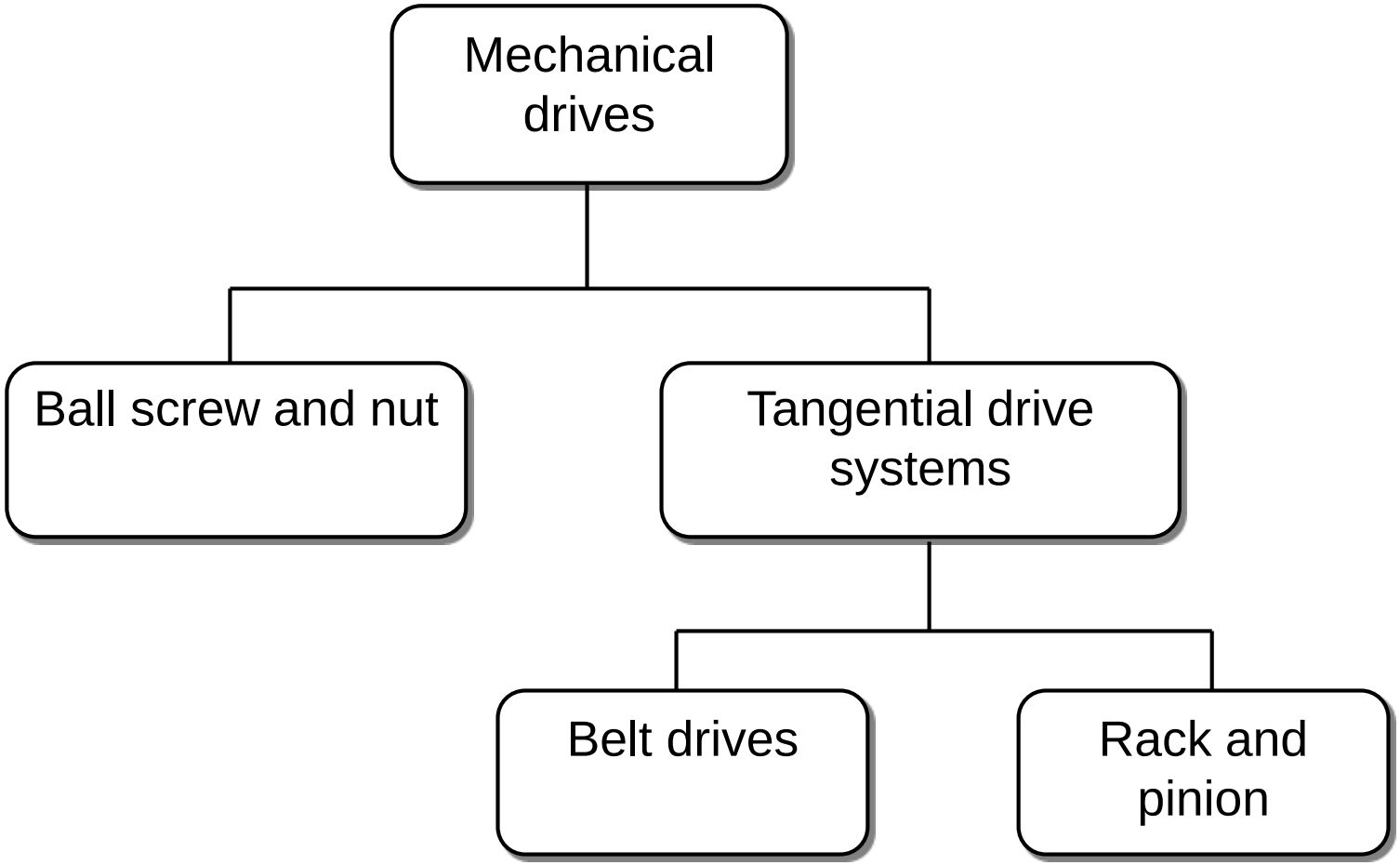
Basic division of drives



Mechanical drives

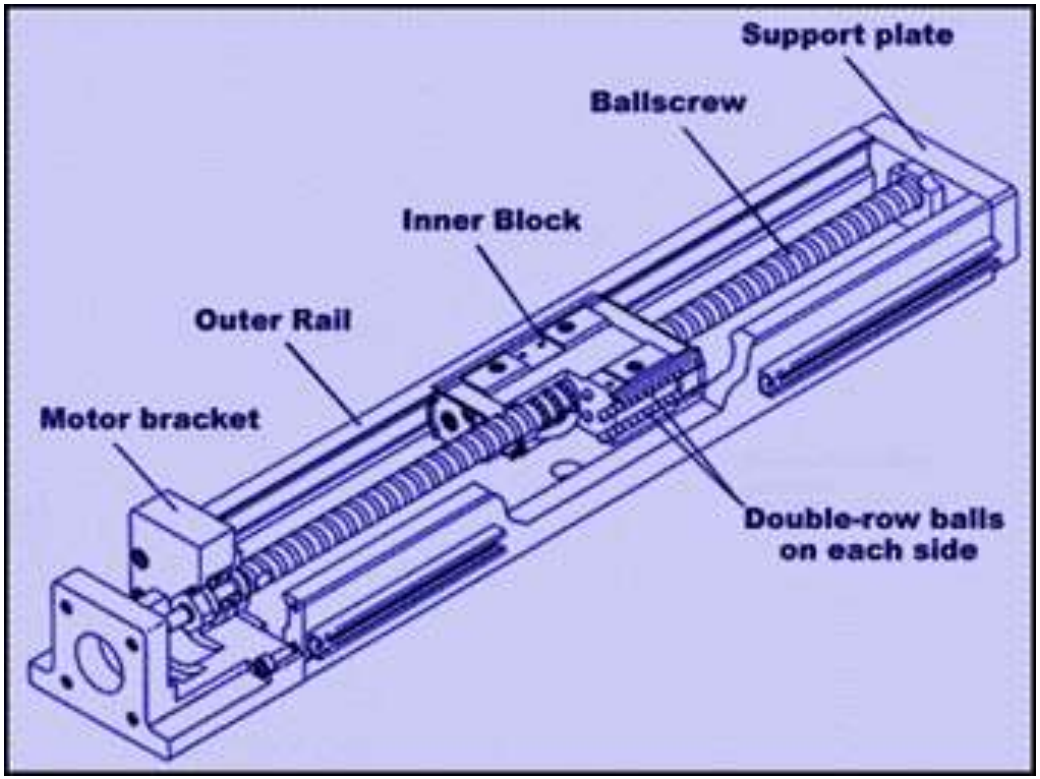


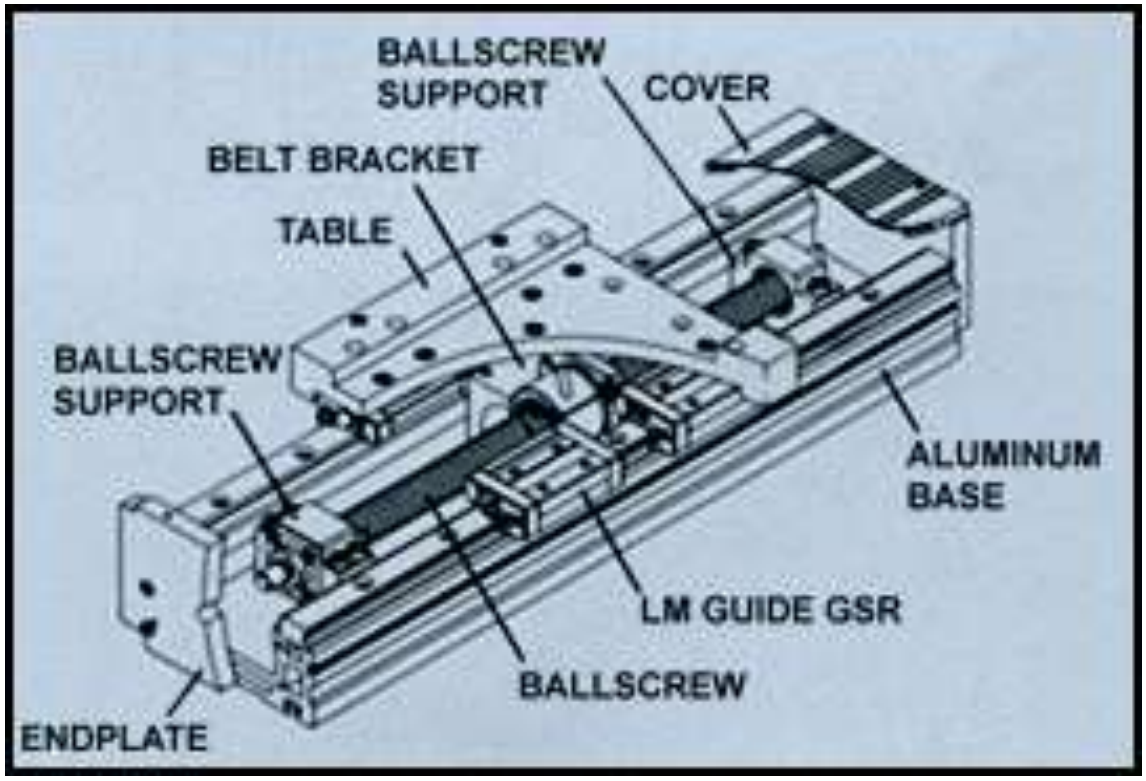
Mechanical drives

- **Used motors:**
  - **servo drives:**
    - **closed loop – need admeasurements,**
    - **high speeds (about 6000 rpm),**
    - **high torques,**
    - **dynamic applications.**
  - **stepped motors:**
    - **opened loop – without admeasurements,**
    - **slow (1000 – 3000 rpm),**
    - **lower torque – overload,**
    - **simpler and cheaper,**
    - **printers and plotters.**

Ball screw and nut

- **the most commonly used mechanism,**
- **high precision,**
- **high inertia.**





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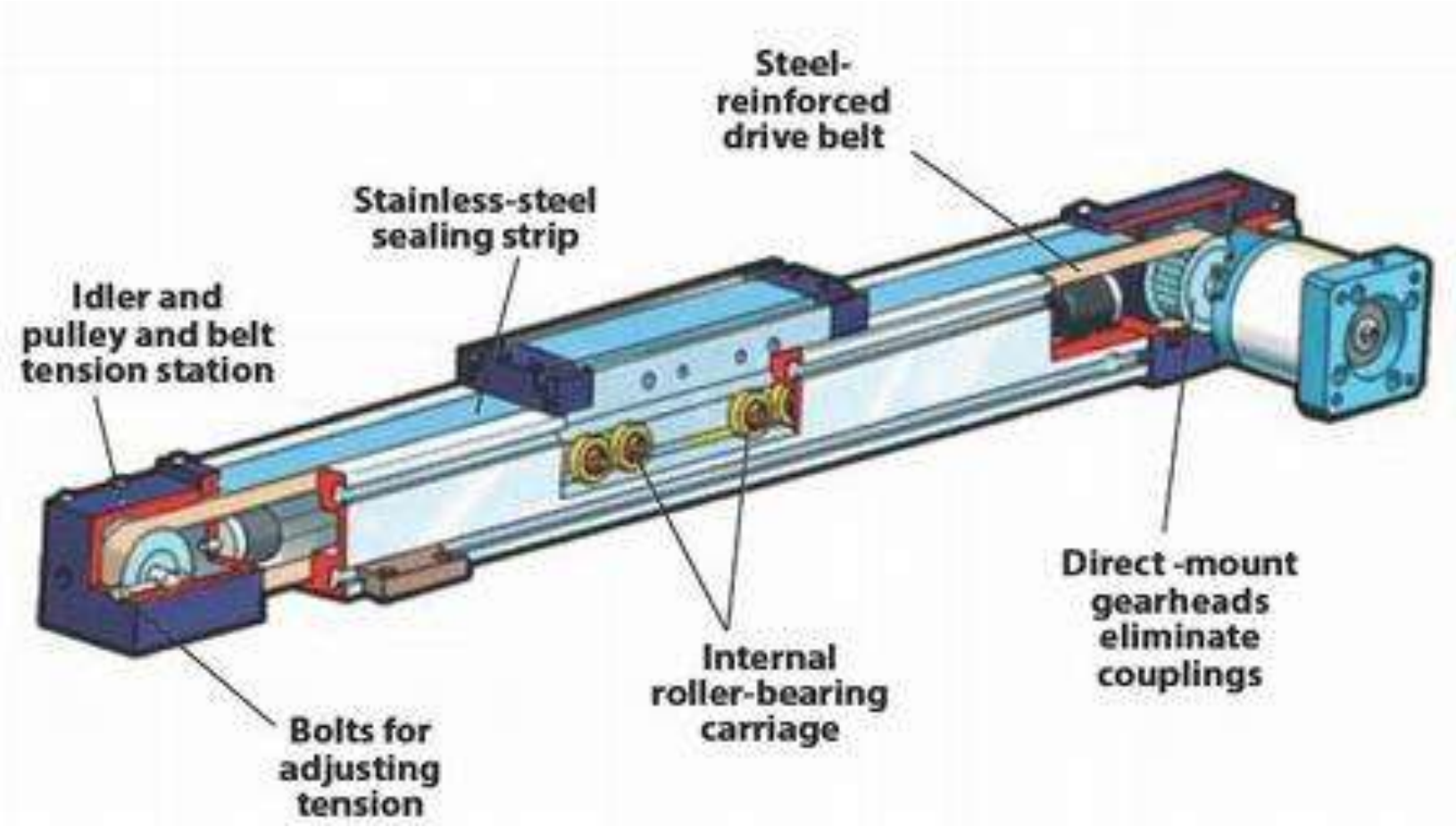
Belt drives

- for larger loads can be used in several lines,
- at greater lengths using a tensioner.



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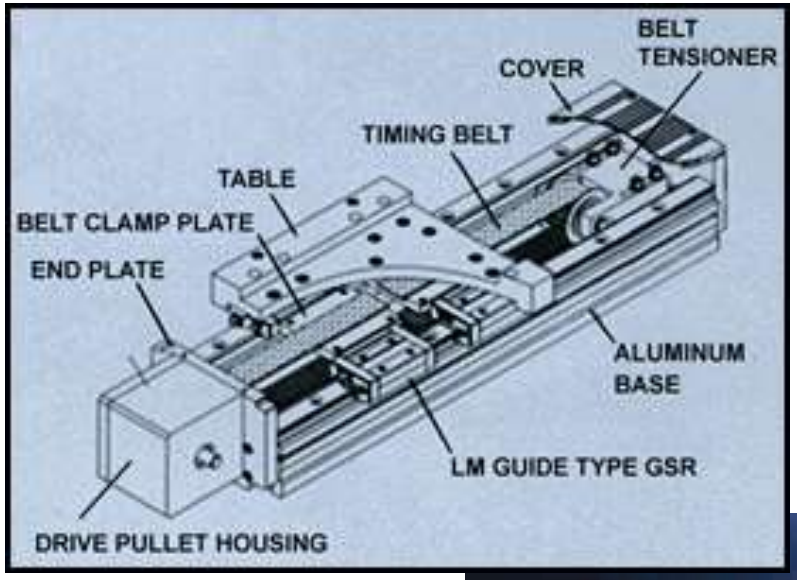
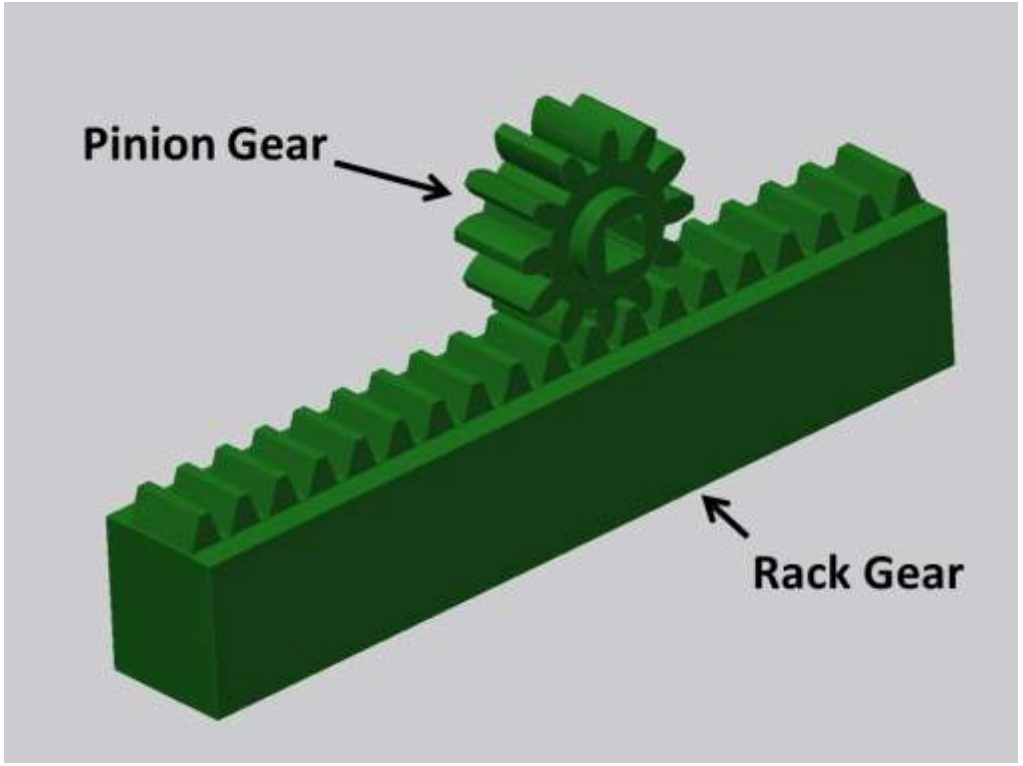
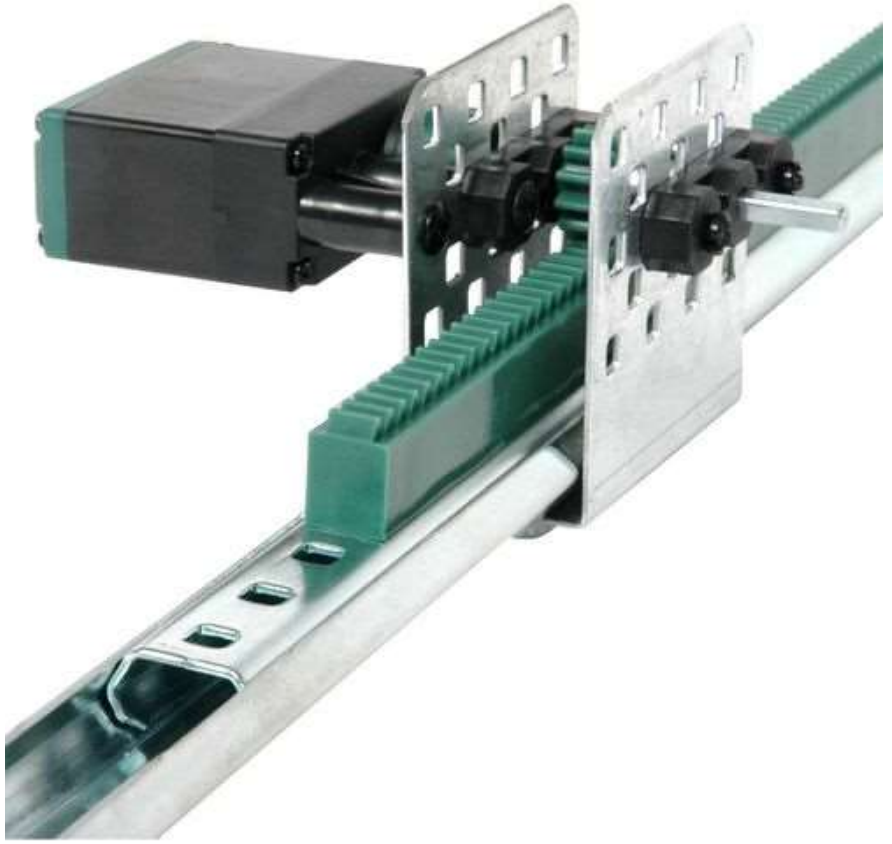
Belt drives


BELT TENSIONER
COVER
TIMING BELT
TABLE
BELT CLAMP PLATE
END PLATE
ALUMINUM BASE
LM GUIDE TYPE GSR
DRIVE PULLET HOUSING

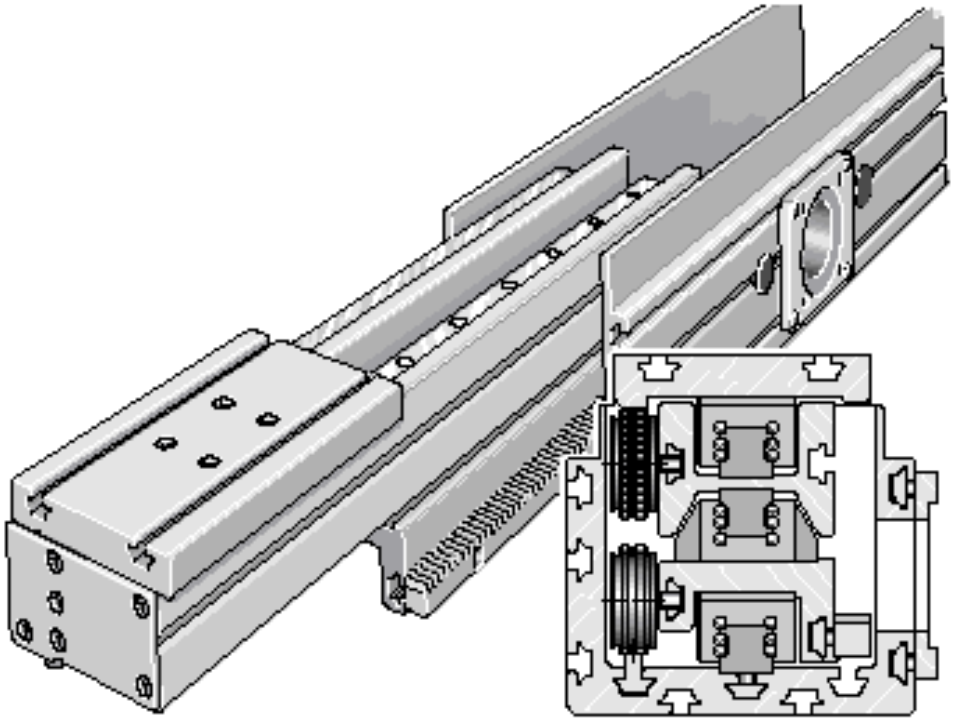
Pinion and rack

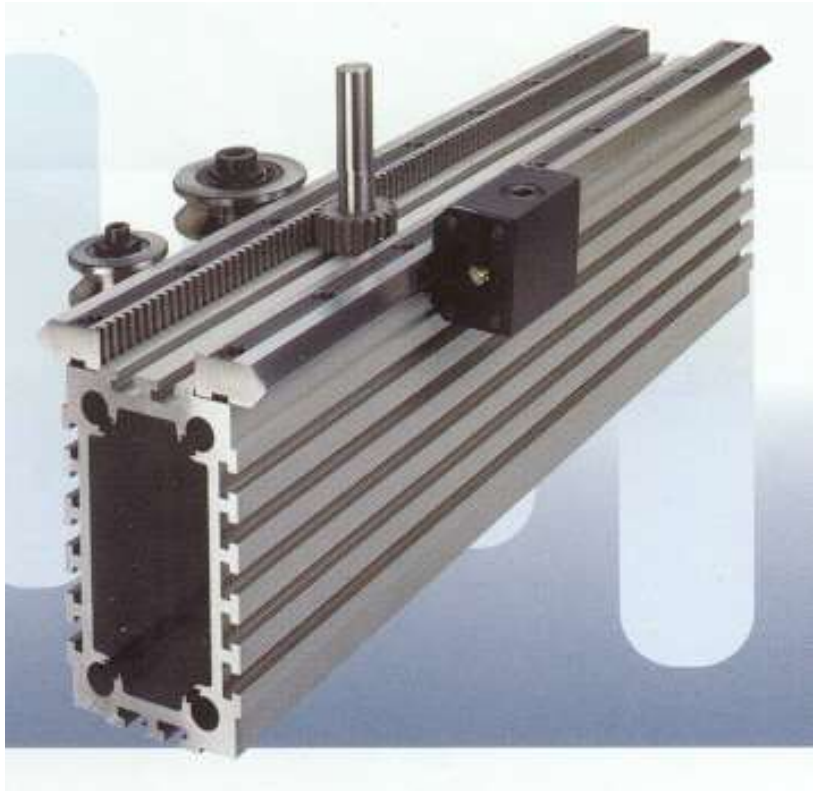
- ability to link individual blocks racks one after another to achieve greater lengths,
- at one point the force is transmitted through only one tooth of pinion - low power.





Pinion and rack



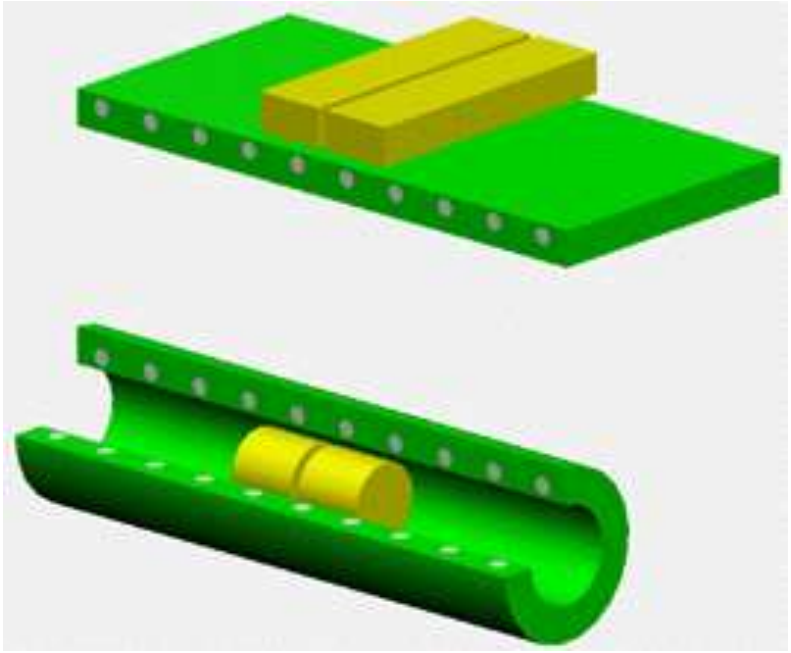


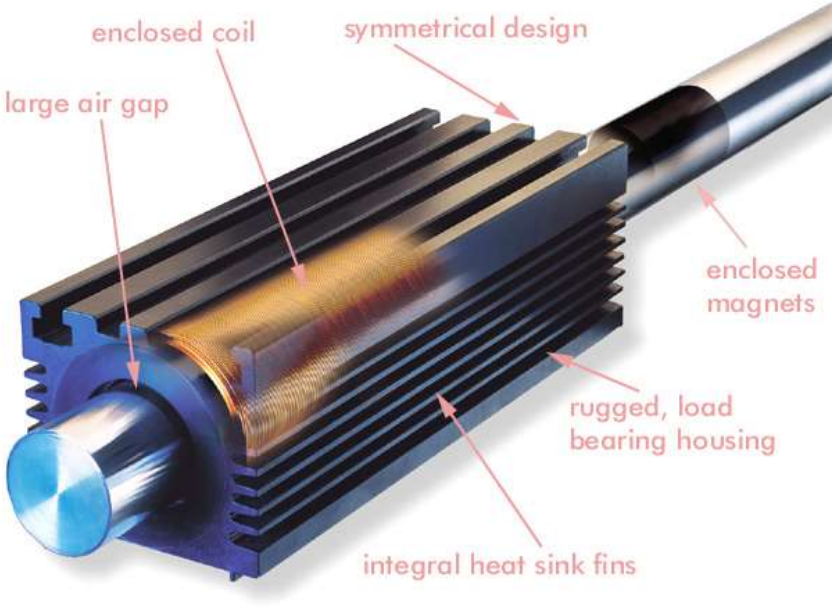
Linear motors

- **linear movement without the use of additional mechanical elements,**
- **principle substantially the same as the principle of the rotary motor - unrolled into a plane.**

Linear motors

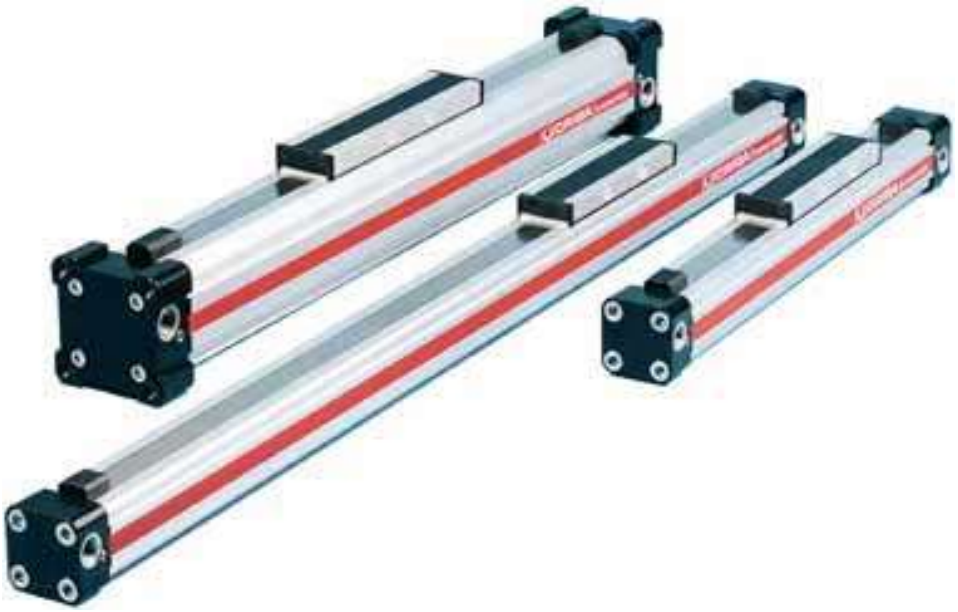
Rod linear motor





Pneumatic linear motors

- **most commonly used rodless pneumatic cylinders - shorter construction.**



Pneumatic linear motors

- **the linear velocity changes with the load,**
- **the need for additional accessories.**

The parameters of linear drives

drive type	Ball screw	Belt drive	Pinion and rack	Linear motor	Pneumatic lin. motor
Max. force [N]	30 000	5 640	2 000	20 000	4 000
Max. acceleration [m/s^2]	15	40	10	200	n
Max. speed [m/s]	3	8	2	11	5
Accuracy [μm/25.4mm]	7.6	25 ÷ 50	0.6 ÷ 4.2	0.2 ÷ 0.7	n
Repeated accuracy [μm]	10	12 ÷ 300	n	0.1 ÷ 30	25 ÷ 150
Stroke length [m]	0.2 ÷ 5.3	0.3 ÷ 8	0.3 ÷ ∞	$0.25 \cdot 10^{-3}$ ÷ ∞	0.01 ÷ 6

Advantages and disadvantages of linear drives

	Advantages:	Disadvantages:
Ball screw:	• large load, • high accuracy.	• high inertia, • small velocity and acceleration.
Belt drive:	• greater speed and acceleration, • low price.	• small loads, • small accuracy.
Pinion and rack:	• high accuracy, • unlimited length, • low price.	• small loads, • low speed and acceleration.

Advantages and disadvantages of linear drives

	Advantages:	Disadvantages:
Linear motor:	• large load, • high speed and acceleration, • high accuracy, • unlimited length, • no additional moving parts.	• high production cost, • the required cooling, • no mechanical advantage, • open magnetic structure (strong magnetic field, the magnetic part).
Pneumatic motor:	• simple.	• small loads, • small accuracy.