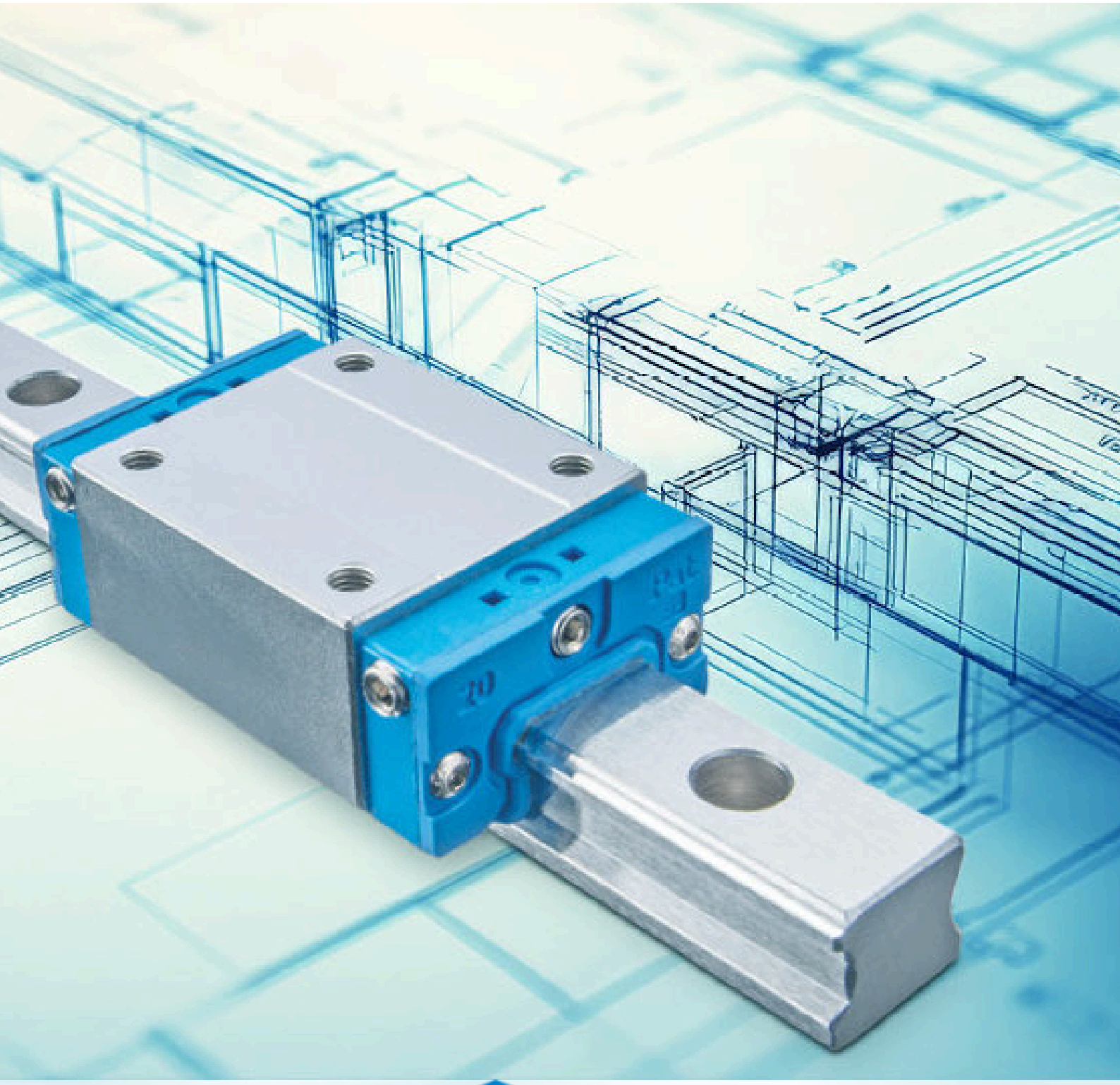
NTN

ALL ABOUT LINEAR MOTION



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Drive variants

In this article, linear axis are categorized according to their drive variants, with toothed belt drives, spindle drives, rack and pinion drives and linear motor drives being the four relevant types. However, you should note that the differentiation can vary, which means that they can be categorized not only according to their drive variants, but also according to the other distinguishing features listed in the table.

Differentiation of linear according to:

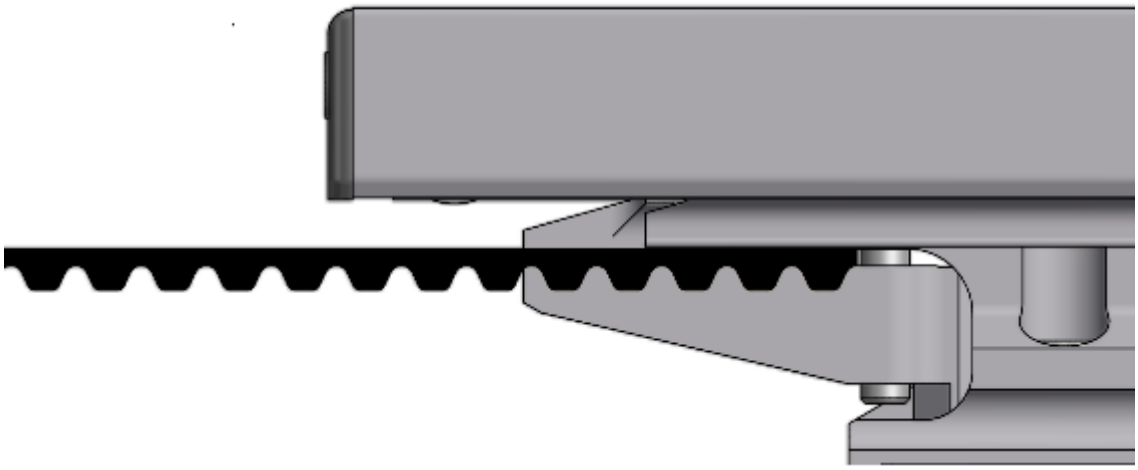
- Types of guide systems
- Internal or external guide systems
- Drive variants
- Base material
- Production of customized lengths or standard lengths

The differentiation by type of drive system is only one of five differentiation options for linear axis.
As it is not possible to make general statements about linear axis, the following section focuses on NTN linear axis of the SNR brand.

Toothed belt drives

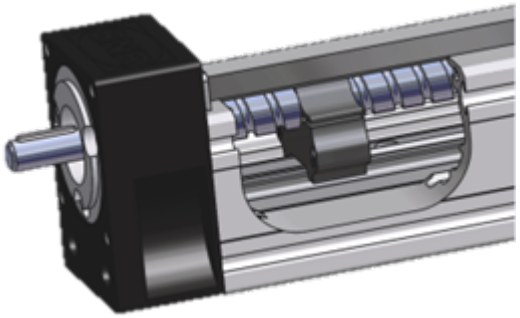
Linear axis with toothed belt drive are suitable for fulfilling fast handling and positioning tasks. All axis are equipped with an AT or STD toothed belt, whereby the toothed belt clamping via the toothed segment in the toothed belt width enables unweakened clamping. Thanks to a radially adjustable bearing of the deflection pulley, the toothed belt tension can also be set precisely using the SNR toothed belt tensioning device, which consists of a force gauge and adapter devices for the respective axis type.
The advantages of this method of tensioning the toothed belt:

- No risk of overloading the toothed belt during installation
- No premature failure of the pulley bearing due to excessive belt tension
- Optimum running properties thanks to centered alignment of the toothed belt during installation
- low wear



Toothed belt drives are characterized by low wear, among other things.

Spindle drives

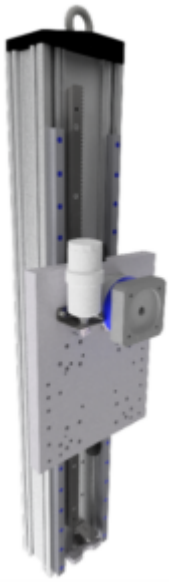


In this illustration you can clearly see the spindle, which is located in the linear axis.

Linear axis with screw drives are characterized by the fact that they can be equipped with ball screws or trapezoidal screws. They are particularly suitable when there are high requirements for positioning accuracy and repeatability in combination with high rigidity of the drive element. In addition, direct drive adaptation is possible via a coupling and coupling cone or with the aid of a deflection belt drive. Spindle drives can also be used to achieve high positioning accuracy over long travel distances. In applications that require longer travel distances and higher speeds, spindle drives can be equipped with spindle support units. In addition to the fact that relatively high speeds are possible, these spindle support units also serve to shorten the free length of the spindles – i.e. the distance between the nut and the floating bearing – by half or two thirds, for example, and thus increase the critical speed.

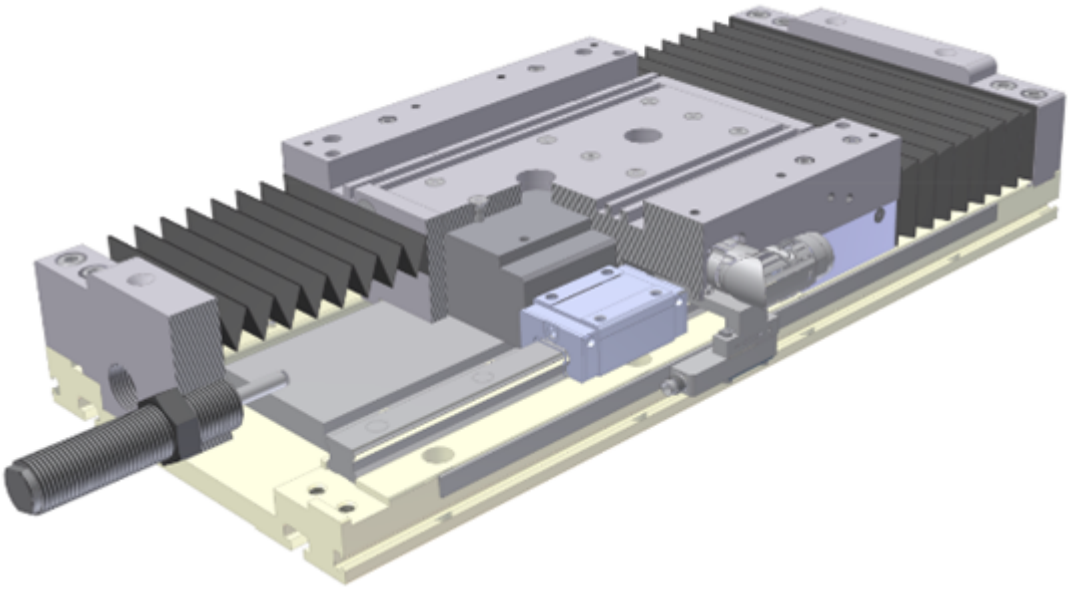
Rack and pinion drives

Rack and pinion drives are another drive variant of linear axis. These are characterized by high operational reliability and are therefore suitable for vertical applications. As the rack consists of rack segments, theoretically unlimited travel distances are possible, which means that linear axis of any length can be built. For this reason, rack and pinion drives are ideal for use in large gantry axis, for example. The induction-hardened racks and gear wheels of this drive variant guarantee a long service life; it should also be mentioned that rack and pinion drives – even with heavy loads – have the highest rigidity in the drive system.



The use of linear axis with rack and pinion drives is particularly suitable for vertical applications.

Linear motor drives



Linear motor drives can be used at very slow speeds without any problems; the same is also possible with rotary drives, but this requires gearboxes with extremely large ratios.

The use of linear motor drives is particularly suitable for applications where the highest demands are placed on positioning accuracy and repeatability. One major advantage is their flexibility, as they are suitable for both extremely slow (e.g. 1 cm per hour) and very fast movements. Linear motor drives are maintenance-free drive elements and can theoretically be used for unlimited travel distances. One disadvantage of linear motor drives is that they have no braking function in the power-off state, which can be critical in vertical applications.

Overview of the advantages and disadvantages of the drive systems

The following overview provides a direct comparison of the most important advantages and disadvantages of the drive systems mentioned above.

	Advantages	Disadvantages
Toothed belt drive	• High dynamics • Long lengths • Cost-effective • Maintenance-free	• Lower dynamic operating load • Lower drive stiffness • Normally a gearbox is necessary • Lower repeatability
Spindle drive	• High positioning accuracy and repeatability • High feeding forces • High drive rigidity • Usually, no gearbox necessary	• Speeds limited by critical speed and DN value • shorter maximum lengths • Relubrication necessary
Rack and pinion drive	• Theoretically unlimited lengths possible • Several independently travelling drive units possible • High feeding forces • Highest drive rigidity	• Relubrication necessary • Lower positioning accuracy and repeatability
Linear motor drive	• Very high positioning accuracy and repeatability • Very high dynamics • Wear-free and maintenance-free drive • Theoretically unlimited lengths possible	• No breaking of the system in the power-off state (vertical use critical) • Relatively high costs

It should always be made dependent on the respective application which drive variant is used.

You may also be interested in

Basics of linear motion

Are you new to the field of linear motion and want to get an overview of what is meant by “linear motion“ and what characterises linear systems? Then this article is perfect for you. What is a linear system? A linear system is a machine component that performs a translational movement. To ensure safe use and prevent the ingress of
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Types of ball bushings

Ball bushings, which are also known as “linear ball bearings“, are an important product in linear motion. This article deals with the different variants of ball bushings and their properties but first provides you with basic information regarding their history, characteristics and design.
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Types of screw drives

You may have heard of ball screws before. These are certainly the best known of the screw drives, but they are not the only ones, as trapezoidal screw drives are a second type. This article will focus on the former, but you will still find everything you need to know about both types here. Design, mode of operation and areas
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Types of linear guides

Linear guides are presented below as one type of linear system. Linear guides are among the most important guide systems on the market, mainly because they can be used universally. Types of linear guides A distinction is mainly made between two types of linear guides: Shaft guides and rail guides. Both can be subdivided into different types. Types of shaft
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Materials

This article is the right address for you if you want to find out more about the materials used in linear systems. First of all, all components that need to be robust are made of steel, including the rolling elements, the guide rails and the carriages. General information on the materials In addition to steel, various other materials are used
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Point, surface and line contact

If you have already dealt with the point and linear contact of rolling bearings, you will recognise a few things. As with rolling bearings, the rolling elements of linear guide systems have either a ball or roller shape. The contact with a raceway (rolling contact) is different for balls and rollers due to their round or elongated shape. With rolling
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