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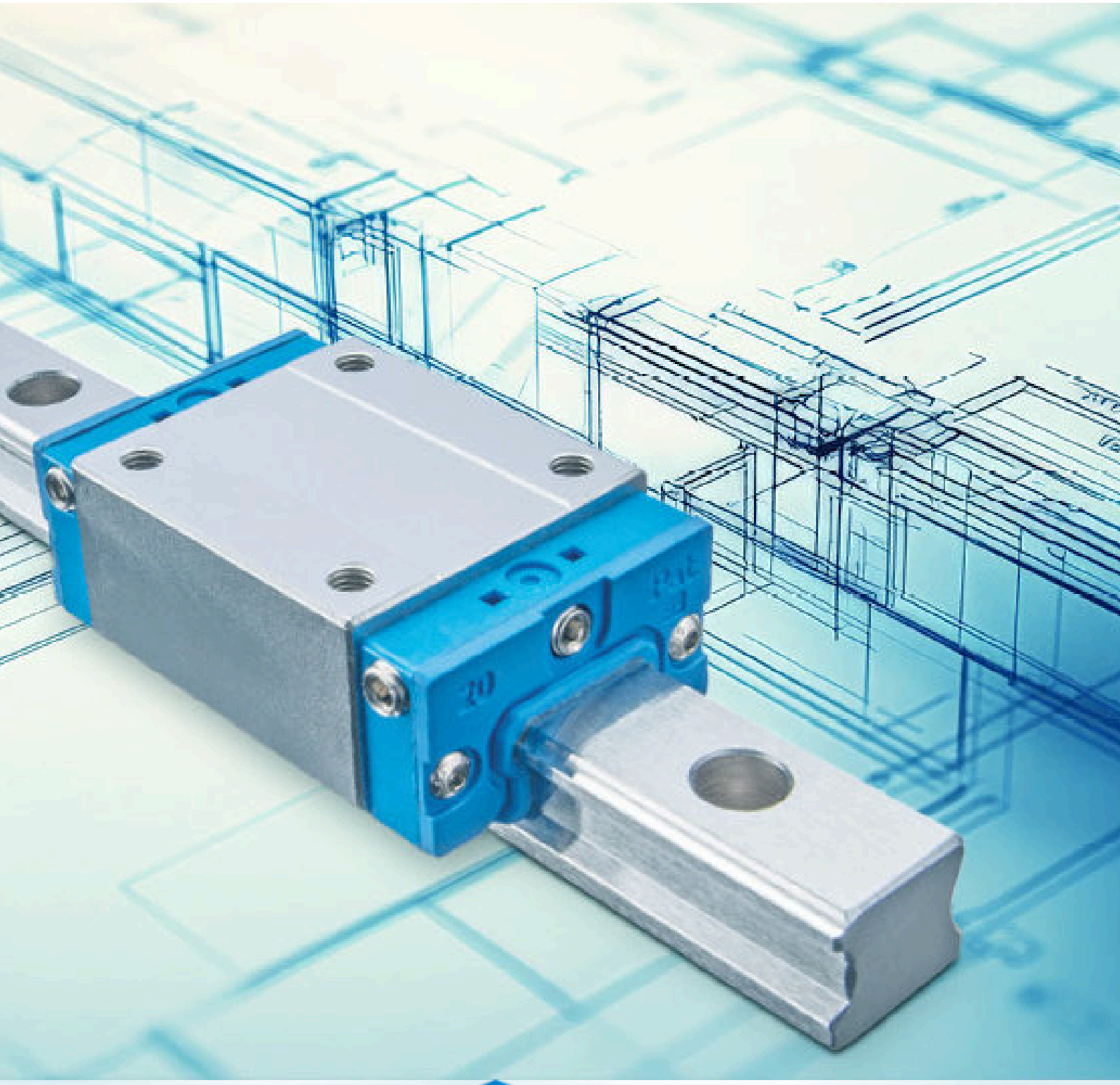
ALL ABOUT LINEAR MOTION



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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?

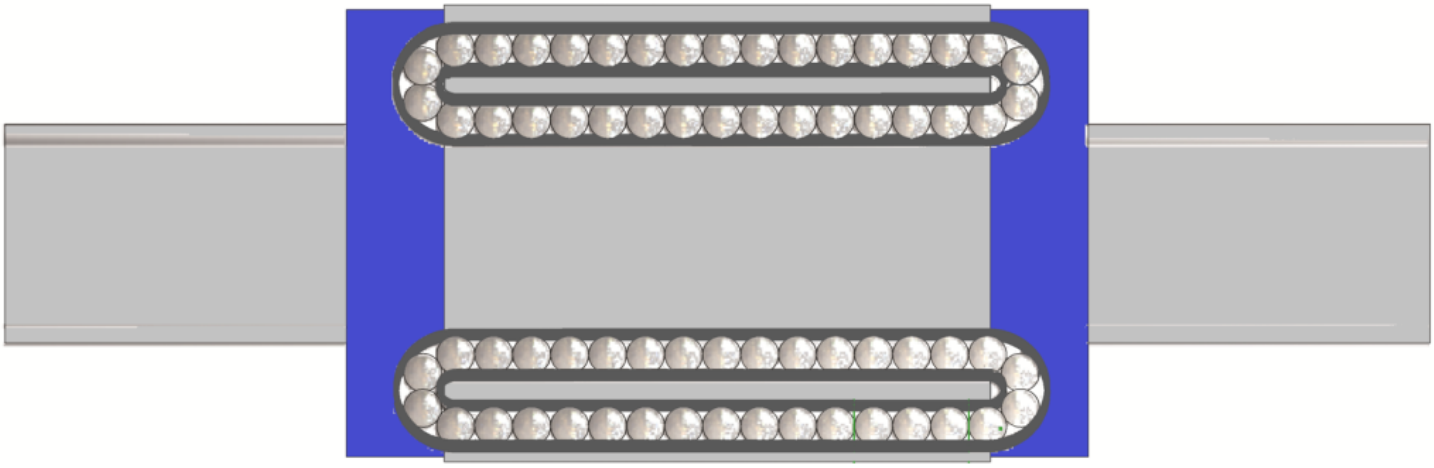
A linear system is a machine component that performs a translational movement. To ensure safe use and prevent the ingress of dust, the entire linear system must be protected by a cover and suitable wipers. A linear guide system is – similar to a rolling bearing – equipped with rolling elements in ball or roller form. Linear motion comprises various products, including linear guides, linear axis, ball screws, ball bushings and ball splines. Today’s linear systems are characterised by the fact that they can be used with low friction, low energy consumption and low noise levels.

Linear guides are the most important linear guide systems on the market today.

Structure and mode of operation

The theories of linear motion are comparable to those of rotary technology. You just have to imagine that a linear guide is unfolded in comparison to the rolling bearing. As in the rotative area, there are rolling elements, raceways in the guide rail and carriage and optionally ball or roller chains, whereby the latter are functionally comparable to cages in the rotative area. Linear guide systems with recirculating ball or roller guides consist of carriages that move along guide rails. In addition to these basic components, other components include end seals, seals on the underside and inside as well as accessories such as cover strips, rail caps and grease nipples.
The rolling elements of a ball or roller guide roll on the raceways of the profile rails and carriages and are deflected in the carriage. The carriages run on the rail with very low friction. Linear guides allow very high loads to be moved with little effort and nearly no stick-slip effect. This is due to the very low coefficient of friction μ of approx. 0.003. When a rolling element reaches the end plate of a carriage, it is deflected there and guided back into return holes within the carriage. This means that a rolling element can roll an infinite number of times in this rhythm – a single cycle! Several (and theoretically an unlimited number of) carriages can be mounted on one guide rail. The rolling elements can be kept at a distance from each

other by the ball chains.



In addition, the rolling element recirculation of the carriage consists of a forward and return run. The rolling elements in the forward line are under load, while those in the return line are not. For this reason, the forward line is also known as the “load zone“.

Areas of application for linear systems

The fields of application for linear motion are just as diverse as in the rotary sector. Today, linear guide systems are used in countless industrial applications, including the electronics and semiconductor industries, machine tool manufacturing, automation technology, packaging machines and woodworking machines. Other areas of application include production machinery, robotics and aircraft and automotive manufacturing. Linear guide systems favour high speed and precision in these applications. In recent history, other areas have also come to rely on linear systems, including battery and solar cell production. Linear guide systems are also used in building technology, including (automatic) sliding doors and ventilation flaps. In the general mechanical engineering, linear guide systems are primarily used to realise infeed and feed movements. Some areas of application are presented in detail below.
Linear motion is indispensable in robotics. Robots are used in factories, for example, to transport products and/or perform pick-and-place movements. Robots often move on linear guides. They often have to be adapted to high requirements, for example when they are exposed to heavy soiling or transport heavy loads. Robots in which linear guide systems are installed are not only used in automation: other examples of applications include pick-and-place machines, stacking systems or automated sewing machines. Linear motion is also used in robots with a seventh axis – i.e. an axis on which the entire robot moves. Thanks to the seventh axis, the robot can extend its range of action almost at will.

Another example is machine tools. Linear guides are used in various types of machine tools such as machining centres, turning and milling machines. High precision and rigidity of the linear guide systems are key requirements here. Linear guide systems enable the compact design of a machine tool, high performance and a relatively long service life. The machines – and therefore also the linear guide systems – must be powerful enough to withstand the reactive forces involved in machining metal workpieces.

You may also be interested in

Types of linear axis

Alongside linear guides, screw drives and ball bushings linear axis are an important product in the field of linear motion. Although the first linear axis came onto the market in the early 1990s, they only became established as a standard component for industrial applications at the beginning of the current century. It should be emphasized that there is no uniform
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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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History of linear motion

Linear motion has been around for a very long time – its history even stretches back to ancient times! In ancient Egypt, it was necessary to transport heavy loads from one place to another to build palaces and pyramids. Creative ideas were already being put into practice back then, as it was of course not possible to simply pull the
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