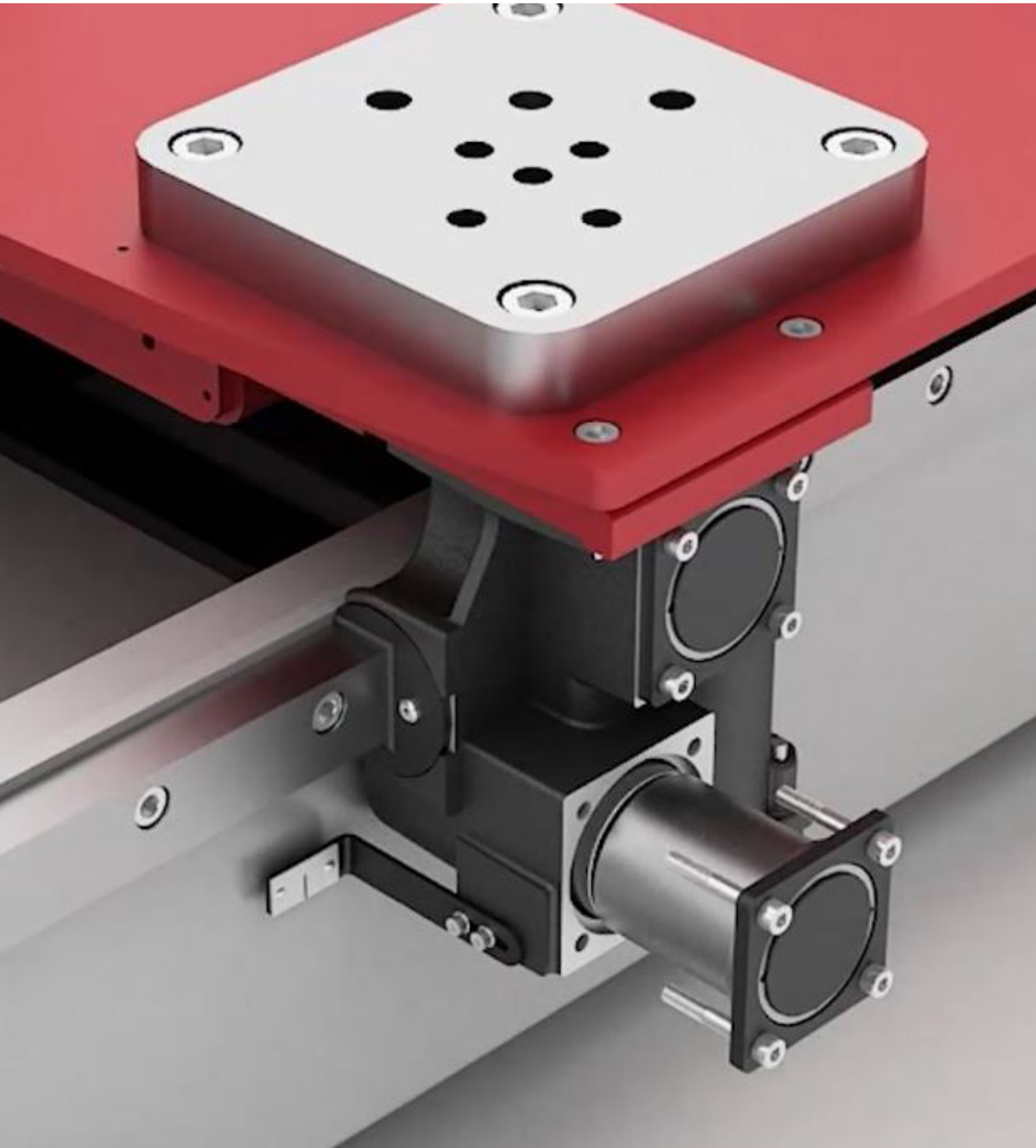
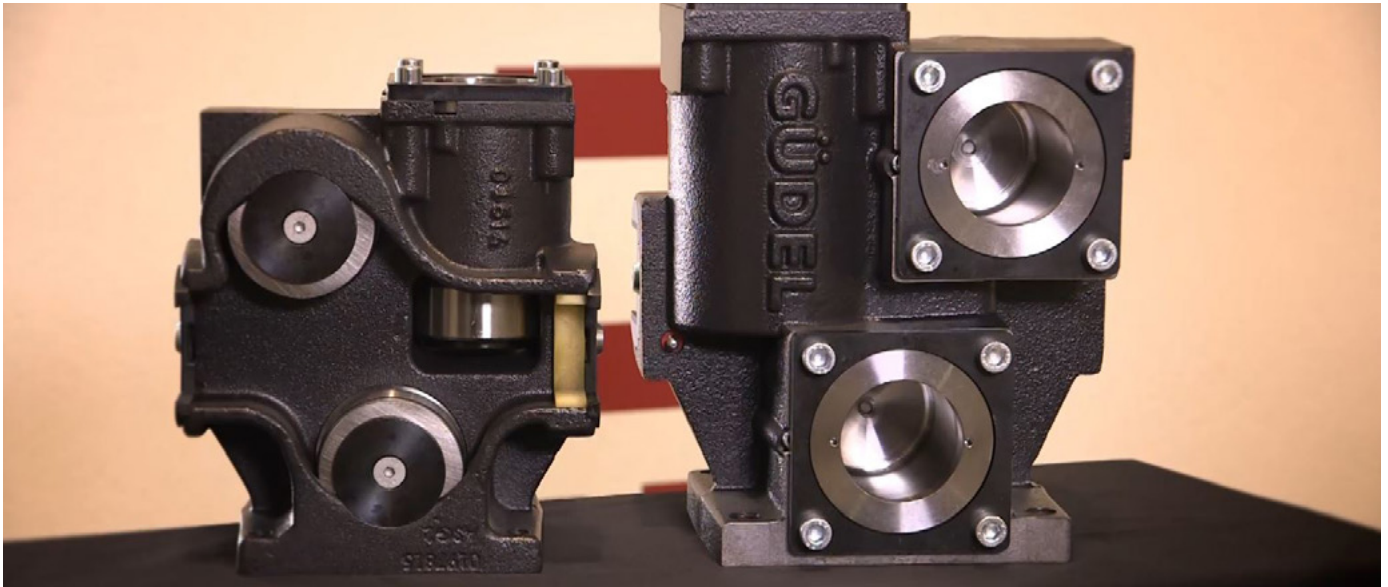


# Technology white paper

The cam follower advantage





Fully enclosed cam follower roller block.



## The cam follower advantage

Adding linear motion to articulated robots extends flexibility and work envelope. The 7th axis tracks that enable this linear motion all provide the same functionality but differ in one significant design feature: the antifriction bearing system used to support and guide the tracks.

Track buyers can select systems incorporating one of two primary options: cam followers or profile guides. This white paper explores how these systems differ in regard to function, installation, maintenance and lifecycle.

### Bearing basics

The cam follower, also referred to as a track follower, consists of a cylindrical roller bearing mounted at the end of a stud. The cam follower rides on a guide rail and uses a simple block configuration.

A system of several cam followers is arranged on the top and side(s) of the rail to provide support for the robot in all directions. A wiper on the block scrapes the rail clean of debris, including paint and weld spatter. Bearings are completely enclosed in the block to keep out contamination.

The profile guide, sometimes referred to

as a linear bearing, used in linear tracks typically consists of two rows of small, cylindrical bearings. Each row rides on an opposing, angled surface of the hardened, ground steel guide rail, providing both vertical (load) support and lateral guidance for the robot. The profile guide provides accurate, stable and smooth linear guidance but, even with scrapers, the bearings are still prone to contamination.

Compared to the profile guide, the cam follower's cylindrical rolling elements tend to be larger. While the bearings of a profile guide directly contact the guide rail, the cam follower has an outer ring, or race, that provides a more robust point of contact between the bearing and rail.

The larger rolling elements and use of the outer race mean that cam followers typically have a larger overall geometry compared to profiled guides. In most applications, this size difference is inconsequential.

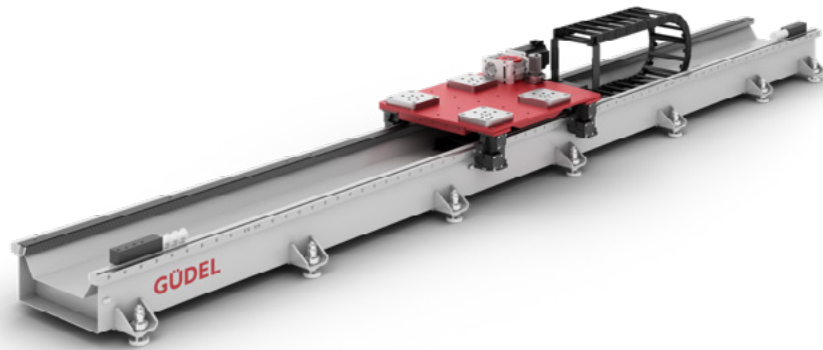
The contact angle of the antifriction bearing and the guide rail is critical. For profile guide-equipped tracks, it is essential that any replacement components — either the guide itself or the guide rail — have precisely matched angles. There is no standardization in this regard. Cam followers are used with a simple



Typical profile guide.



Typical cam followers.



Güdel TrackMotion TMF-3 with fully enclosed bearings.

rectangular guide rail, so this is not an issue. The roller or the rail can be replaced independently of one another with no performance issues. Some cam followers, however, are different in that they incorporate profiled, slightly curved contact surfaces that provide performance and lifecycle advantages.

#### Loads, speeds and precision

The all-metal construction and larger contact surfaces of cam followers typically make them more suitable for the higher loads required to support larger robots. The sturdy design of the cam follower provides more reliable performance in high-inertia applications created by rapid reversals of linear motion. In applications where faster linear motion is required, the cam follower, as a result of its larger rolling element, has an advantage over a profile guide. The smaller cylindrical elements in the profile guide are more subject to damage when operated at relatively high speeds.

There are varying precision requirements for robots and the supporting 7th axis tracks. Buyers can specify the required level of precision or stiffness required regardless of which antifriction device is used. Cam followers and profile guides offer a range of precision options. Motion accuracy of +/- 0.5 mm is readily achievable. This accuracy, however, is as dependent on the guide rail as it is on the rollers. These components work together as a system.

Cam followers offer the benefit of

adjustability by setting the preload torque. Higher preloads provide greater stiffness and precision, but excessive preload adds stress that increases component wear. Users have the freedom to adjust the cam follower to achieve the desired precision/life balance.

#### Physical and environmental challenges

Cam followers and profile guides incorporate design elements such as shields, seals and covers to prevent contamination of the internal rolling elements. For large debris such as metal chips, the protection approaches for profile guides and cam followers are equally effective.

In applications where fine-particle contaminants are present, such as foundry, painting or spraying, these shields are ineffective at preventing ingress of potentially harmful contamination when it comes to profile guides. Dust, soot and other abrasives find their way into the bearing, consume the lubricant, and accelerate wear on the contact surfaces.

Cam followers, with fully enclosed bearings and the larger size of the rolling elements, are much more resilient to these types of harsh industrial environments. The larger internal cylindrical rollers, as well as the large outer race that rides on the guide rail, are simply better able to roll over debris.

Anyone who has taken a fall while using an old-fashioned, metal-wheeled skateboard or roller skates is painfully aware of what happens when debris comes between the



Güdel TMO (TrackMotion Overhead) utilizes the latest cam followers and linear motion technology found in all TrackMotion modules.

wheel and the sidewalk. Much the same happens with profile guides. On a track, the profile guide's rolling element will typically stop rotating when it encounters debris and will slide along the guide rail, accelerating rail and bearing wear. In a worst-case situation, one or more rolling elements will dislodge from the support block with possibly catastrophic results.

### Maintenance and repair

Robot tracks typically see a total life of 10 or 15 years. During that time, some service will be needed, which typically means replacing one or more of the antifriction bearings. Determining when to perform this replacement is more easily accomplished with the cam follower.

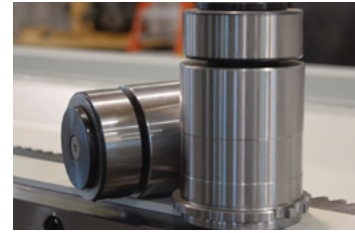
For both systems, rail wear is relatively easy to assess via visual inspection. Gauging wear on the antifriction bearings also requires visual inspection. Cam followers have an advantage here because they can be readily removed and inspected. Getting eyes on the profile guide requires moving entire carriages off the end of the guide rails, which is clearly a tedious and time-consuming activity.

It follows that the cam follower's easier accessibility is also a benefit when the bearings must be replaced, whether due to normal wear or as a result of a crash or accident. An individual cam follower can easily be removed, replaced and adjusted in 10 minutes. The comparable replacement time for a profile guide is likely to require an entire production shift — time that the robot is sitting idle.

### The cam follower advantage

Cam follower-equipped track units generally start with a somewhat greater investment, but this is easily recovered in the reduced inspection, maintenance and replacement time required. Considering that the typical robot track will require multiple bearing replacements over its life, financial outlay for the cam follower's total lifecycle is considerably less than for profile guides.

Additional benefits of the cam follower include increased reliability and virtually no need for track covers. This is a direct result of the cam follower's ability to resist damage and wear from debris, particularly the fine contaminants encountered in dirty production environments. For reliability, maintainability and total cost of ownership in linear axes for articulated robots, cam followers typically provide a superior option.



Güdel cam followers are designed as cartridges that can be replaced in 10 minutes.



Vertical integration of Güdel linear motion technology from cam rollers, racks and rails and every component needed in standard modules for dynamic and static payloads. Pictured: TMO overhead configurations for ceiling mount; wall mount; Elevated; and TMF floor mount.

### About Güdel Inc.

Güdel Inc. is the US subsidiary of Güdel Group, a global manufacturer of robotic automation products, systems and services. Güdel supplies linear-motion modules, robot track motion units, gantry robots and components to OEMs, systems integrators and machine builders serving the automotive, aerospace, logistics, heavy industrial and power generation industries. Güdel Inc. is located in Ann Arbor, Michigan, in a dedicated 45,000-square-foot facility, providing North American customers with engineering, design, production and customer service support.

Güdel Group was founded in 1954. Headquartered in Langenthal, Switzerland, today Güdel operates in more than 30 locations worldwide.

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