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FOR DESIGN ENGINEERS AND MACHINE BUILDERS

KCS/KCN High-Performance Cages for Linear Guideways

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Introduction

In precision mechanics, linear guideways are a critical component, directly influencing a machine's accuracy, durability, and load capacity. With the KCS high-performance cage (with cage control) and the KCN high-performance cage (without cage control), SCHNEEBERGER has introduced an engineering advancement that significantly enhances the performance of conventional rolling-element retainers.

The KCS/KCN cages are direct replacements for the existing KBS and KBN standard cages. Existing systems can therefore be upgraded on a one-to-one basis without requiring modifications to the rail or carriage.

Challenges of Conventional Cages

Standard cages for linear guides in the RN and RNG series are designed for a wide range of applications. However, in demanding operating conditions, they can reach their performance limits. These limitations include reduced load capacity due to suboptimal rolling-element spacing, lower stiffness under high loads, and increased wear resulting from uneven load distribution.

Up to 25% Increase in Load Capacity

The actual load capacity of a cage depends on the specific application and operating conditions. To quantify the performance improvement, the new cage design was evaluated against the existing design using a standardized testing procedure.
The key benefit of the KCS/KCN cage is its dynamic load rating (C_{100}), which is up to 25% higher than that of the previous design, depending on the actual application.
This improvement has been verified in accordance with ISO 14728 and applies to all available sizes (3, 4, and 6).
In addition to the increased load capacity, the optimized design also contributes to greater machine-axis stiffness, supporting improved overall system performance.

The graphic comparison from the old cage type to the new one is illustrated below. The graphic below illustrates the comparison between the previous cage design and the new design.

Technical Specifications

The KCS/KCN cage is designed for a wide range of applications:

- Maximum speed: 1 m/s
- Maximum acceleration: 300 m/s² with KS (with cage guidance control), 50 m/s² without KS
- Cage material: PEEK (high-temperature resistant, chemically resistant)
- Pinion material: POM – reliable interaction with the existing rack
- Operating temperature: –40 °C to +80 °C
- Cleanroom compatible
- Vacuum compatible up to 10^{-7} mbar

Direct Replacement Without Redesign

A key advantage of the KCS/KCN cage is its complete compatibility with the existing linear guideways of the RN and RNG series. Machine developers and maintenance personnel can use these new high-performance cages as direct one-to-one replacements for KBS/KBN cages without requiring any design modifications to the rail or carriage. This significantly simplifies the modernization of existing systems and enables immediate performance improvements. Alternatively, the length of the guideway assembly can be reduced while maintaining the same performance specifications.
The KCS variant (with forced cage control) is particularly suitable for high-speed applications involving frequent direction changes, as the forced control ensures uniform cage movement and prevents cage drift. The KCN variant (without forced cage control) is the preferred choice for applications with simpler kinematics.

Applications

The increased load capacity and stiffness of the KCS/KCN cage open up new possibilities in demanding industries:

- **Machine tool construction:** Increased stiffness improves machining accuracy and reduces vibrations in milling, turning and grinding machines.
- **Semiconductor and electronics industry:** Vacuum compatibility and cleanroom suitability for wafer transport, lithography systems and inspection equipment.
- **Medical technology:** Precision movements in diagnostic equipment, surgical robots and laboratory automation benefit from high positioning accuracy and clean cleanroom operation.
- **Measuring and testing technology:** Coordinate measuring machines and laser measuring systems require maximum positioning consistency, which is ensured by improved stiffness and repeatability.
- **Automation technology and robotics:** Fast positioning tasks with high masses benefit from increased load capacity and high permissible accelerations.

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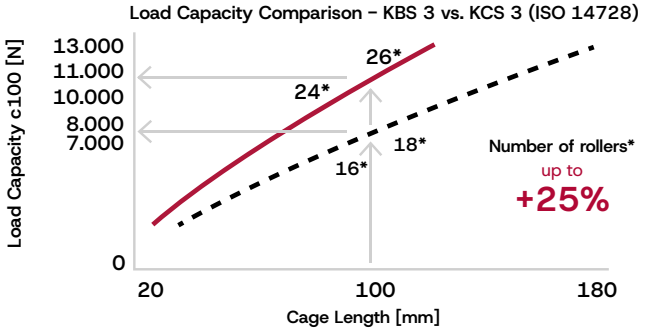
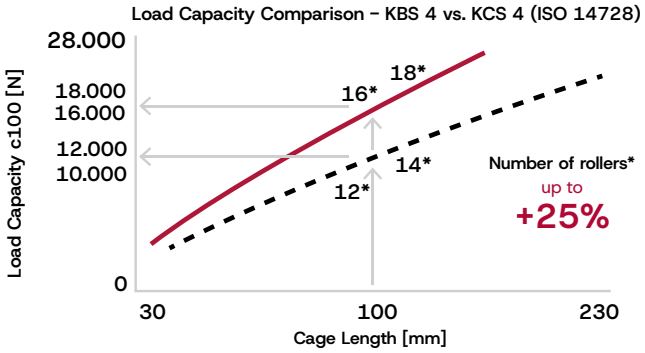
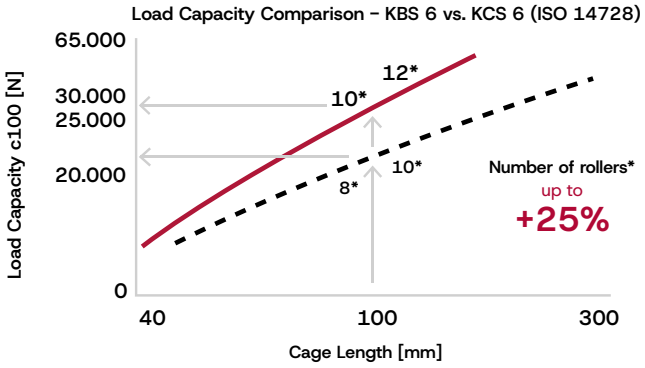
Load Capacity Comparison According to ISO 14728

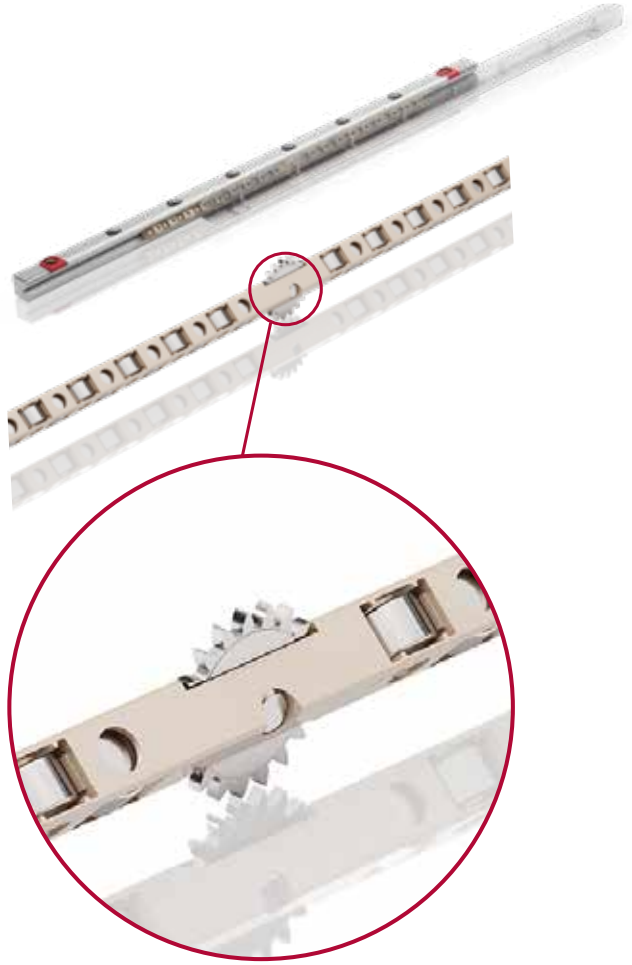
The following diagrams illustrate the performance differences between the existing KBS cages and the new KCS high-performance cages across all three sizes. The red line represents the new KCS cage, while the dashed gray line represents the previous KBS standard.

EXISTING KBS — — NEW KCS ——









* The higher load capacity refers exclusively to the cage. The maximum permissible load for the effective set is application-specific.

Product Comparison: Existing vs. New

Type	KBN / KBS	KCN / KCS
Material	POM / Steel	PEEK, POM / Steel
Vacuum / Cleanroom	bis 10^{-7} mbar & cleanroom	bis 10^{-9} mbar & cleanroom
Load capacity	Standard	**up to +25 %**
Speed	1 m/s	1 m/s
Accelerations	50 m/s2 / 300 m/s2	50 m/s2 / 300 m/s2
Compatibility		**100 % kompatibel (1:1 Ersatz)**
Options	Corrosion-resistant rollers; with / without ball cage	Corrosion-resistant rollers; with / without ball cage

Application Examples

Semiconductor and Electronics Industry: Precise wafer transport and placement systems require the highest positioning accuracy, as well as vacuum and cleanroom compatibility. The KCS/KCN cage fully meets these requirements while simultaneously offering increased load capacity for heavier payloads.

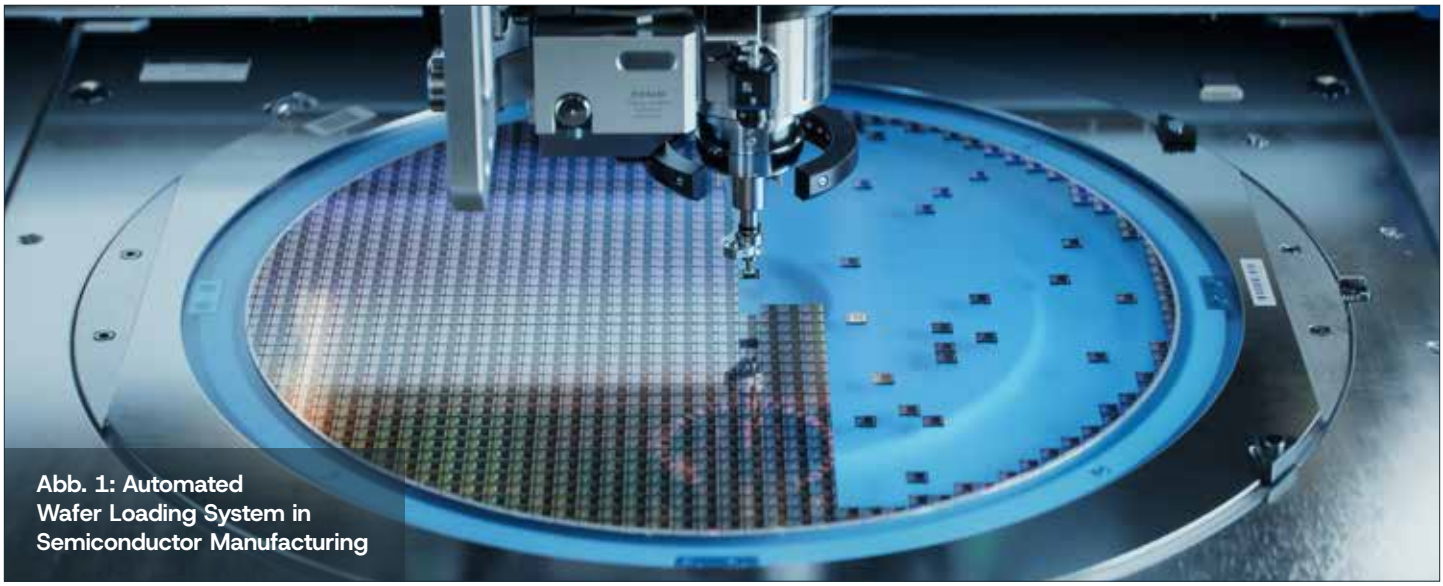


Abb. 1: Automated Wafer Loading System in Semiconductor Manufacturing

Electronics and PCB inspection: In inspection and testing systems for printed circuit boards and chips, the KCS/KCN cages ensure improved rigidity and higher measurement accuracy.
Note VB: *speed and acceleration remain the same.*

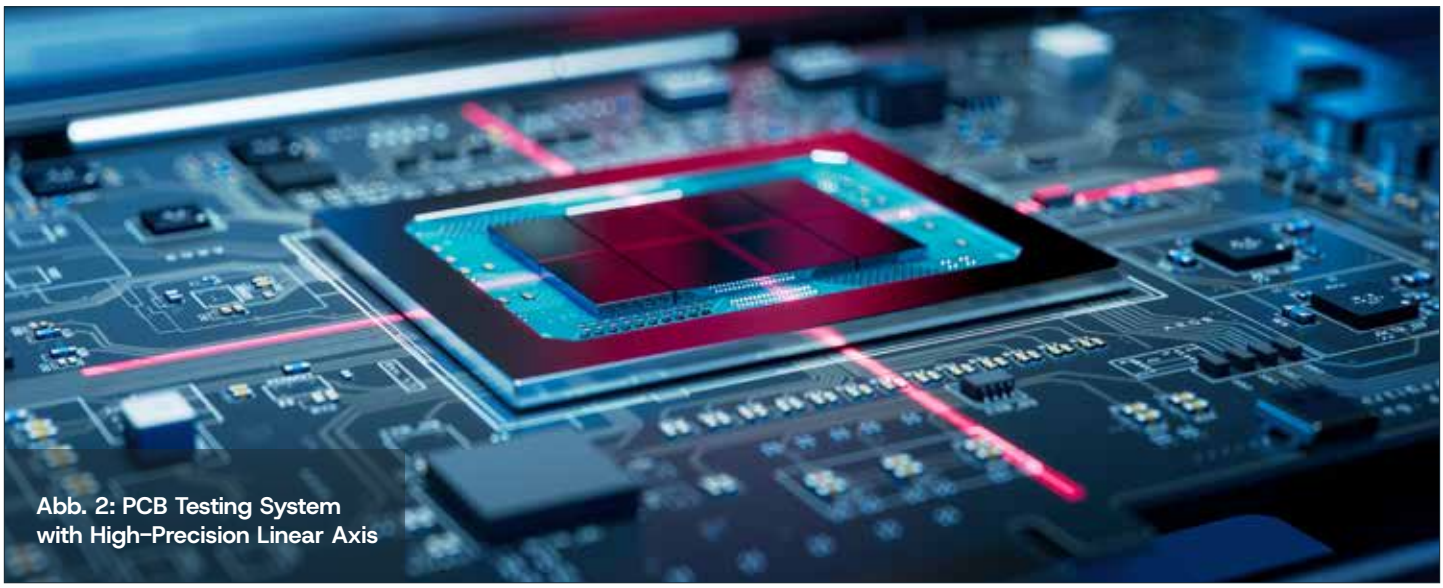


Abb. 2: PCB Testing System with High-Precision Linear Axis

Conclusion: More Performance Without Compromise

The SCHNEEBERGER high-performance cage KCS/KCN represents a significant advancement in linear guideway components. With a load capacity increase of up to 25% while maintaining full backward compatibility, it offers clear and measurable added value without additional integration effort.
For design engineers upgrading existing systems or developing new high-performance machines, the KCS/KCN provides a compelling solution. The combination of increased load capacity, improved rigidity, cleanroom and vacuum compatibility, and direct interchangeability makes this cage an excellent choice for demanding precision applications.

More information about the high-performance KCS and KCN cages, as well as the complete SCHNEEBERGER linear guideway range, can be found at: www.schneeberger.com

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About SCHNEEBERGER

Founded in 1923 as a precision mechanical workshop, SCHNEEBERGER began producing linear guides more than 70 years ago. In 1984, the Systems Business Unit was founded for the production of customized, multi-axis motion systems, and in 1992, SCHNEEBERGER introduced the first integrated measuring system for roller bearing linear guides. With plants now located in Switzerland, the U.S., and China, industries served range from machine tools to medical devices to semiconductor manufacturing.

From initial consultation to full production, SCHNEEBERGER focuses on delivering solutions that combine technological leadership with operational excellence, ensuring that our systems perform at the highest level while remaining cost-effective. This approach has solidified SCHNEEBERGER's position in the high-end application market, where precision, performance, and reliability are paramount.

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