

An Introduction to Cam Follower Styles, Construction, Installation and Selection

When you need to convert rotary motion to linear motion, cam followers offer precision, easy mounting, reliability and maintenance advantages.



Cam followers are among the most simple yet versatile motion control components available, with applications across a broad range of industries. Despite being an essential mechanism, cam followers are often a forgotten product. However, it would be a mistake to gloss over cam followers when specifying motion components for your equipment.

Basic stud cam followers have a straightforward design and come in many versions to suit specific application requirements and environments. That means your overall system's performance and reliability can depend on your understanding of cam follower fundamentals and the various configurations that are available. If you select the wrong cam follower or mount one incorrectly, it can suffer from improper loading, misalignment, contamination and premature failure.

This article will provide an overview of cam follower working principles, load handling capabilities, construction elements, mounting and maintenance. With an understanding of cam follower fundamentals, you'll be able to select a unit that will maximize the performance of your machine or system over a long lifetime.



What Is a Cam Follower?

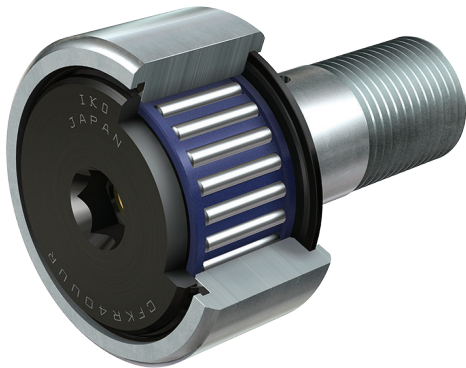
A cam is a device that converts rotary motion to linear motion in various machines. A cam follower is a guide mechanism that makes rolling contact to the cam lobe profile and transfers a prescribed motion to the component that needs to move on a linear axis. Cam followers are relatively inexpensive, with some machines containing as many as 20 or 30 cam followers. An entire plant may use hundreds or thousands of them.

Typical applications include machine tools, industrial robots, conveyors, pallet changers, packaging machinery, electronic parts production, office automation equipment and sewing machines. They are also often used as valve opening mechanisms in internal combustion (IC) engines. While other mechanisms can perform the same functions as a cam follower, they're generally not well-suited for the application.

Cam Follower Characteristics

An appropriate cam follower, when properly installed, will distribute loads evenly without deflections and misalignment. Many cam followers incorporate a stud and a rotating outer ring, while others mount to the mating part via a through hole. Units with a thick outer ring typically have a small radial gap, giving them excellent load capacity and a greater ability to alleviate impact loads and dampen shocks and vibrations.

Standard cam followers typically offer a broad range of stud diameters to suit a wide variety of applications. They traditionally include a hex fitting on the outside of the bearing for tightening into place. Newer cam followers also include a hex fitting on one or both ends of the stud. This allows installers to hold and tighten the bearing, wherever it is positioned on the machine, with greater accuracy and consistency.



Cam followers are typically easy to install and tighten using a hex key/Allen wrench.

Prevent Contamination and Ensure Reliability in Harsh Environments

Many cam followers come in stainless steel versions that provide excellent corrosion resistance for equipment prone to washdowns. Stainless steel construction also makes them suitable where oil cannot be used, and in cleanrooms, space or vacuum environments. In fact, some cam followers are found aboard space stations and satellites, opening or closing antennae or solar panels.

Because equipment used in space and vacuums most likely cannot be accessed for maintenance, and lubricating greases can outgas and contaminate sensitive components, your supplier will recommend a more suitable grease. Metallic seals are often preferred in these environments, while other seal materials — such as Viton™ — are also available to meet your specific needs.

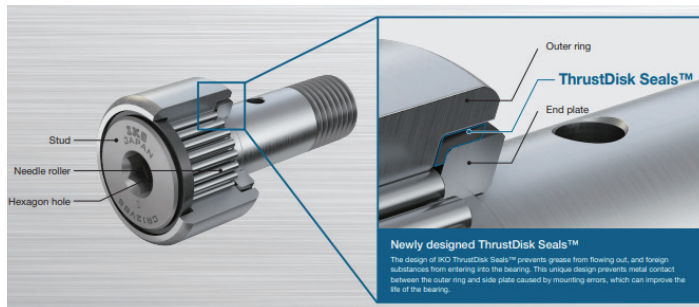
In many applications, an effective seal will keep foreign substances out, prevent grease from leaking and protect against several conditions that can lead to premature failure, like thrust loads. One such seal, IKO's ThrustDisk Seals™, has a synthetic resin disk that sits between the shoulders of the outer ring, stud head and side plate to handle axial loads caused by mounting errors, preventing friction and abrasion inside the bearing while providing exceptional wear and heat resistance. In addition to the ThrustDisk Seals™ cam follower family, rubber seals are also offered with IKO's C-Lube and Miniature cam follower families.

Application Challenges

Some cam follower models are specially designed to withstand difficult operating conditions. Cage-type cam followers secure the bearing's needles to prevent misalignment-related wear and friction, while full-complement units withstand high radial loads. Here are some common application challenges along with cam follower features to look for during the selection process to solve them:

- **Heavy payloads.** Cam followers with a thick outer ring have a larger load area, while those with a heavier stud also have greater strength. Both elements keep direct contact with the guiding surface, ensuring accurate, smooth motion for heavier loads. In addition to this construction element, some cam followers have an outer ring consisting of a double-row of cylindrical rollers in order to handle large radial loads along with typical axial loads in heavy-duty applications.

- **Uneven loading.** To prevent uneven loading, consider a cam follower with an eccentric collar fixed to the stud. The rotating collar creates a uniform line that easily adjusts in the radial direction against the opposing track surface to evenly distribute the load across the outer ring.
- **Impact loads from poor tracks.** Sometimes, the mating part plays a larger role in motion quality than the cam follower. For these situations, a rubberized or coated outer ring can alleviate impact loads caused by a poor track. Depending on the coating or material, the cam follower's outer ring may have lubricating characteristics that can help prevent track wear.
- **Space constraints.** If a standard cam follower cannot fit your tight space, you can still find cam followers with stud diameters down to 1.4 millimeters. These compact designs employ very thin needle rollers within a small outer-ring diameter. Others have a mounting structure that solves the space limitations that often exist on the stud side of the assembly region.



IKO's ThrustDisk technology is built into the sliding contact areas of the outer ring, stud head and slide plate to handle axial loads

Cam Follower Selection: Considerations and Trade-Offs

Depending on the application, various factors and trade-offs must be considered. These include (but are not limited to) the load and its direction, speed, deflection and misalignment, the operating environment and maintenance needs. If your equipment requires oscillating or reciprocating motion, select a cam follower that follows the same motion.

Above all, the stud and outer ring must support the expected load. The track capacity along with the stud's deflection limits will also determine the cam follower's load magnitude and, ultimately, the type and size of your cam follower. Note that the stud structure may deflect under load, creating misalignments between the track or cam that may cause corner loading and diminish the unit's thrust load capability.

To counter corner loading, consider cam followers with crowned outer rings. To handle high radial loads, look for full-complement cam followers with cylindrical outer rings. Full-complement cam followers are better suited for slower speeds, while cage-type cam followers can support higher speeds but with lower load ratings. Caging also prevents roller-to-roller contact and allows cooler operation because it can manage higher speeds. A robust, thick outer ring fortifies against heavy rolling or shock loads.

As mentioned earlier, your vendor can offer stainless steel construction for a washdown-intensive, clean or vacuum environment, and optional seals can prevent contamination. When it comes to lubrication, many cam followers come pre-packed with grease which is particularly desirable for slower-speed applications. Oil-based lubricants — which may also come pre-supplied with the unit — typically deteriorate less over time, making them appropriate for higher-speed applications. For applications requiring longer lube intervals or those that may be hard to reach, IKO's C-Lube cam followers provide a thermoset solid lubricant within the bearing space for long-lasting, maintenance-free operation.

Mounting Tips and Best Practices

Proper mounting is critical to the performance and lifetime of your cam follower. Otherwise, a resulting misalignment can create thrust forces and metal contact between the bearing's outer ring and side plate. Here are some tips and best practices to keep in mind:

Basic cam followers can be bolted into a drilled or tapped hole or through a plate with a nut attached to the back end. These units can be fastened into place with an Allen wrench or a screwdriver. Most newer units include hexagon holes on both ends so they can be mounted from either side. Be sure to follow your manufacturer's dimensional tolerance chart to ensure a close fit without play between the stud and the hole, particularly if the cam follower will experience heavy impact loads. If the outer ring does not make good contact with the mating running surface, consider a crowned outer ring.

Because some applications may call for dozens or even 100 cam followers or more, consistency is important. Use a standard torque wrench and make sure the torque on the nut is exactly the same for all your cam followers. Don't forget to keep a clean work environment that's free from contaminants.



Cam Follower Designs Tackle Mounting Challenges

While cam followers offer clear benefits, installation may sometimes present challenges. For example, space constraints may prevent installers from mounting a cam follower to their preferences. And when a cam follower is mounted incorrectly, the resulting misalignment causes impact loads that create wear and friction between the bearing's outer ring and side plate. The consequences: breakdowns and downtime.

Fortunately, cam follower manufacturers like IKO have developed design features that can simplify mounting and alleviate misalignment and its associated effects. One such cam follower has stepped areas on the stud, allowing users to secure them from the top with a set screw for easy attachment. Another cam follower — IKO's CFC...B — is designed for applications with limited mounting space, especially on the stud side of the assembly region. Its mounting structure includes a hexagon socket head bolt and a dedicated flange nut, creating a more compact cam follower that reduces the required mounting space on the stud side by up to 34 percent.



IKO's CFC...B cam follower features a short stud and a mounting structure that solves limited mounting space on the stud side of the assembly

And when you work with IKO, you'll get the same high accuracy and performance that you've come to expect from our other quality motion components. With careful selection and the right supplier, there's a cam follower that will perform reliably in your design for a long time.

For more information, please visit our website at www.ikont.com.

Karl Wickenheisser,
VP of Sales & Marketing, IKO

Choose a Supplier With a Broad Selection and Motion Expertise

When selecting a cam follower supplier, look for a large portfolio of products, extensive motion expertise and the ability to tailor a unit to your needs. At IKO, we're more than a high-performance linear or needle bearing manufacturer. We also offer the most comprehensive range of cam followers in the industry, with shapes and styles — in both inch and metric series — to suit most any application.

By incorporating needle-style rollers between a stud and outer ring, our cam followers provide good rotational performance, high load capacity, low coefficient of friction (COF) and increased lifetimes. The lineup includes standard cam followers in basic, solid eccentric, heavy-duty and miniature styles, plus easy-to-mount compact stud-type roller units as well as unique technologies like ThrustDisk Seals™ and C-Lube.