

Crossed Roller Bearings Offer Many Benefits for Robotic Systems



As modern robotics and automated machines perform more tasks than ever, bearings that enable complex motion and effective load handling are making it all possible. For example, many robots and cobots incorporate articulating arms to move, position or rotate heavy objects or perform routine tasks like welding and assembly. And, as robot functionality demands increase, design sizes continually shrink. Crossed roller bearings deliver precise, repeatable motion and can handle large axial, radial and moment loads simultaneously to perform complex tasks. They also fit within the tight confines of today's robots and cobots.

Crossed Roller Bearings: An Overview

Crossed roller bearings feature a unique design in which the rollers are alternately crossed at right angles to each other between inner and outer rings. This arrangement creates greater contact with the raceways to allow the bearing to handle heavy or complex loads from any direction at the same time. The orthogonal array of rollers gives crossed roller bearings their compact size for space-constrained designs. Not only are crossed roller bearings essential for robotic systems, they are also well-suited for use in machines with moderate rotational speed requirements such as machine tools and medical equipment. Here are just some of the benefits they offer robotic systems:

- **Greater rotational accuracy.** The large contact area where the rollers meet the raceway surfaces allows crossed roller bearings to exhibit less deflection under load and very small elastic deformation versus other bearing types, which only provide a single point of contact. As a result, they achieve greater stiffness and rigidity, and taken together, crossed roller bearings provide greater rotational accuracy. Crossed roller bearings can also be manufactured with pre-loads and higher-precision grades to provide superior rotational accuracy.
- **Exceptional load handling.** In addition to high accuracy, greater roller contact with the raceway surface gives crossed roller bearings greater load handling capability. Because the rollers are alternately crossed and positioned at right angles to each other between inner and outer rings, these bearings can take radial, thrust and moment loads from any direction at the same time. That means crossed roller bearings are more than capable of supporting the complex motion needs of robotics.
- **Space savings.** The orthogonal arrangement of rollers allows crossed roller bearings to take up less space than other types of bearings. Their compact size is critical for ever-shrinking robotic designs, especially mechanisms that perform wrist and arm motion.
- **Easy installation and handling.** Certain crossed roller bearings feature solid-inner and outer ring construction with mounting holes on both rings to simplify mounting and eliminate the need for special housings or fixing plates. Handling is also easy. For example, the outer rings of IKO's standard crossed roller bearings are made of two split pieces that are bolted together to prevent separation during transportation or mounting.



Figure 1. Crossed roller bearings are well-suited for use in joints for a variety of robot types, such as industrial robots with articulating arms or a bionic exoskeleton shell.

- **Efficiency.** Many crossed roller bearings exhibit lower rotational torque than that of plain bearings, and the difference between the static torque and the dynamic, or kinetic, torque is minimal. As a result, crossed roller bearings can help machines consume less power and limit operating temperature increases for greater overall efficiency.
- **Long life and quiet operation.** Crossed roller bearings with a built-in cage or separators exhibit a small coefficient of friction (CoF), which both reduces wear for a better lifetime and minimizes noise.

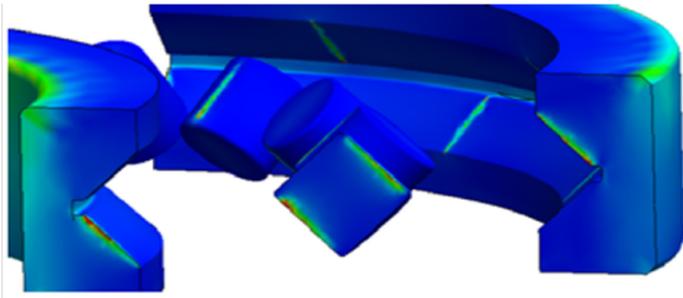


Figure 2. Stress analysis showing how crossed roller bearings can handle radial, thrust and moment loads from any direction at the same time.

What To Look For in a Crossed Roller Bearing for Your Robotic Application

Not only do crossed roller bearings handle diverse loads with high precision, their versatility also makes them an attractive option for robotics. As robotic motion becomes more complex and mechanisms continue to shrink, bearing manufacturers like IKO International have incorporated different design elements into their crossed roller bearings to address these challenges. When specifying crossed roller bearings for robotic applications, here are some of the design elements to look for, using products from IKO's diverse lineup as examples:

When you need extra rigidity. Crossed roller bearings that combine the inner and outer rings to form one solid piece achieve higher rigidity. In addition, a one-piece element with mounting holes is less affected by the housing structure, which results in even greater rigidity and accuracy.

When you need smooth rotation. Separators between the cylindrical rollers promote smoother rotation and save driving power. Crossed roller bearings with separators are especially desirable for applications requiring relatively high rotational speeds.

When you need a thin design and weight savings. When space is at a premium, look for slim bearings with a smaller outside diameter versus the bore diameter, as well as a narrow width. In fact, certain crossed roller bearings are extremely slim and lightweight. For example, IKO's CRBT Super Slim Type crossed roller bearing is available with a width of 5 millimeters — 60% slimmer than conventional crossed roller bearings — a cross sectional height of 5.5 millimeters, and a mass ratio of 0.11. One-piece construction also reduces the number of parts in the assembly, which contributes to design miniaturization and weight savings.

For easier mounting. Many types of crossed roller bearings have mounting holes pre-drilled on the inner and outer rings. These mounting holes make direct fixing and mating easy, and they help to eliminate mounting errors. IKO offers both high rigidity- and super slim-type crossed roller bearings — the CRBVF Series and CRBTF Series, respectively — that feature mounting holes in a single structure that combines both inner and outer rings for simple bolt-on installation.

Meet a Diversity of Robotic System Requirements

Designers of robotics systems must answer demands for more functionality, load capability and complex, yet accurate motion. Crossed roller bearings are constructed to position heavy loads with precision, and certain design elements can deliver even greater rigidity, accuracy and mounting ease for challenging applications. IKO International's crossed roller bearing lineup comes in a variety of sizes and designs to deliver a broad range of benefits to optimize performance for a host of robotic systems.

For more information about IKO International's crossed roller bearings for industrial robot applications, visit www.ikont.com.