



## Cage-Guided Needle Roller Bearings

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## A Revolutionary Product Made Even Better

Needle bearings were originally conceived with a full set of needles positioned between a shaft and housing — a design that became known as the “full complement” needle roller bearing. However, with increasing performance requirements such as higher speeds and less lubrication, the limitations of the full-complement design were exposed. These limitations, such as increased frictional resistance, typically resulted from roller misalignment due to the nature of the full-complement design as well as the inherent dynamics within the application, e.g., deflection and misalignment.

That is why 60 years ago Dr. Georg Schaeffler, whose company at the time was known as Industrie Nadellager (or INA, for short), invented the cage-guided needle roller bearing. This remarkable innovation “captured” the needle rollers in a cage, guiding them to reach higher speeds than had been possible before, while maintaining the low profile of the full-complement bearing with outstanding load-carrying capacity. Continuous product improvement has resulted in a doubling of the static capacity and a five-fold increase in the service life vs. our original cage design.

INA cage-guided needle bearings from Schaeffler provide everything you need to ensure maximum performance and reliability from your machines:

- High load-carrying capacity, thanks to guided rollers that are not prone to skewing
- Significantly reduced friction, typically 50% less than full-complement bearings
- Operating temperatures at high speeds reduced by 40%
- Compact design

Schaeffler offers a comprehensive portfolio of INA products that ranges from customized, high-performance drawn-cup needle roller bearings to precision ground X-life™ needle roller bearings.

### Typical Applications

- Motorcycles
- ATVs
- Snowmobiles
- Engines
- Transmissions
- Starter clutches
- Small combustion engines
- Small/industrial gearboxes
- Chassis
- Planetary gear sets
- Crank pins and piston pins
- Connecting rods
- Agricultural equipment
- Construction equipment
- Mining equipment
- Oilfield equipment
- Production machinery
- Textile machinery
- Printing machinery
- Paper mills
- Pumps
- Compressors
- Chain conveyors
- Industrial door openers
- Power tools
- Robotics
- Medical equipment
- Dental drills
- Fitness equipment

### Schaeffler Cage-Guided Needle Roller Bearings Offer:

- Extremely cost-effective performance
- Readily available inventory
- Parallel roller guidance
- Roller separation
- Roller retention
- Lubrication reservoir
- Reduced friction
- Reduced operating temperatures (less heat is generated)
- Higher speeds
- Full use of load rating for extended operating life
- Greater resistance to shaft deflection and misalignment
- Available sealed versions
- Integral sealing, which allows for simplified designs & assemblies



Cage-Guided



Skewed Full Complement



Comparison of Roller Contact Stress Cage-Guided vs. Full Complement

Full-complement bearings may publish higher load ratings, but these are mathematical values that assume ideal operating conditions. However, real-world applications typically result in slight shaft misalignments that cause the rollers to skew. Consequently, the real-world rating life for full-complement bearings is actually lower than the published ratings.



## Drawn Cup Needle Roller Bearings

Drawn cup needle roller bearings – available with open ends or with a closed end – are complete units that consist of a thin-walled drawn cup outer ring, and either a needle roller and cage assembly, or a full complement of needle rollers.

The thin-walled outer cup and the ability to function, when appropriate, without an inner ring enable drawn cup needle roller bearings to have extremely small radial dimensions. They combine high load-carrying capacity with the ability to handle high speeds, while also being particularly easy to mount. A hardened and ground bearing raceway is required on the shaft. If it is not practical to use the shaft as a raceway, drawn cup needle roller bearings can be combined with Schaeffler's hardened and ground or deep-drawn, case-carburized inner rings.

Schaeffler's HN-series full-complement drawn cup needle roller bearings offer extremely high load-carrying capacity within a very small design envelope. However, their use at high speeds is limited. For applications where higher speeds are required, a cage-guided bearing is recommended.

Standard shell bearings are also offered in a heavy-duty series for the same shaft diameters. The heavy-duty series is designed for applications where the loading conditions are too great for the standard series. The heavy duty variant features a larger cross section and incorporates needle rollers with a larger diameter.

### Technical Advantages

- Low running friction
- Exceptionally high running speeds

### Customer Benefits:

- High load-carrying capacity
- Excellent reliability
- Extremely cost effective
- High efficiency due to low running friction
- Can be used in combination with axial needle roller bearings

### Typical Applications

- Textile weaving machines
- Power drills
- Pinion shafts in vehicle steering systems
- Piston pumps in combines, excavators, wheel loaders
- Angle grinders



## Machined Needle Roller Bearings

Machined needle roller bearings are available in a variety of configurations: with and without ribs, as self-aligning bearings, and as combination thrust/radial needle roller bearings.

In addition, machined needle roller bearings are available with and without inner rings. The latter version is used if the shaft on which the bearing is mounted can be hardened and ground.

Machined needle roller bearings with ribs have a low radial height and high load capacity. They are an excellent solution for designs with limited radial space.

Needle roller bearings without ribs on the outer ring are not self-retaining, which makes mounting considerably easier.

Self-aligning needle roller bearings can compensate for static misalignment of the bearing axis by as much as 3°.

Combination needle roller bearings are radial bearings with an axial component capable of supporting loads. They are used as either semi-locating or locating bearings.

Machined needle roller bearings with and without ribs as well as self-aligning needle roller bearings are available in X-life quality. X-life bearings feature raceways with optimized surface finishes and geometrical accuracy, which provides superior load-carrying capacity and longer life.

### Technical Advantages

- Compact design
- Available in X-life quality
- Higher precision due to optimized raceway surfaces
- Significantly lower friction
- Lower operating temperature
- Also available in full-complement versions

### Customer Benefits:

- Able to support significantly higher loads within the same design envelope
- Rating life and operating life extended by as much as 50%
- Maximizes available design space
- Greater efficiency due to reduced energy consumption
- Increased reliability
- Lower total cost of ownership (TCO)
- Lower oil and grease consumption
- Can be combined with axial needle roller bearings
- Available with or without inner rings

### Typical Applications

- Mud pumps - crosshead bearings
- Packaging machines – die-lifting tools
- Connecting rod bearings
- Crankshaft journal bearings
- Tractor axles
- Printing machines - gripper systems
- Robotic arms and handling systems



## Drawn Cup Roller Clutches

Drawn cup roller clutches are one-way clutches that consist of thin-walled, drawn outer rings with ramps on the inside diameter, plastic cages, springs and needle rollers. They transmit torque in one direction only, allowing freewheeling in the opposite direction.

Drawn cup roller clutches provide very precise indexing because the steel or plastic spring forces the needle to maintain contact with the ramp on the inside of the shell and the shaft. Because of their low mass and the resulting low moment of inertia, drawn cup roller clutches are able to index at very high frequencies. They also offer low overrunning frictional torque.

Drawn cup roller clutches have a wide variety of uses, including indexing, back-stopping and overrunning.

Drawn cup roller clutches can also be supplied with knurled shells to ensure positive location in plastic or light metal housings.

Drawn cup roller clutches are also available with integral support bearings. These can consist of either needle rollers retained by plastic cages, or plain bearings. They are arranged on either side of the clutch unit and support radial loads.

### Technical Advantages

- Precise indexing because each needle roller has a dedicated spring to keep it in place
- Low overrunning frictional torque
- Low mass enables high indexing frequencies
- Low moment of inertia
- Compact design
- Small section height
- Increased power density
- Process reliability in high-volume production

### Customer Benefits:

- Combination of clutch and bearing significantly reduces customer assembly costs
- Significant cost advantages
- Downsizing and space-saving bearing arrangement possible
- Allows for decoupling of motor and drive train
- Improved ride comfort in vehicle applications
- Available with or without bearing arrangements

### Typical Applications

- Indexing clutches
- Back-stopping clutches
- Overrunning clutches
- Shifting elements
- Office equipment
- Bicycles
- E-bikes



## Needle Roller and Cage Assemblies

Needle roller and cage assemblies, or unit cages, are self-contained single- or double-row bearing assemblies with precise, individually guided and retained needle rollers. Because the radial section height of unit cages corresponds to the needle roller diameter, they make it possible to have bearing arrangements with a very small radial cross section. Needle roller and cage assemblies combine high load-carrying capacity with the ability to run at high speeds, while also being particularly easy to mount.

Unit cages with their high precision rollers allow for bearing arrangements with high runout accuracy, which is influenced by the geometrical accuracy of the raceways.

Needle roller and cage assemblies require a hardened and ground raceway on the shaft and in the housing. The radial internal clearance can be influenced by the needle roller sort as well as by the shaft and housing tolerances.

Needle roller and cage assemblies are also available in designs for connecting rod bearing arrangements. This includes the KZK-series for crank pin bearing arrangements as well as the KBK-series for piston pin bearing arrangements.

### Technical Advantages

- High load-carrying capacity
- High running speeds
- Compact design

### Customer Benefits:

- Outstanding operational reliability
- Space-saving bearing arrangement
- Lightweight
- Requires little or no maintenance

### Typical Applications

- Small combustion engines
- Power tools/drills
- Industrial transmissions
- Crank pins & piston pins in motorcycles
- Manual transmissions in automobiles
- Planetary gear bearings

## Axial Needle Roller Bearings



AXK-series axial needle roller and cage assemblies consist of plastic or metal axial cages with integral needle rollers. Despite their very low axial section height, the cage assemblies can support high axial forces in one direction. Radial loads, however, must be supported by separate means.

Thrust bearings require hardened and ground running surfaces as a raceway. AS-series axial bearing washers are suitable for use if the adjacent machine part is not hardened, provided that it is sufficiently rigid and geometrically accurate. They can be used as shaft or housing locating washers.

The AXW-series axial needle roller bearing consists of an AXK-series axial needle roller and cage assembly in combination with an axial bearing washer with a centering spigot. The running surface for the mating component must be hardened and ground. AXW-series bearings can be combined with drawn cup needle roller bearings (either open-ended or with a closed end) or with precision-ground needle roller bearings. This combination of bearings can support radial loads and tilting moment loads in addition to axial loads.

Axial needle roller bearings have a particularly small cross section. They offer very high load-carrying capacity and tilting rigidity relative to the axial space required.

### Technical Advantages

- Low axial section height
- High load-carrying capacity
- Can support high axial forces in one direction
- High rigidity

### Customer Benefits:

- Space-saving bearing arrangement
- Can support tilting moments when fitted in pairs
- Can be combined with drawn cup needle roller bearings and machined needle roller bearings

### Typical Applications

- Drill spindle arrangement
- Industrial gearboxes



X-life™ is Schaeffler's seal of quality for ultra-high performance products from our INA and FAG brands. X-life bearings offer higher dynamic load ratings than conventional products, resulting in a longer rating life and extended operating life.



### Longer service life.

In applications where the load and design envelope are unchanged, X-life bearings have a longer rating and operating life. This makes it possible to extend the intervals between maintenance operations.



### Greater load-carrying capacity.

Conversely, if the same design envelope and the same rating life are maintained, X-life bearings make it possible to apply higher loads.



### More efficient use of space.

In cases where both the rating life and the load are unchanged, X-life bearings make it possible to downsize to a smaller bearing. X-life thereby delivers greater power density, an optimized design envelope, and less weight.

**X-life:** More Capacity. More Rigidity. Less Friction. Less Downtime.

Proven to be better. Only from Schaeffler.

## New Products



### TWin Cage

Needle roller bearings with TWin Cage consist of a plastic cage with two adjacent needle rollers per pocket, along with a machined outer ring. Customers benefit from significantly improved efficiency with Twin Cage, as this innovative design reduces friction by up to 25%.

Needle roller bearings with TWin Cage are available in X-life quality, featuring raceways with an optimized surface for greater load-carrying capacity and longer rating life.

#### Technical Advantages

- Friction reduced by as much as 25%
- Higher dynamic load rating Cr
- Higher precision due to optimized raceway surfaces
- Low operating temperature
- Greater rigidity due to the increased quantity of needles in plastic cage
- Reduced contact pressure due to improved load distribution

#### Customer Benefits

- Greater efficiency due to reduced friction and energy consumption
- Longer rating and operating life
- Low total cost of ownership (TCO)
- Lower operating temperatures
- High load-carrying capacity
- Improved precision due to reduced temperature differentials
- Extended relubrication intervals



### -D-XL Bearings

Needle roller bearings with the suffix D feature a newly developed, profiled steel cage that is produced using state-of-the-art forming technology. The cage has been designed to enable the bearing to accommodate a larger number of longer needle rollers – even though the bearing dimensions remain unchanged! This increases the basic load ratings by as much as 25%, thereby enabling the bearing to support significantly higher loads within the same design envelope.

These types of bearings are also available in X-life quality (with the suffix XL), featuring raceways with an optimized surface for greater load-carrying capacity and longer rating life.

#### Technical Advantages

- Bearing weight reduced by as much as 20%
- Bearing width reduced by as much as 15% (under the same load conditions)
- Friction reduced by as much as 30%
- Higher dynamic load rating (Cr)
- Higher static load rating (COr)
- Higher precision due to optimized raceway surface
- Lower operating temperature
- Increased roller capacity

#### Customer Benefits:

- Supports significantly higher loads within the same design envelope
- Up to 50% longer rating and operating life
- Greater efficiency due to reduced energy consumption
- Offers increased load ratings while bearing dimensions remain unchanged
- Lower total cost of ownership (TCO)
- Improved reliability
- Increased performance density, resulting in smaller components and subassemblies
- Reduced oil and grease consumption