Tapered Roller Bearings
for axle drive pinions
In automobile axles, various stresses are caused by acceleration, deceleration, and cornering forces in a complex manner from all directions. They're truly a key mechanical part of every vehicle. In response to the demand for ever more advanced bearings that support drive pinions, JTEKT goes one step beyond making proposals. Every elemental technology imaginable is rethought from scratch to ensure products with unequalled levels of low friction loss and high capacity.

**Compact & Lightweight, Low-torque, High-capacity & High-durability. JTEKT’s TRBs support enhancement of vehicle’s environmental performance.**

Tapered roller bearing development timeline (for automobile drivelines)

<table>
<thead>
<tr>
<th>Bearing trends and needs</th>
<th>Enhanced reliability</th>
<th>Enhanced seizure resistance</th>
<th>Responding to needs for more compact size and lower torque</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Development initiatives</strong></td>
<td><strong>Low torque</strong></td>
<td><strong>Low torque</strong></td>
<td><strong>Low torque</strong></td>
</tr>
<tr>
<td><strong>Compact &amp; Lightweight</strong></td>
<td><strong>Longer service life</strong></td>
<td><strong>Reduced lubricant churning resistance</strong></td>
<td><strong>Size reduction by adopting KE or KEⅡ heat treatment</strong></td>
</tr>
<tr>
<td><strong>LFT-I bearing:</strong></td>
<td><strong>10% lower torque</strong></td>
<td><strong>LFT-II bearing:</strong></td>
<td><strong>20% lower torque</strong></td>
</tr>
<tr>
<td><strong>Special processing of inner ring rib surface</strong></td>
<td><strong>Low Friction Torque Bearing</strong></td>
<td><strong>Optimized internal design</strong></td>
<td><strong>Life reduction by adopting KE or KEⅡ heat treatment</strong></td>
</tr>
<tr>
<td><strong>HC bearing became a standard for TRB</strong></td>
<td><strong>Increased service life</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>1960</strong></td>
<td><strong>1970</strong></td>
<td><strong>1980</strong></td>
<td><strong>1990</strong></td>
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<tr>
<td><strong>KE bearings:</strong></td>
<td><strong>15-fold longer service life</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>Patent No. 4217818</strong></td>
<td><strong>High-concentration carburizing technology</strong></td>
<td><strong>High surface hardness</strong></td>
<td><strong>Fine carbide</strong></td>
</tr>
</tbody>
</table>
**Tapered Roller Bearings**

**Torque reduction technologies LFT**

**Target**

To reduce bearing rotational torque by focusing on friction loss caused by sliding, rolling and lubricant churning.

For axle drive pinion application, we are pleased to propose a model specially designed for that purpose as a recommended model. In addition, we can offer LFT-Ⅲ as its option since LFT-Ⅲ has a premium specification including the control of lubricating oil flow.

**Applied technologies**

1. Optimized surface roughness and shape of sliding parts
2. Optimized raceway crowning profile
3. Optimized internal design
4. Size reduction enabled by excellent heat-treatment technologies
5. Control of lubricating oil flow

**Performance**

“Recommended” models significantly contribute to torque reduction compared to standard TRBs.

**Bearing flaking mode**

- Flaking in Clean Oil
- Flaking Initiated from Surface
- Flaking Initiated from Dent
- Mixed Flaking

**Relationship between bearing surface hardness and service life with contaminated oil**

- Increased Surface Hardness for
  - Improved Wear Resistance
  - Reduced Plastic Deformation
  - Residual austenite optimized
  - Early elimination of Plastic Deformation
  - Optimized matrix C%
  - Optimized surface hardness of rolling element

**Size/ Weight reductions**

Contribution to fuel economy enhancement

- 10-fold longer service life with contaminated oil
- 40% reduction

**Target**

Significant extension of service life with contaminated oil by adopting JTEKT’s own heat treatment technologies.

1. Increase bearing surface hardness
2. Optimize the amount of retained austenite

**Effective to surface originated flaking which occurs when lubricated by contaminated oil**

**Bearing failure probability (%)**

- Cumulative failure probability (%)
- Service life (hr)

**Relationship between the amount of retained austenite and Weibull slope with contaminated oil**

- Retained austenite γR (%)
- Weibull slope
- Service life
- Foreign matter hardness at time of testing

**Modes**

- Abrasive wear by small, hard particles
- Plastic deformation caused by outside force or large and hard particles
- Material defect at maximum shear stress depth

**Relationship between bearing surface hardness and service life with contaminated oil**

- Foreign matter hardness at time of testing
- Service life (hr)
- Surface hardness (HRC)

**KE Bearing**

Embodiment of Size/Weight Reduction Technologies

Contribution to fuel economy enhancement

- Equivalent service life
- Approx. 35% lighter
**Example Technology Review**

**CAE analysis**

JTEKT’s design and development are conducted utilizing the latest equipment in an advanced CAE environment.

As JTEKT developed its own high-precision tapered roller bearing’s torque calculation formula based on accumulated data, research and analysis, rotational torque can be easily obtained and used for examination. JTEKT considers the rigidity of the whole axle system, which supports the axle, bearing service life, contact stress, etc. and propose the best TRBs for your applications.

**Calculation is possible as axle system.**

**Service life calculation**

<table>
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<tr>
<th>Life (hour)</th>
<th>Test</th>
<th>2.0E+003</th>
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<tr>
<td>50000</td>
<td>Load</td>
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<tr>
<td>100000</td>
<td>Load</td>
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</table>

**Surface pressure calculation**

![Surface pressure calculation diagram](image)

**Deflection of pinion gear’s meshing point**

![Deflection diagram](image)

**Simulation test equipment**

In response to customers’ requests, we conduct evaluations utilizing various vehicle driving conditions.

At JTEKT, prior to evaluations in actual vehicles, evaluations simulating various driving conditions are possible (such as oil flow check and torque loss measurement), which enables the reduction of development and evaluation periods. Simulation of mountain road driving, high-speed cornering, driving in urban areas, etc.

**Example Evaluation**

CAE analysis result is verified by using an actual final reduction gear unit with an actual drive pinion.

**Pinion bearing torque measurement results**

![Pinion bearing torque measurement results graph](image)

**Oil temperature measurement results of differential gears**

![Oil temperature measurement results graph](image)

**Testing methods:**
- "Pinion bearing torque measurement results" for torque reduction
- "Oil temperature measurement results of differential gears" for temperature rise.
Technical centers located around the world ensure quick response and technical support for customers’ needs.

Fully utilizing our knowledge as a world-leading systems supplier, JTEKT conducts driving evaluations and analyses of products installed in vehicles. We exhaustively pursue the highest standards in product safety and operation on a test course capable of simulating various road and weather conditions around the world. As a total systems supplier, our highest value is to provide our customers with products that deliver outstanding performance and the best quality that help to make automobiles that are more than just fun to drive.

**Recommended Series Bearing Numbers**

Please select from the recommended bearing numbers when considering axle drive pinion bearings.

<table>
<thead>
<tr>
<th>No.</th>
<th>d</th>
<th>D</th>
<th>T</th>
<th>C</th>
<th>C0</th>
<th>C0r</th>
<th>bearing number</th>
<th>ADBA bearing number</th>
<th>load center position</th>
<th>Constant</th>
<th>Load factor</th>
<th>Reference (Max) kN</th>
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Boundary dimensions can be changed upon request.
For details, please contact the nearest JTEKT sales office.

These dimensions can be changed.