Together with Our Customers, Our Bearing Business Continues to Evolve

**Changes in Spindle Technologies in Response to Market Needs**

<table>
<thead>
<tr>
<th>Society/Machine tool manufacturer trends</th>
<th>Mass production, improved productivity</th>
<th>High-mix, low-volume manufacturing</th>
<th>High functionality/High quality</th>
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<tbody>
<tr>
<td>Machining center (MC) trends and market needs</td>
<td>○ Horizontal/Vertical MCs ○ High-speed rotation ○ Fan seas ○ Rapid acceleration/deceleration</td>
<td>○ Double-column MCs ○ Fan seas ○ Seizure ○ Narrow-width MCs ○ Large MCs ○ Low noise (versus environment) ○ Chatter measures</td>
<td>○ Multi-spindle MC ○ Responding to IoT</td>
</tr>
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**Transitions in bearings for the machining center main spindle**

- **1960s**: 7000-series High-strength brass cages
- **1970s**: 7000-series High-speed rotation, Lightweight resin cage
- **1980s**: World’s first application of ceramic ball bearings
- **1990s**: Innovation of high-speed matched pair angular contact ball bearings, Lightweight polyamide resin cages
- **2000s**: Ultra-high-speed cylindrical roller bearings with optimized internal dimensions, Lightweight, high-strength PEK resin cages
- **2010s**: High-speed, minimal single-row cylindrical roller bearings, Brass cages
- **2020s**: Next-generation series, high-performance series under development

**Transitions in bearings for the lathe main spindle**

- **1960s**: Standard series 7000
- **1970s**: High-ability series HAR, 3NCHHAX
- **1980s**: High-ability NX series HAN1000BK
- **1990s**: High-speed matched pair angular contact ball bearing ACT000DB
- **2000s**: Next-generation series high-performance series

**Lathe trends and market needs**

- ○ Standard lathes ○ Vertical lathes ○ NC lathes ○ High rigidity ○ Higher speed ○ CNC lathes ○ Longer ○ Life grease ○ Combination lathes ○ Ultra-precision lathes ○ Multi-spindle lathes ○ Responding to IoT

**Horizontal/Vertical MCs**

- High-speed rotational machinery tools
- Rapid acceleration/deceleration

**Double-column MCs**

- Fan seas
- Seizure

**Narrow-width MCs**

- Large MCs
- Low noise (versus environment)
- Chatter measures

**Multi-spindle MC**

- Responding to IoT

**Products for Machine Tools**

- Jtekt 02
- 02 

**Society/Machine tool manufacturer trends**

- Mass production, improved productivity
- High-mix, low-volume manufacturing
- High functionality/High quality

**Market needs**

- Standard lathes
- Vertical lathes
- NC lathes
- High rigidity
- Higher speed
- CNC lathes
- Longer
- Life grease
- Combination lathes
- Ultra-precision lathes
- Multi-spindle lathes
- Responding to IoT
Machining centers
Bearings for ultrahigh-speed spindles

High-ability **NX Series** Extremely Ultrahigh-speed Angular Contact Ball Bearings

**Four million of value \( dm_n \) is realized by oil-and-air lubrication**

- Outer ring lubrication hole
- Outer ring (bearing steel)
- Ball (ceramics)
- Inner ring (case carburizing steel)
- Cage (PEEK resin)

**Enhanced performance by optimized designs of cage and bearing rings**

- High-speed performance
- Temperature increase

**High-speed performance**

- High-speed performance 20% UP

**Temperature increase**

- Low-temperature performance improved 40% DOWN

**New Series**

**World-fastest level**

- Value \( dm_n \times 10,000 \)

High-ability **NX Series** Ultrahigh-speed Cylindrical Roller Bearings

**Three million of value \( dm_n \) is realized by steel rollers and oil-and-air lubrication**

- Outer ring (bearing steel)
- Roller (bearing steel) is also applicable to ceramic rollers
- Cage (PEEK resin)
- Inner ring (bearing steel)

**Enhanced performance by optimized cage design**

- High-speed performance
- Temperature increase

**High-speed performance**

- High-speed performance 30% UP

**Temperature increase**

- Low-temperature performance improved 35% DOWN

- Value \( dm_n \times 10,000 \)
# Bearings for Spindle

## Bearings for Machining Center Spindle

<table>
<thead>
<tr>
<th>Bearing Type</th>
<th>Cross-section</th>
<th>Bearing Series</th>
<th>Contact Angle</th>
</tr>
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<tbody>
<tr>
<td>Standard Type</td>
<td>70C, 70C, 72C</td>
<td>15°</td>
<td>NNU490 (K)</td>
</tr>
<tr>
<td>HAR9C, HAR9C</td>
<td>15°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HAR9CA, HAR9A</td>
<td>20°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HAR9, HAR9</td>
<td>30°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3NCHAC9C, 3NCHAC9C</td>
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<td></td>
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</tr>
<tr>
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<td>20°</td>
<td></td>
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## Examples of Bearing Arrangements

**For Machining Centers**

- Matched pair angular contact ball bearings + Double-row cylindrical roller bearings
- High-speed performance

**For Lathes**

- Tapered roller bearings + Double-row cylindrical roller bearings
- Double-row cylindrical roller bearings
- Double-direction angular contact thrust ball bearings + Double-row cylindrical roller bearings
- High-speed performance

Combined purchase with spacers is also possible.

## Example of Technology Examination

### Examination Flow

1. Customer specification conditions
2. Bearing type and arrangement
3. Bearing dimensions
4. Bearing fits and preload amount
5. Service life of bearings
6. Examine main spindle rigidity/critical speed
7. Propose best bearing type and arrangement

### Calculation of Entire Spindle Deformation

![Graph showing spindle deformation before and after improvement.](image-url)
Ball screw related products

The following chart lists ball screws for support bearings.

- External ball circulation (standard)
- Internal ball circulation (compact)
- Return-block type (compact/high load/high lead)

Ball screw support bearings (SAC series) / Ball screw support unit (BSU series)

- SAC2562B For φ25 shaft diameter
- SAC3062B For φ30 shaft diameter
- SAC3572B For φ35 shaft diameter
- SAC4072B For φ40 shaft diameter

Ball screw support bearing selection chart

Number of rows to receive axial load: Sample combination (arrow indicates direction of load.)

- Triple row
- Double row
- Single row

Ball screw shaft dia.

For lathes

- SAC2562B
- SAC3062B
- SAC3572B
- SAC4072B

Max. Axial loads (kN)

Bore diameter (mm)

SAC2562B SAC3062B SAC3572B SAC4072B

Ball screw related products

Spindle unit products

For machining centers

- NT30 standard/high-speed type
- NT40 standard/high-speed type
- NT50 standard/high-speed type

For lathes

- SPM 100CA
- SPM 100CB
- SPM 100CE

Example of rotational speed/rigidity range and spindle unit selection

- SPM 100CA series
- SPM 100CB series
- SPM 100CE series

Please contact JTEKT for details regarding the machining center spindle unit.

High-performance, Reliable Products Supporting Machine Tools

Shaft diameter: mm

Limiting speed: min⁻¹

Lubrication method

Drive method

Bearing type

Cross-section

Bearing series

Contact angle

Double-seal type

SAC

60°

Single-seal type

BSU

96°

Precision ball screw support bearings

Precision ball screw support bearing unit
High-performance, Reliable Products Supporting Machine Tools

Product line-up for machining centers

- Oil air lubricator
  - High reliability
  - Clean environment

- Motor bearings
  - High speed
  - Minimal temperature increase

- Spindle unit
  - High speed
  - High precision
  - Minimal temperature increase

- Spindle bearings
  - High speed
  - High precision
  - Minimal temperature increase

- Air clean unit
  - Clean environment

- Slowing rim bearings for table
  - Ultrahigh rigidity
  - High precision

- Ball screw support bearing unit
  - Easy installation
  - High rigidity
  - High precision

- Ball screw
  - High transmission efficiency

Product line-up for lathes

- Spindle unit
  - High rigidity
  - High precision
  - Minimal temperature increase

- Ball screw support bearing unit
  - Easy installation
  - High rigidity
  - High precision

- Ball screw
  - High transmission efficiency

- Spindle bearings
  - High rigidity
  - High precision
  - Minimal temperature increase

- Ball screw support bearing unit
  - Easy installation
  - High rigidity
  - High precision

- Ball screw support bearings
  - High rigidity
  - High precision
  - Long Life

Please consult JTEKT for detailed information on products other than the main spindle bearings.
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