Cylindrical Roller Bearings for Multi-roll Mill Backup Rolls
JTEKT started producing cylindrical roller bearings for backup rolls for Sendzimir mills in the 1950s and has continued to provide superior products for customers around the world.

As regards to the backup rolls assembling products, which is the Key component of the Sendzimir mill, we concluded a production agreement for licensing with SENDZIMIR JAPAN, LTD. in 1970 and now supply over 100 products for Sendzimir mills around the world.

We support our customer’s operations stability not only with cylindrical roller bearings for backup rolls, but with cylindrical roller thrust bearings for work rolls, bearing-regrinding jigs, measurement of the bearing’s section height with equipment developed at JTEKT and our technical know-how and experience.

JTEKT has a long history of providing high quality products and the experience to offer products with high durability and reliability.
Multi-roll mills enable our customers to utilize extremely small diameter work rolls with a choice of 12 or 20 rolls. Thereby, we are now capable of rolling hard materials such as stainless steel sheets and electrical steel sheets as well as rolling ultrathin copper. Cylindrical roller bearings for backup rolls play a significant role in obtaining this high level of efficiency.
Cylindrical roller bearings for multi-roll mill backup rolls

JTEKT has provided Cylindrical roller bearings for backup rolls with high durability and precision, contributing to the utmost performance in multi-roll mills.

**Required performance and issues**
- Seal structure that maintains a favorable lubricated state
- Longer inner ring rolling fatigue service life
- Improving outer ring durability
- Improving outer ring rotational accuracy
- Improving ease of outer ring regrinding work (P15-16)

**Bearing configuration and features**

The bearings which are used for multi-roll mill backup rolls are attached to the rolls on 1 shaft and the bearings outer diameter are fit closely to the intermediate roll which rotates while loading the rolling component force. Therefore, the outer ring must be fabricated having sufficient rigidity and fatigue strength as well as high precision. At JTEKT, we assemble the bearings in a specially controlled clean working environment.

- The outer surface of the bearing is manufactured through crowning, which accounts for the contact stress distribution to prevent damage to the intermediate roll due to edge load.

![Uncrowned outside surface](image1)

![Crowned outside surface](image2)

- Typical contact stress distribution of the outer-ring’s outside surface (Refer to P16 for the dimensions of the outer ring crowning)

- By ensuring that high precision in both the variation of the bearing’s section heights and high rotation accuracy is achieved for optimum distribution of the bearing loads and supporting the development in rolling precision and the quality of the coils.

![Variation of bearing section heights on one shaft](image3)

- Variation between two adjacent bearings on one shaft ≤ 0.002mm

![Shaft (backing shaft) Bearing for backup rolls](image4)

- Developed steel hardness distribution at Processed steel

![Surface-hardened layer improved approximately 3-fold](image5)

- Surface-hardened layer improved approximately 3-fold

Outer ring is fabricated by JTEKT original developed steel and cored hardening.

- Cored hardening is applied to bearings of over 130mm inner diameter.

![Typical hardness distribution of cored hardening outer ring](image6)
Long life, highly corrosion-resistant JHS is driving innovations in steel production equipment. Iron manufacturing and rolling mill lines must operate continuously while maintaining high reliability in severe production environments. Answering these needs through the realization of epoch-making long-life and high corrosion resistance is JTEKT Hyper Strong (JHS). By adopting newly developed materials and processes for bearing steel, seal materials and other components, we have realized a 2-to-4-fold increase in bearing service life compared to previously used bearings. Continuing on from JHS220 for rolling mill roll necks and JHS210 for Sendzimir rolling mill backup rolls, we are steadily expanding the bearing series according to each application. The JHS bearing series offers total support for achieving maximum performance and durability in the ever-evolving field of steel equipment. Please keep your expectations high. We won’t let you down.

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**Bearing for oil mist lubrication**

**Advantages**
- Improving bearing service life (2-fold/4-fold compared to conventional types)
- High sealing performance
- Oil seal’s Space-saving size for simple installation/ removal

**Service life**
- Conventional type
- Approx. 2-fold (JHS210 standard specification)
- Approx. 4-fold (JHS210 premium specification)

**Premium specifications**
Case-hardened steel is used for the inner ring to suppress the loss of rolling service life under low-viscosity lubrication. Bearing service life is approx. 4-fold compared to the conventional type.

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**Bearing for forced oil lubrication**

**Advantages**
- Outer ring with both high rigidity and durability realized
- High resistance to fatigue realized owing to superior materials composition
- Design optimized to match surrounding structure

**Service life**
- Conventional type
- Approx. 1.5~3-fold (JHS210 premium specification)

**Premium specifications**
Case-hardened steel is used for the inner ring to suppress the loss of rolling service life under low-viscosity lubrication. Bearing service life is approx. 1.5~3-fold compared to the conventional type.
Bearing instruction

Here is an illustration of how we disassemble, assemble and inspect the bearings. Please follow this for bearing maintenance.

Bearing for oil mist lubrication

Inner ring disassembling points

(1) Remove inner rings (both rings)
Seal plate will be removed with inner rings due to the press-fitting of the inner ring.

Caution
Be careful when handling the seal plate. Any damage to seal plate may affect the performance of the bearing’s sealing.

Inner ring inspection points

Confirm for no axial scratches on raceway
Confirm no rust
Confirm no discoloration due to temperature raise
Confirm no abrasion on rib face
Confirm that race way has no unbalanced, asymmetrical roller contact marks on both rows.

※ Please use 10-40kPa for oil mist manifold pressure.
Oil seal disassembling points

(2) Remove snap ring (both pieces)
(3) Remove oil seals (both pieces)

[!] Caution
Be careful to not scratch the oil seal when removing the snap ring and oil seal.

Roller · Cage disassembling points

(4) Hold the cage and remove it with the roller (both rows)

[!] Caution
Be sure to keep all rollers and other parts separate from other bearing parts and manage each bearing independently.

Oil seal inspection points

Confirm no cracking or chipping on seal lip part

[!] Caution
In case of cleaning the oil seal with cleaning oil, please wipe off the cleaning oil immediately.

Roller inspection points

Confirm no abrasion
Confirm no discoloration due to temperature rise
Confirm no cracking or chipping
Confirm no rust

Outer ring inspection points

Confirm no cracking or chipping
Confirm no slipping scratches or brinelling

Confirm no discoloration due to temperature rise
Confirm no rust
Confirm that race way has no unbalanced, asymmetrical roller contact mark on both rows
Confirm no abrasion on rib face
Bearing instruction

Here is an illustration of how we disassemble, assemble and inspect the bearings. Please follow this for bearing maintenance.

Assembling cylindrical roller bearings for backup rolls

(1) Remove inner ring (1 piece)
(2) Assemble the bearings in the reverse order of disassembling.
(3) Before inserting the inner ring (with seal plate), supply the initial lubricating oil (mist oil) into the bearing.

Caution
- Be careful to insert only appropriate bearing parts. There are no compatible parts with other products.
- During re-assembly, be careful not to contaminate the bearing with any foreign matter. Please handle with care so as not to scratch any surfaces of the bearing.

Bearings for forced oil lubrication

Inner ring disassembling points

Inner ring inspection points

- Confirm there are no axial scratches on the raceway
- Confirm no discoloration due to temperature rise
- Confirm that raceway has no unbalanced, asymmetrical roller contact mark on 3 rows
- Confirm no rust
Confi rm no slipping
scratches or brinelling

Confi rm no cracking or
chipping

Confi rm no discoloration
due to temperature rise

Confi rm no rust

Confi rm no abrasion

(2) Hold the cage and remove it with roller (2 rows and 1 row)

[Caution]
Be sure to keep all rollers and other parts separate from other bearing parts and manage each bearing independently.

Outer ring inspection points

Confirm no slipping
scratches or brinelling

Confirm no discoloration
due to temperature rise

Confirm that race way has
no unbalanced, asymme-
trical roller contact mark
on 3 rows

Confirm no rust

Assembling cylindrical roller bearings for backup rolls

(1) Complete cleaning of each part before re-assembling
(2) Assemble the bearings in the reverse order of disassembling

[Caution]
- Be careful to insert only appropriate bearing parts. There are no compatible parts with other products.
- During re-assembly, be careful not to contaminate the bearing with any foreign matter. Please handle with care so as not to scratch any surfaces of the bearing.
Examples of bearing failures and countermeasures

JTEKT’s countermeasures for various failures. Please follow this bearing maintenance program for optimum performance.

### Outside surface of outer ring’s slipping scratches and grinding burn

**Probable causes**
- Slip with the intermediate roll (Sheet jam, involution and so on)

**Countermeasures**
- Review operating conditions

**Probable causes**
- Improper regrinding of outer ring (Heavy grinding, lack of grinding fluid, clogged grinding stone, etc.)

**Countermeasures**
- Optimizing the grinding conditions, improving grinding stone

**Probable causes**
- Improper regrinding of outer ring (Heavy grinding, lack of grinding fluid, clogged grinding stone, etc.)

**Countermeasures**
- Optimizing the grinding conditions, improving grinding stone

**Countermeasures**
- Dispose

### Transcription mark on intermediate roll

**Probable causes**
- Improper regrinding of outer ring (Clogged grinding stone) → rough outside surface (include scratches and foreign matter)

**Countermeasures**
- Removing transcription mark on intermediate roll

**Probable causes**
- Reusable by grinding outside surface
- Reusable by grinding intermediate roll

**Countermeasures**
- Optimizing grinding conditions, improving grinding stone and cleaning outside surface and shaft

### Brinelling on raceway

**Probable causes**
- Foreign matter jam (rolling material’s fragmentation, etc.)

**Countermeasures**
- Rolling oil cleaning

**Countermeasures**
- Reusable by regrinding outside surface. Reusable by lapping raceway surface. However, if damage is too severe, dispose

### Raceway ring’s cracking

**Probable causes**
- Excessive axial load due to misaligned roll or irregular section height of bearings in one shaft.

**Countermeasures**
- Restraining misaligned roll
- Control of section height of bearings in one shaft

**Countermeasures**
- Dispose
Raceway • roller flaking

**Raceway flaking**

- Rolling fatigue service life, excessive loading, improper lubrication
  - Rolling fatigue service life
  - Excessive loading
  - Improper lubrication

**Roller flaking**

- Review operating conditions
- Review viscosity of oil lubrication
- Dispose

However, in the case of minimal flaking of the inner ring, it’s usable by removing the flaking and setting in an unloading position.

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Rust • scratches

**Rust**

- After use, equipment has been left for a long period without disassembling
- Improper storage condition
- Intrusion of mill water

**Scratches**

- Rubbing during bearing’s disassembling or re-assembling

**Probable causes**

- After use, equipment has been left for a long period without disassembling
- Improper storage condition
- Intrusion of mill water

**Countermeasures**

- Dispose

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Smearing or abrasions

**Roller Smearing**

- Minimal loading
- Improper lubrication
  - Proper loading
  - Review lubricant condition

- Reusable by lapping using oil grinding stone or sandpaper
- In case of severe condition, dispose

**Roller abrasion**

- Bearing misalignment
- Improper lubrication
- Foreign matter jam
  - Maintaining alignment of the bearing
  - Review lubricant condition

- Usable by lapping using oil grinding stone or sandpaper
- In case of severe condition, dispose

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Raceway wear

**Raceway wear**

- Excessive loading
- Improper lubrication

**Fretting**

- Loose fitting between shaft and inner ring

**Probable causes**

- Excessive loading
- Improper lubrication

**Countermeasures**

- Proper loading
- Review lubricant condition
- Usually disposal

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Conclusions

- After use, disassemble and clean as soon as possible
- Perform rust prevention maintenance
- Confirm the seals condition
- Reusable by lapping using oil grinding stone or sandpaper
- In case of severe condition, dispose

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- Maintain alignment of the bearing
- Review lubricant condition
- Usable by lapping using oil grinding stone or sandpaper
- In case of severe condition, dispose
A list of available bearings can be found in the following dimensions table. For any dimensions which are not on the table, please consult JTEKT.

### Bearing dimensions table

<table>
<thead>
<tr>
<th>Boundary dimensions (mm)</th>
<th>Basic load ratings (kN)</th>
<th>Fatigue limit load (kN)</th>
<th>Bearing No.</th>
<th>Design</th>
<th>Bearing section height manufactured (mm)</th>
<th>Mass (kg)</th>
<th>Amount of bearings required per mill</th>
<th>Applicable multi-roll mill type</th>
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Note 1) The numbers in parentheses, show necessary bearing quantities per mill. Differences in numbers in parentheses mean it is necessary to use other bearings as well.
# Bearing dimensions table

A list of available bearings can be found in the following dimensions table. For any dimensions which are not on the table, please consult JTEKT.

## Dimensions mark design

![Dimensions mark design](image)

## Design 8

![Design 8](image)

## Design 9

![Design 9](image)

## Design 10

![Design 10](image)

## Design 11

![Design 11](image)

## Design 12

![Design 12](image)

### Boundary dimensions (mm)

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Note 1) The numbers in parentheses, show necessary bearing quantities per mill. Differences in numbers in parentheses mean it is necessary to use other bearings as well.
Regrinding jig

The outer surfaces of the bearings used on the backing shafts of multi-roll mills should be ground periodically to retain precise bearing performance, thus ensuring the quality of rolled products. JTEKT supplies the jigs that grind bearing’s outside diameter surface with high precision.

Once the bearing is installed into the jig, the jig completely nullifies any clearance on the fitting surface between the jig and bearing and the internal clearance of the bearing, eliminating play in the radial direction. The jig grinds the outside diameter surface while turning the outer ring and retaining the inner ring as stationary, enabling grinding under the same conditions as when in operation. Grinding of the bearings radial run-out can be performed with a high level of accuracy.

**Advantages**

- **The jigs minimize the radial run out of the bearings after regrinding.**

  The outer surfaces of the bearings used on the backing shafts of multi-roll mills should be ground periodically to retain precise bearing performance, thus ensuring the quality of rolled products. JTEKT supplies the jigs that grind bearing’s outside diameter surface with high precision.

- **The jigs improve efficient installation and removal**

  Bearings can be installed on and removed from the jig easily without the need of disassembling the inner ring and outer ring. There is no possibility that rollers will come off.

**Required performance and issues**

- **Improving ease of outer ring regrinding work**

**Overview**

Bearings can be installed on and removed from the jig easily without the need of disassembling the inner ring and outer ring. There is no possibility that rollers will come off.

**Advantages**

- **The jigs minimize the radial run out of the bearings after regrinding.**

- **The jigs improve efficient installation and removal**

  Bearings can be installed on and removed from the jig easily without the need of disassembling the inner ring and outer ring. There is no possibility that rollers will come off.

**Bearing assembly**

Easy installation/ removal

Bearings remain in place

The jigs improve efficient installation and removal

Bearings can be installed on and removed from the jig easily without the need of disassembling the inner ring and outer ring. There is no possibility that rollers will come off.

**Cylindrical grinder for outer ring-regrinding**

JTEKT provides the GE series which is capable of processing both roll grinding and outer ring-regrinding with high accuracy using cylindrical grinders. (TOYODA brand)

Mounting the regrinding jig and bearing assembly to the cylindrical grinder
When the outer surface of a bearing is ground, it is critical to accurately control the variation of bearing's section heights of all the bearings installed on the backing shaft. JTEKT supplies Measurement for bearing section height that suit the individual bearings listed on the dimensional table.
JTEKT established a large size bearing technology development center to evaluate and analyze large size bearing uses in the industrial machinery field.

Until now, with regards to large size bearings used in the industrial machinery field, investment was made in the actual machines before accurate modeling was done resulting in customer dissatisfaction. As a result, development time took too long due to the problems that arose.

Now, we are able to simulate and evaluate production conditions close to the real machines in our large size bearing technology developing center.

The accumulated data for bearing testing equipment for steel production equipment introduced has allowed us to improve the accuracy of CAE analysis (simulation analysis) which gives us a significant reduction for the products developmental period and in the development of new high value-added products for the future.

**Bearing testing equipment for steel production equipment**

Our testing equipment is able to evaluate the scattering rolling mill water under a high temperature environment to recreate close to actual conditions.

In this way, we can deliver bearings and oil seal components with excellent performance.
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Value & Technology