Koyo

Roll neck bearings for rolling mill

JTEKT

JTEKT CORPORATION

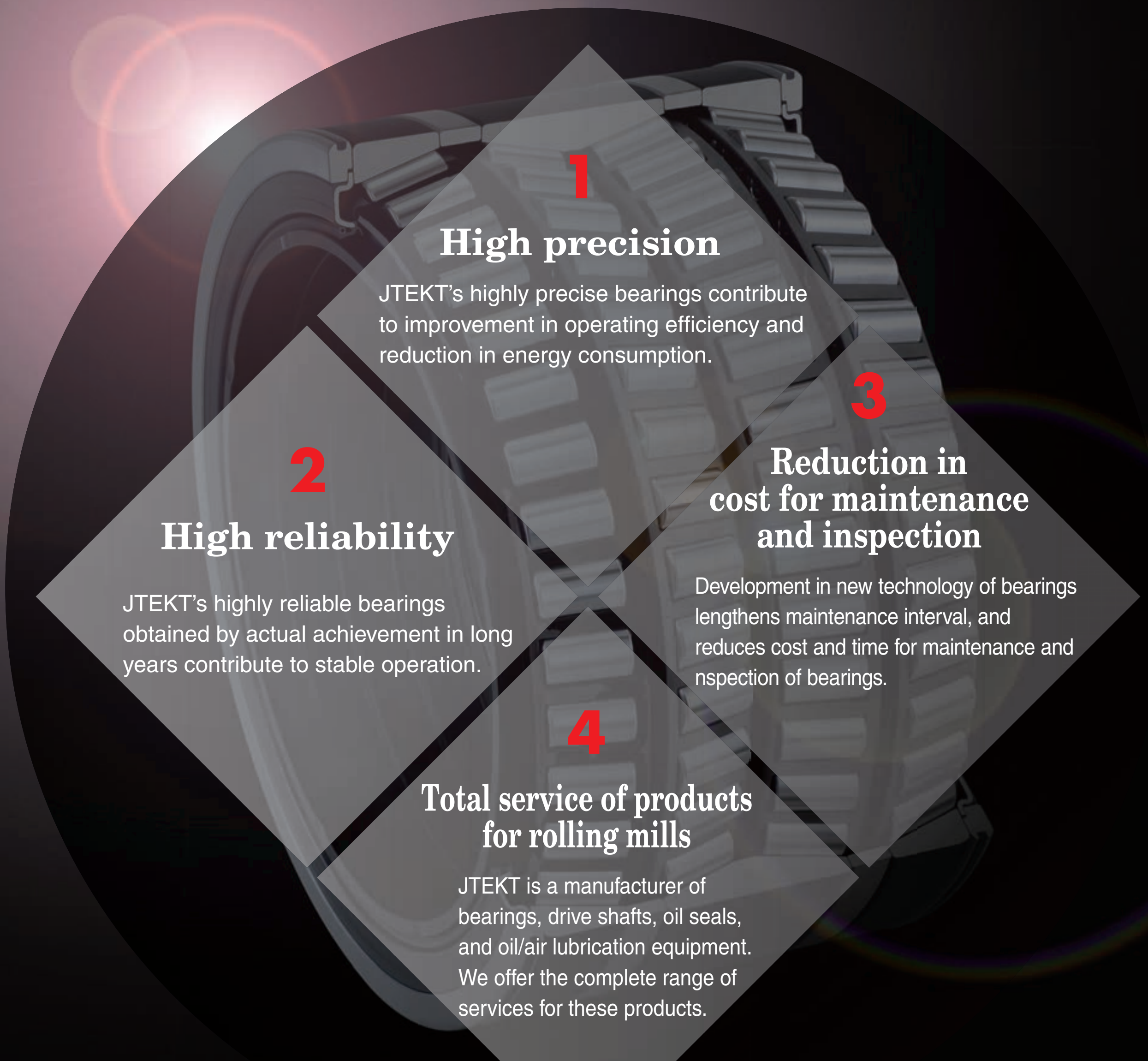
JTEKT Koyo TOYODA

CAT. NO. B2013E-1

Preface

In 1943, JTEKT became the first successful domestic manufacturer of four-row tapered roller bearings for rolling mills in Japan. Since then, we have cultivated advanced technology and technical know-how to serve our customers. To meet with customers' requests, JTEKT strives for development of more highly precise and reliable bearings for rolling mills while using experience and actual achievement for technical development and research.
JTEKT will do a service by customer-oriented "monozukuri" (Japanese way of manufacturing) in the future.

Features of JTEKT products



1 High precision

JTEKT's highly precise bearings contribute to improvement in operating efficiency and reduction in energy consumption.

2 High reliability

JTEKT's highly reliable bearings obtained by actual achievement in long years contribute to stable operation.

3 Reduction in cost for maintenance and inspection

Development in new technology of bearings lengthens maintenance interval, and reduces cost and time for maintenance and nspection of bearings.

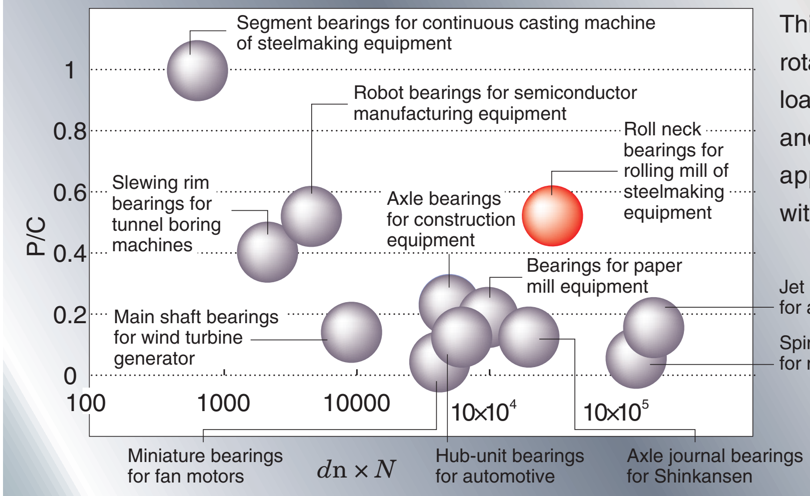
4 Total service of products for rolling mills

JTEKT is a manufacturer of bearings, drive shafts, oil seals, and oil/air lubrication equipment. We offer the complete range of services for these products.

Operating environment of bearings for rolling mill

Bearings in every industry are used under various kinds of severe conditions. For instance, bearings used in automobiles, railway stocks, and aircrafts are required to have ultimate reliability, as due to safety reasons, they are never allowed to fail during operation. While bearings used in machine tool spindles are required to have ultra-high rotational speed performance and high running accuracy. Bearings for rolling mills must withstand heavy loads and high-speed rotations as well as very severe operating environments. In various industries, they are used under severe conditions in every respects.

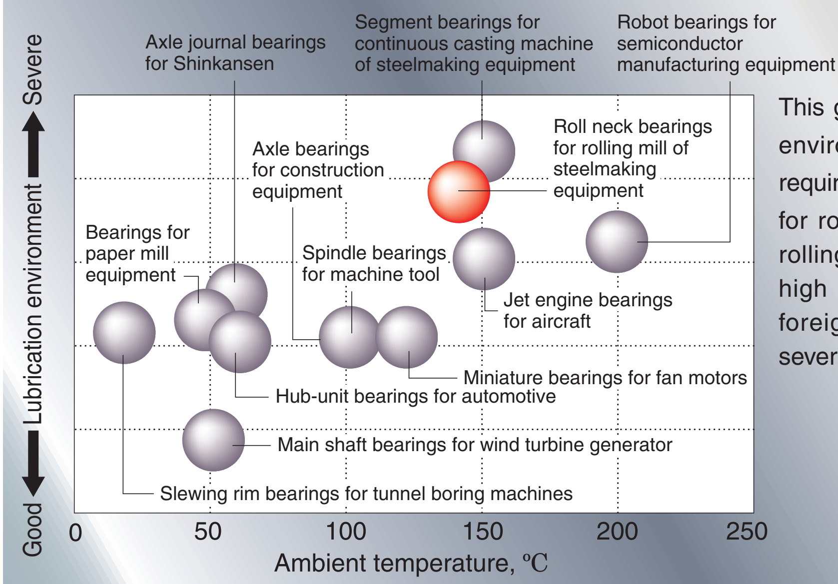
Load and rotational speed of bearings



Bearing load ratings and rotational speeds

This graph of $dn \times N$ (dn : bearing bore dia., N : rotational speed) and P/C (P : dynamic equivalent load, C : basic load rating) shows the bearing load and rotational speed required for various bearing applications. Bearings for rolling mills need to withstand high-speed rotation and heavy load.

Operating environment



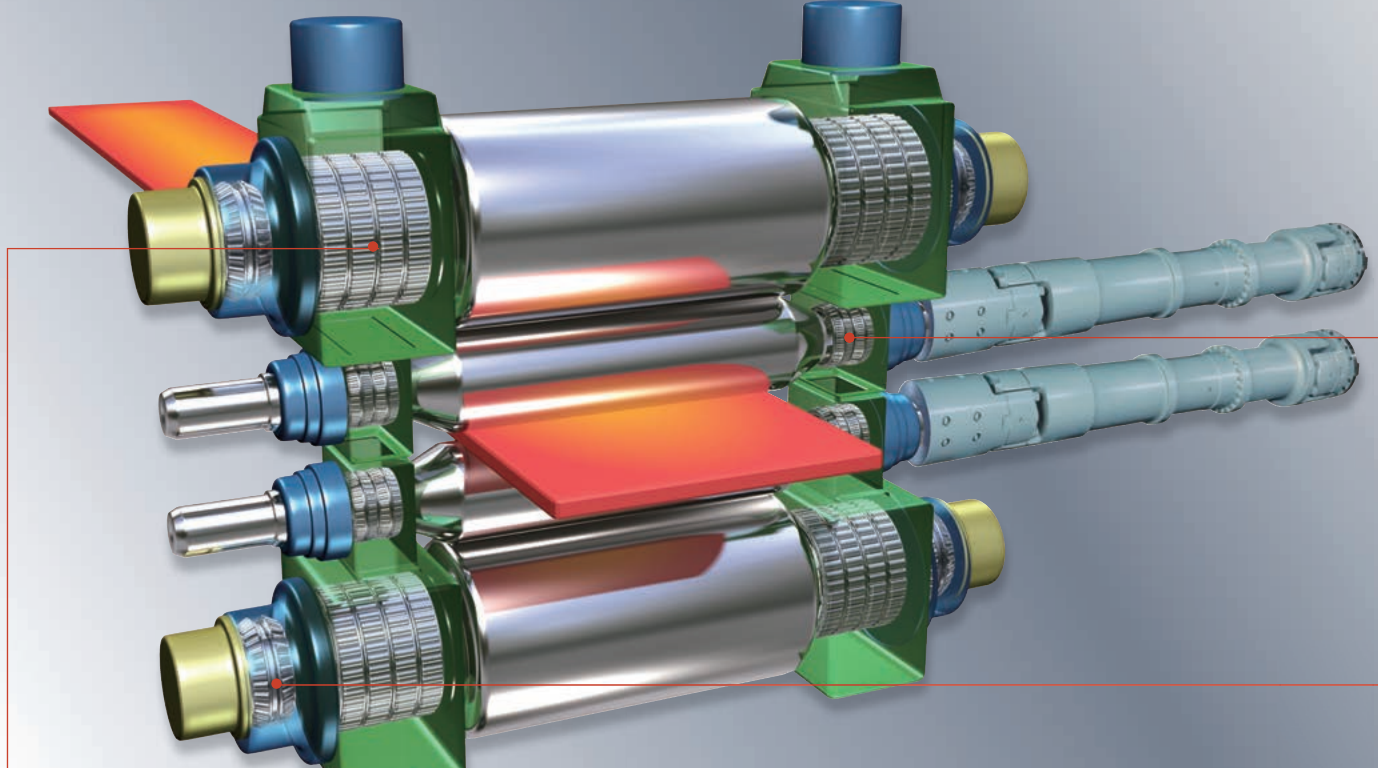
Bearing ambient temperature and lubrication conditions

This graph of ambient temperature and lubrication environment shows the operating environments required for various bearing applications. Bearings for rolling mills, especially in the process of hot rolling, are often used under severe conditions, high temperature and possibility of intrusion of foreign matters. Thus, they must endure these severe conditions.

Roll neck bearings for rolling mill

* For information on bearings not listed here, consult with JTEKT.

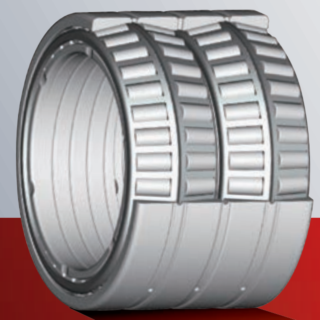
Hot / cold strip mill



Sealed type four-row tapered roller bearings

These bearings are mainly used for the work rolls and intermediate rolls of cold strip mills.

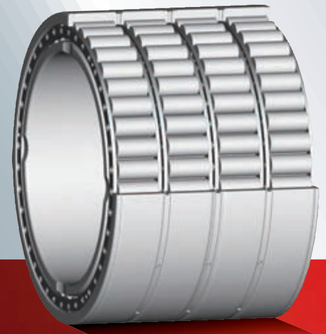
Boundary dimensions (mm) Bore diameter	Outside diameter	Cones overall width	Cups overall width	Basic load ratings (kN) C_r	C_{0r}	Fatigue load limit (kN) C_u	Bearing No.	Mass (kg)
220	295	315	315	1 930	3 910	429	47TS443032	53
240	338	340	340	2 960	5 360	580	47TS483434	88
245	345	310	310	3 150	6 020	631	47TS493531	90
260	370	354	354	3 880	7 410	778	47TS523735	120
279.4	393.7	320	320	3 610	6 900	702	47TS563932	120
280	380	340	340	3 520	6 940	710	47TS563834	106
310	430	350	350	4 110	7 870	777	47TS624335A	146
343.052	457.098	254	254	3 590	7 030	695	47TS694625D	110
482.6	615.95	330.2	330.2	5 660	12 400	1 130	4TRS19D	239
711.2	914.4	420	420	9 870	22 200	1 840	4TRS711L	678



Four-row tapered roller bearing (Open type)

These bearings are mainly used for the work rolls and intermediate rolls of hot strip mills and cold strip mills.

Boundary dimensions (mm) Bore diameter	Outside diameter	Cones overall width	Cups overall width	Basic load ratings (kN) C_r	C_{0r}	Fatigue load limit (kN) C_u	Bearing No.	Mass (kg)
343.052	457.098	254	254	3 560	6 950	680	47T694625	111
400	530	370	370	6 150	12 900	1 200	45D805337	208
482.6	615.95	330.2	330.2	6 540	15 000	1 330	4TR19D	241
509.948	654.924	379	379	7 260	16 700	1 460	4TR510A	316
609.6	787.4	361.95	361.95	8 520	19 900	1 680	EE649241D/310/311D	461
711.2	914.4	317.5	317.5	8 550	18 800	1 580	4TR711	531



Four-row cylindrical roller bearing

These bearings are mainly used for the back-up rolls of cold strip mills.

Boundary dimensions (mm) Bore diameter	Outside diameter	Inner rings overall width	Outer rings overall width	Raceway contact diameter of inner ring	Basic load ratings (kN) C_r	C_{0r}	Fatigue load limit (kN) C_u	Bearing No.	Mass (kg)
690	980	750	750	766	24 100	52 300	4 240	138FC98750	1 830
755	1 070	750	750	837	28 000	60 300	4 740	151FC107750A	2 220
770	1 075	770	770	847	29 000	63 500	4 950	154FC108770A	2 230
820	1 130	800	800	903	29 300	66 900	5 110	164FC113800	2 520
850	1 180	850	850	940	31 800	72 700	5 610	170FC118850	2 910
900	1 220	840	840	989	34 600	83 300	6 240	180FC122840A	2 990

Double-row tapered roller bearing

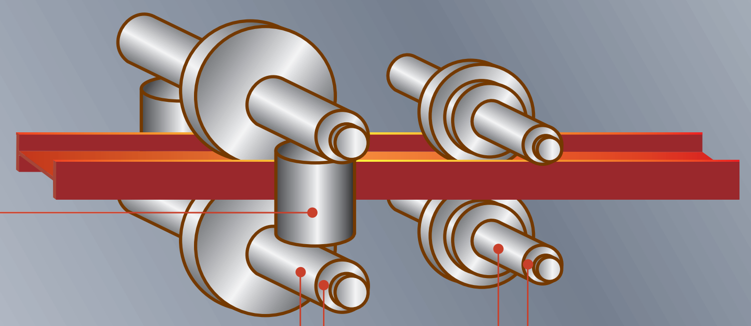
These bearings are mainly used for the roll neck thrust bearings of hot strip mills and cold strip mills.

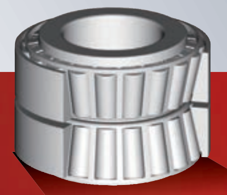
Boundary dimensions (mm) Bore diameter	Outside diameter	Cones width	Cups overall width	Basic load ratings (kN) C_a	C_{0a}	Fatigue load limit (kN) C_u	Bearing No.	Mass (kg)	(Reference) Cup preload (kN)
305	500	200	200	2 220	5 490	533	45T615020	148	3.5
400	650	240	240	4 070	11 000	965	2TR400L	299	6.5
509.998	733.5	200.02	200.02	3 270	9 880	859	2TR510L	263	5.2

Roll neck bearings for rolling mill

* For information on bearings not listed here, consult with JTEKT.

Shaped-steel rolling mill

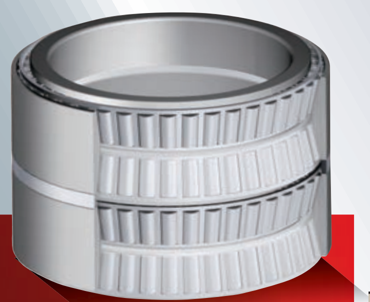




Double-row tapered roller bearing

These bearings are mainly used in the V rolls of shaped-steel rolling mills.

Boundary dimensions (mm) Bore diameter	Outside diameter	Cones overall width	Cups overall width	Basic load ratings (kN) C_r	C_{0r}	Fatigue load limit (kN) C_u	Bearing No.	Mass (kg)
240	440	274	224	4 210	6 850	665	46T484427	180
247.65	406	247.65	203	3 520	6 110	603	46CTR504112A	120
255	500	350	285	6 360	10 300	939	46CTR515018	304
260	480	282	220	4 740	7 670	730	46CTR524814A	210

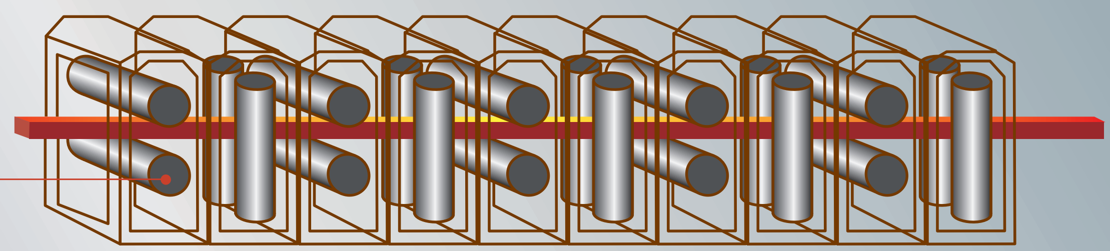


Four-row tapered roller bearing

These bearings are mainly used in the V rolls of shaped-steel rolling mills.

Boundary dimensions (mm) Bore diameter	Outside diameter	Cones overall width	Cups overall width	Basic load ratings (kN) C_r	C_{0r}	Fatigue load limit (kN) C_u	Bearing No.	Mass (kg)
450	595	390	352	6 970	15 600	1 410	48T906039A	289

Rod / wire rod rolling mills

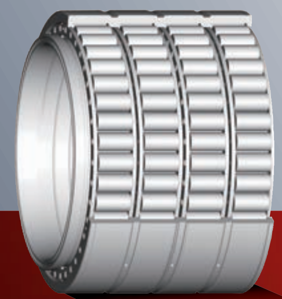


Spherical thrust roller bearing (combination of two single-row bearings)

These bearings are mainly used for the roll neck thrust bearings of shaped-steel rolling mills.

Boundary dimensions (mm) Bore diameter	Outside diameter	Cone width	Cup width	Assembling width	Basic load ratings (kN) C_a	C_{0a}	Fatigue load limit (kN) C_u	Bearing No.	Mass (kg)
180	360	69.5	52	109	2 650	6 890	426	29436B	48
200	340	53.5	41	85	1 940	5 390	328	29340B	30
260	480	83	64	132	4 250	11 900	524	29452B	95

* The values in the above table are those for single-row bearings.



Four-row cylindrical roller bearing

These bearings are mainly used for the roll neck bearings of shaped-steel rolling mills and rod rolling mills.

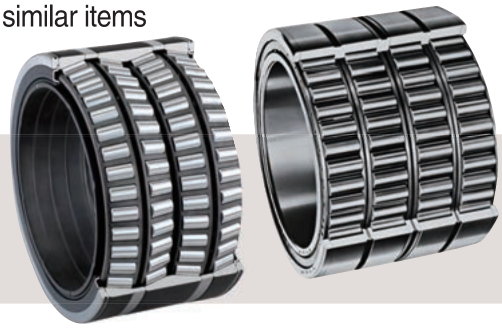
Boundary dimensions (mm) Bore diameter	Outside diameter	Inner rings overall width	Outer rings overall width	Raceway contact diameter of inner ring	Basic load ratings (kN) C_r	C_{0r}	Fatigue load limit (kN) C_u	Bearing No.	Mass (kg)
200	280	200	200	222	1 820	3 090	365	313893-1	38
200	290	192	192	226	1 840	3 030	350	313811	42
220	310	192	192	247	1 910	3 270	369	313837-1	46
240	330	220	220	264	2 300	4 120	462	48FC33220	54
260	370	220	220	292	2 500	4 330	476	313823	76
280	390	240	240	312	3 070	5 620	608	56FC39240	88
300	420	300	300	331	4 280	7 750	805	60FC42300DW	127
300	420	335	300	332	4 700	8 690	896	60FC42300L	134
320	450	240	240	355	3 990	5 730	604	64FC45240	117
340	480	385	350	378	5 990	11 500	1 150	68FC48350N	212
360	500	250	250	394	4 390	7 340	756	72FC50250	145
380	540	400	380	422	7 530	14 300	1 400	76FC54380	288
440	620	485	450	487	9 900	20 000	1 840	88FC62450A	457

Roll neck bearings

These bearings are required to withstand heavy loads and high-speed rotations in severe environments.
At JTEKT, we strive every day to develop bearing materials and technology that minimizes temperature increases and to improve the sealing performance of bearing seals and other similar items in order to meet these needs.

Issues and required performance

- Improvement of durability and service life to withstand heavy loads and high-speed rotations
- Prevention of the intrusion of water and mill scale



Improvement of durability and service life to withstand heavy loads and high-speed rotations

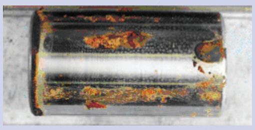
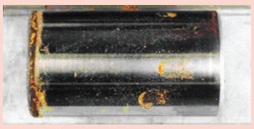
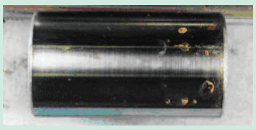
Long-life / high corrosion-resistant carburized steel

JHS520 JTEKT HYPER STRONG

◆ **Standard**
By using our newly developed case-hardening steel in the bearing rings, we have greatly improved the rolling life, toughness, and corrosion resistance compared to our conventional products.

◆ **Premium**
By using our newly developed case-hardening steel and by applying special heat treatment, we have provided the premium specification with further improved rolling fatigue life and corrosion resistance.

Features
1. Long-life and high corrosion-resistant steel with optimized content of chromium and molybdenum
2. Original carbonitriding heat treatment improves corrosion-resistance and wear-resistance qualities.

	Results of evaluations of bearings in an environment prone to rust (filled with water-mixed grease)		Results of evaluations of bearings in clean oil
	Rust resistance comparison	Life (JTEKT bench test)	
Conventional product			
Developed steel, carburized product 1 (JHS520 standard)		Approx. 2.2 x	Approx. 4 x
Developed steel, special heat treated product 1 + 2 (JHS520 premium)		Approx. 3.8 x	Approx. 7 x
Test conditions	Humidity cabinet test conditions Test temperature: 49°C ± 1°C Relative humidity: 95% or more Test period: 96 hours	Sample: Tapered roller bearing Main dimensions: ø50 × ø120 ×30 Lubrication: Grease (water content ratio, 30%)	Test piece form: 20 mm dia., 32 mm length Maximum contact stress: 5 800 MPa Loading cycle frequency: 285 Hz Lubricating oil: Turbine oil (ISO #VG68) Oil supply: 2 L/min (room temperature) * Test was stopped after 50 × 10^7 times.

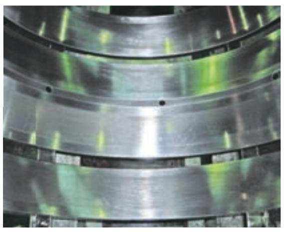
Examples of actual use

Cold strip mill work roll (open type) 1 [JHS520 standard]

Conventional type

Used approximately 4 million tons (under DS)

Approx. 5 x



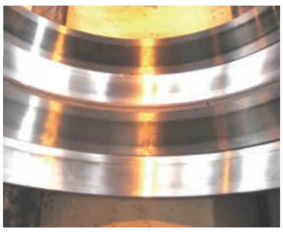
No flaking

Cold strip mill work roll (sealed type) 1 + 2 [JHS520 premium]

Conventional type

Used for approximately 24 months (under OP)

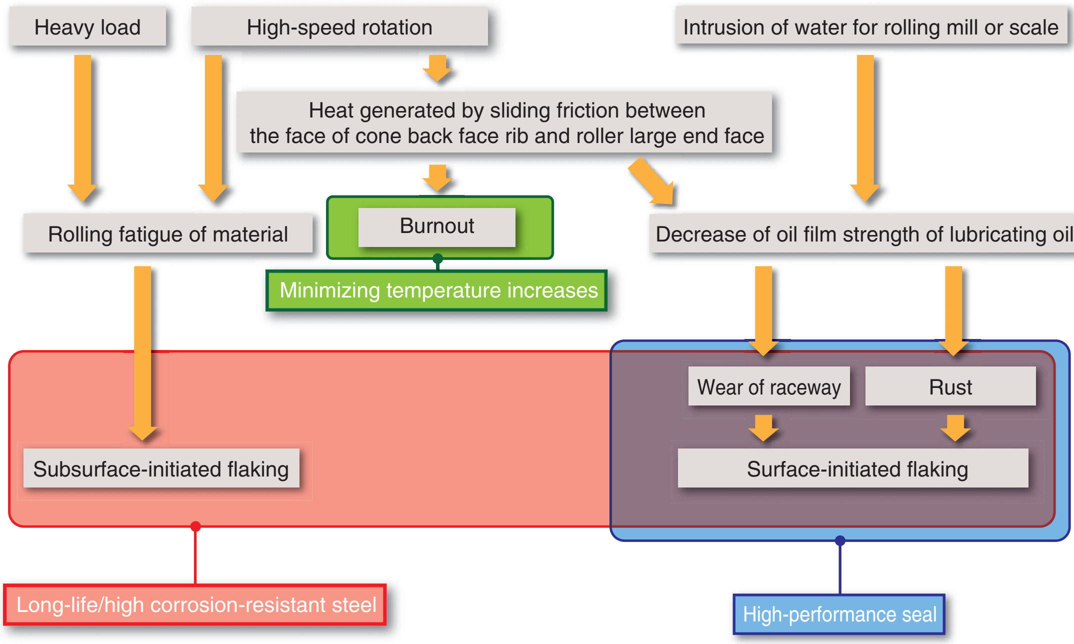
Approx. 4.8 x



Hardly any indication of rust

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 JHS520 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.



Improvement of durability and service life to withstand heavy loads and high-speed rotations

Technology for minimizing temperature increases

Features

- On the basis of the EHL theory, improvement of the lubrication of the rolling part between the roller large end face and the face of cone back face rib
- Optimization of the shapes and suppression of temperature rising for the rolling part between the roller large end face and the face of cone back face rib

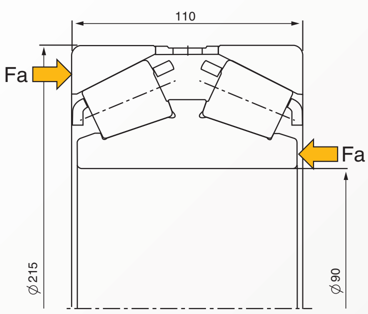
[Failure concerns]

Signs of temperature rise on the roller large end face

Scuffing occurrence on the roller large end face

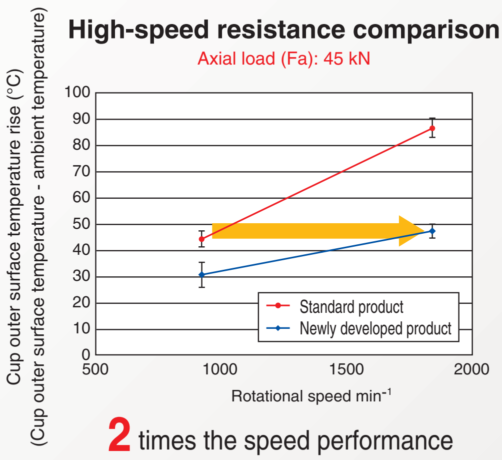
Test bearing

Bearing No.: 45T182211
Main dimensions: ø90 × ø215 ×110 mm
Ca: 228 kN
Lubrication: Grease (Palmax RBG)



High-speed resistance comparison

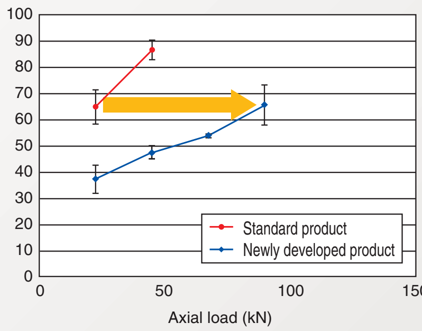
Axial load (Fa): 45 kN



2 times the speed performance (at the same temperature rise)

Load resistance comparison

Rotational speed: 1840 min^{-1}

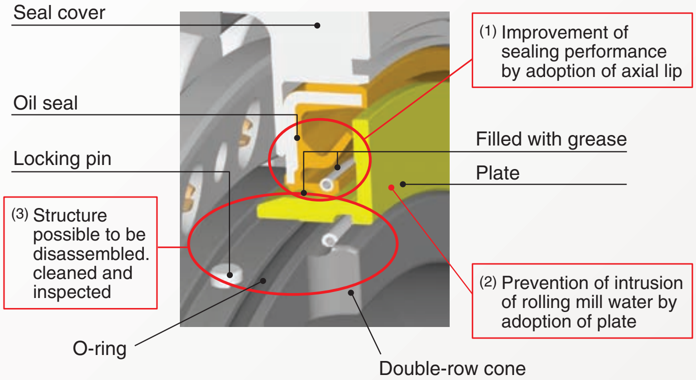


4 times the load performance (at the same temperature rise)

Prevention of the intrusion of water and scale

High-performance seal

JTEKT dramatically extended bearing life by completely preventing the intrusion of rolling mill water and/or scale into the bearing, which is the major cause of failure through the use of enhanced seals. Moreover, maintenance interval has been also lengthened by maintaining high sealing performance. This product was developed by collaboration of JTEKT and Koyo Sealing Techno Co.,Ltd. in JTEKT group.



The tables below show the appearance status and application history of bearing with high-performance seal adopted. Low water content in the grease and little to no rust generation is proof of excellent sealing performance.

	Before cleaning of grease	After cleaning of grease
Cup		
Cone assembly		

Post-use appearance of bearing with high-performance seal

Application	Hot strip mill work roll
Service period	1 486 h (Without any maintenance or re-greasing)
Bearing appearance	Good, no flaking and slight wear
Grease penetration	About 280 (New : 300)
Water content in grease	About 1%

Application history of bearing with high-performance seal

Oil Seal

JTEKT can supply oil seals for various purposes for rolling mills or feeding tables.

Features of Koyo oil seal

1. Lightweight, compact, and energy-saving

· Koyo oil seals offer high sealing performance, while being compact with reduced seal width.

2. High sealing performance by optimum lip design

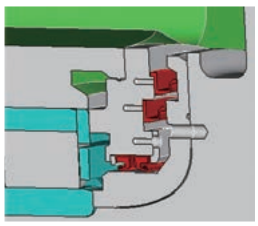
· Koyo oil seals adopt a linear-contact lip, which provides proper radial lip load.

· The lip design ensures excellent sealing performance, low torque, proper flexibility and high allowability for eccentricity.

3. Low heat generation and long service life by highly self-lubricating rubber materials

· These products show limited chemical changes such as hardening, softening, and aging.

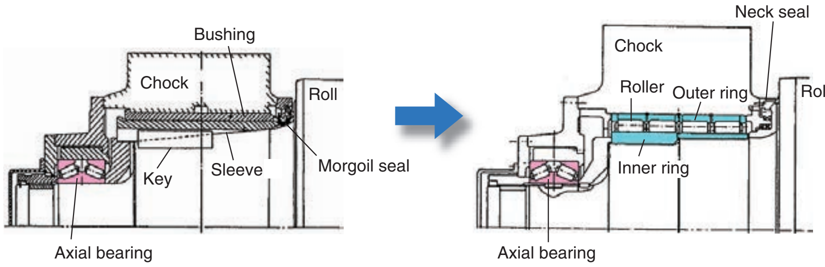
· These materials, having excellent durability, can offer long service life with less heat generation even under high-lip speed.



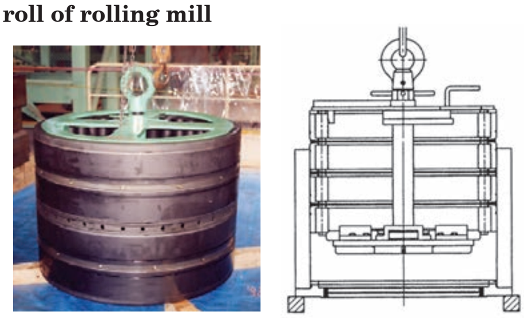
For details of oil seals, see CAT.NO.R2001E.

Replacing oil film bearing with rolling bearing

In 1972, JTEKT adopted four-row cylindrical roller bearings for new cold tandem mill tandem back-up rolls (BUR) at first in Japan. Since then, JTEKT has supplied bearings for BUR to many steel manufacturers all over the world. Since JTEKT carried out the modification design and delivered rolling bearings for the modification of the plate mill by replacing the oil film bearing of the back-up roll with the rolling bearing in 1984, JTEKT has completed about twenty-seven projects (maximum record in Japan) until 2014 and has contributed to offer highly-precise products for rolling mills.



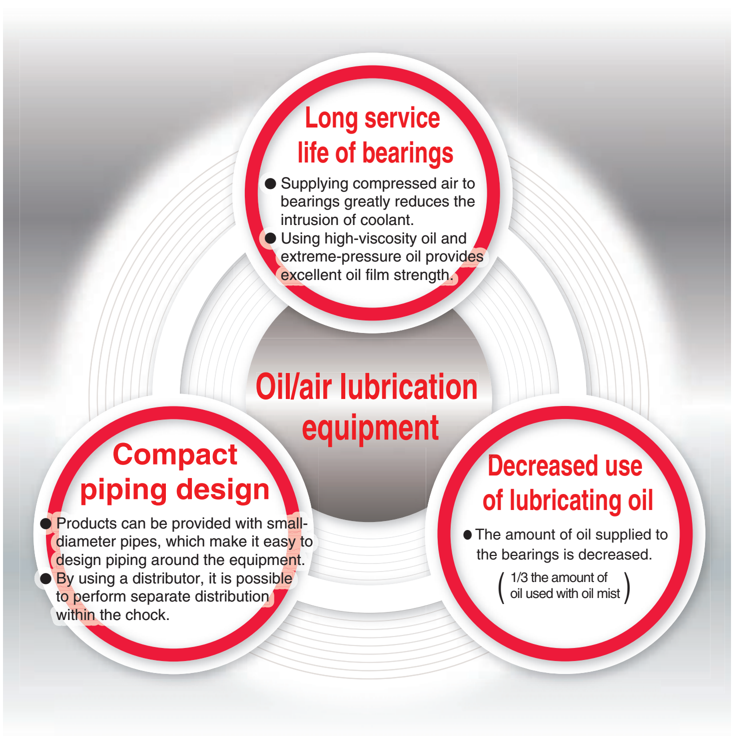
Replacement of oil film bearing with rolling bearing for back-up roll of rolling mill

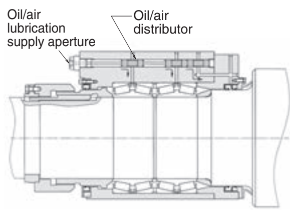


Lifting tool for rolling bearing assembly

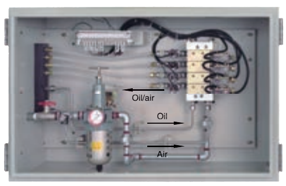
Oil / air lubrication for steelmaking equipment

By improving the lubrication of bearings used in severe environments such as rolling mills and continuous casting machines, JTEKT provides support for these environments.

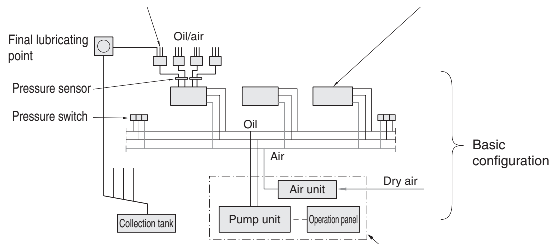




Oil/air distributor



Mixing panel



Lubricated object	Rolling mill roll neck bearing Rolling mill auxiliary roll bearing Continuous casting machine guide roll bearing Feed roll bearing, etc.
Tank capacity	From 250 to 2 000 L
Number of lubricating points	1 000 points or more are available
Alarm unit	Respective sections in main unit End of oil and air piping
Lubricated oil q'ty	$Q = 0.085 \cdot d \cdot R / A$ Q : Lubricated oil q'ty cm³/hour d : Bearing bore diameter mm R : Bearing row number A : Speed coefficient (normally A = 5)

Main unit

Handling bearings

**This section provides an overview of how to overhaul, assemble, and inspect bearings.
We hope this information will be of use to you in maintaining your bearings.**

Precautions before opening the package and installing bearings

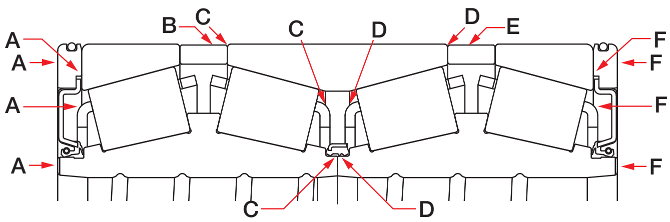
(1) Do not open the bearing packaging or wrapping until right before you install the bearing.
(2) Make the work area where you will install the bearing as clean as possible, and prevent foreign materials such as trash, dust, and iron powder from adhering to the bearing.
(3) When removing a sealed type bearing from its wooden box, exercise sufficient caution to prevent the oil seal attached to the seal cover from being damaged.
(4) Handle the bearing gently and do not subject it to impacts or shocks.
(5) Thoroughly clean the roll neck and the chock to ensure that no trash or other foreign material is affixed to them.
(6) Sufficiently check that the roll neck diameter and chock inner diameter dimensions are within the permissible tolerances or that the chamfer dimensions of the roll neck diameter and chock inner diameter are the prescribed dimensions before beginning work.
(7) For sealed type bearings that have been stored for a long period of time (3 years or longer), we recommend that you replace the grease with new one.

Required tools

Lifting tool	• A tool for lifting the entire bearing assembly • Use this tool when installing the bearing into a chock or when removing the bearing from a chock.
Timber	• Use this tool when putting down the bearing. • This tool can also be used to create a space in which to insert the claws of the lifting tool under the base of the bearing.
Gauge	Use this tool to accurately measure the amount of lubricant to enclose inside a sealed type bearing.
Brass rod	• Use this tool when lightly striking the bearing such as when installing the bearing into a chock or when removing the bearing from a chock. • You can use a plastic hammer or a similar tool as a replacement so long as this tool is soft.

Bearing symbols

In addition to the bearing number, the bearing serial number (combination number) and the row number are also displayed on the bearing.
Assemble the bearing according to these numbers. Mistaking these numbers and assembling the bearing may lead to bearing failure.

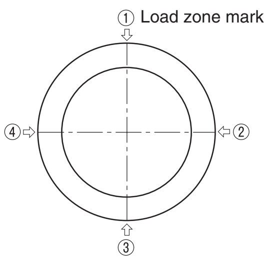


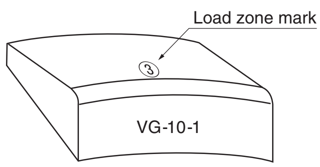
Example VG-10-1
Serial number Row number

Display position	Number displayed (example)
A	VG-10-1
B	VG-10-1~2
C	VG-10-2
D	VG-10-3
E	VG-10-3~4
F	VG-10-4

Serial number and row number display positions

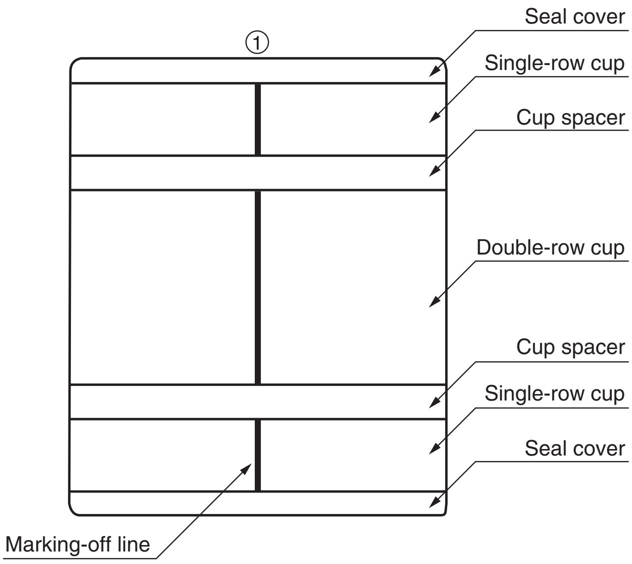
Load zone marks are displayed on the bearing outside surface. If you change the load zone (the cup loading range) each time that you recombine the bearing after overhauling and cleaning it, you will be able to use the bearing for a longer length of time.

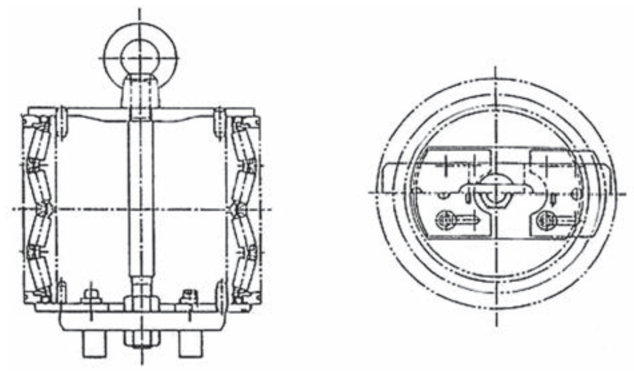




Bearing installation and removal

(1) Open the bearing packaging, and then align the marking-off line displayed on the outside surface of the bearing or the load zone mark with each row.
(2) Check that the oil seal and O-ring are in the correct states.
(3) Fix the bearing in place with a bearing lifting tool like that shown in the figure on the right.
For sealed type bearings, we recommend that you use a lifting tool that makes it easy to install the bearing into a chock.
(4) Apply grease to the bore surface of the chock to enable smooth installation of the bearing.
(5) Check the load zone (first, align load zone No.① [see the figure on the right] with the top of the loading range), and then use the lifting tool and wires along with a hoist or a similar tool to install the bearing into the chock. If the bearing is slanted and can no longer move during the installation, lightly strike the bearing with a brass rod or a similar tool to correct the bearing's orientation. In this situation, be careful to prevent the oil seal from being damaged.
(6) Confirm that the bearing has been installed in the prescribed position, and then remove the lifting tool.
(7) Attach the chock cover to the chock in the same manner as conventional method.
(8) Before mounting the chock, in which the bearing has been installed, into the roll neck, apply a sufficient amount of grease (or a similar lubricant) with molybdenum disulfide to the cone bore and roll neck surfaces.
(9) To remove the bearing, attach the lifting tool to the bearing, and then pull the bearing out from the chock.

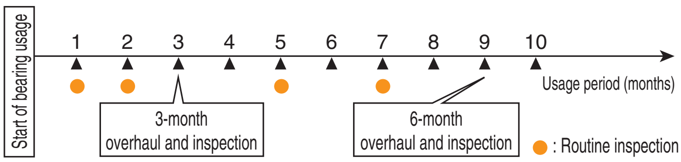




Bearing lifting tool

Bearing overhaul and inspection interval

For sealed type bearings, the operating environment varies depending on the type of the rolling mill used and on the stand. It is not possible to determine a uniform interval for the overhaul and inspection (overhaul → cleaning → assembly) of the bearing.
Therefore, in order to determine the period of continuous use, it is necessary to inspect the internal status of the bearing by first setting a short overhaul and inspection interval, and then gradually increasing this interval.
Routine inspections are also necessary.
Gradually increase the usage period by changing the overhaul and inspection interval to 3 months and then to 6 months.
After the 6-month overhaul and inspection interval, determine the period of continuous use while observing the status of the bearing.



Routine inspection

Until the period of continuous use of the bearing is determined, inspect the inside of the bearing by removing the chock cover and just the seal cover and the first row of the cup. Perform this routine inspection between the overhaul and inspection operations. If there are no problems, reassemble the bearing and continue operations. If you find a failure, perform an overhaul and inspection.

Cleaning the bearing

The main points when cleaning the bearing during an overhaul and inspection are shown below.
(1) Before washing the bearing, use your hands or a spatula to remove as much of the grease that has affixed to the bearing as possible.
(2) Separate the washing into two steps: rough washing and finishing washing.

Handling bearings

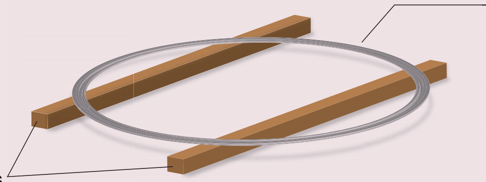
This section provides an overview of how to overhaul, assemble, and inspect bearings.
We hope this information will be of use to you in maintaining your bearings.

Bearing assembly (1)

This section provides the procedure to follow to assemble the bearing after overhauling and cleaning it.

(1) Use an air blower to dry off the washing oil that has affixed to the bearing, and then wipe down the bearing with a rag or similar object.

(2) Place the 4th-row seal cover onto two timbers.



(3) Attach the prescribed O-ring to the outside groove of the seal cover.

(4) Place the 4th-row single cup onto the 4th-row seal cover.

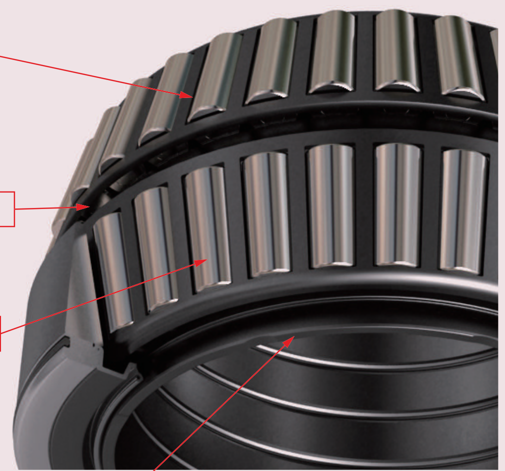
(5) Apply bearing sealing grease to the oil seal lip embedded in the seal cover. (For the brand of the grease, see the provided figure.)

(6) Apply a light layer of bearing sealing grease to the raceway surface of the 4th-row single cup.

(7) Apply approximately 1/3 of the grease for the entire bearing in the space between rollers, the cage, the cone raceway and rib of the cone assembly of the 3rd and 4th rows.
Apply the grease while rotating the rollers and the cage.

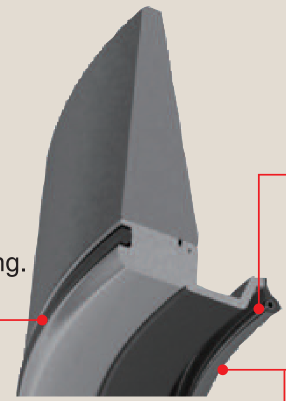
(8) Orient the part so that the 4th row is on the bottom, and then place the cone assembly on top of the 4th-row single cup. In this situation, be careful to prevent the oil seal lip attached to the seal cover from being damaged while you assemble the parts.

(9) Place the 3rd to 4th-row cup spacer on top of the 4th-row single cup. The cup spacer does not have a top or bottom.

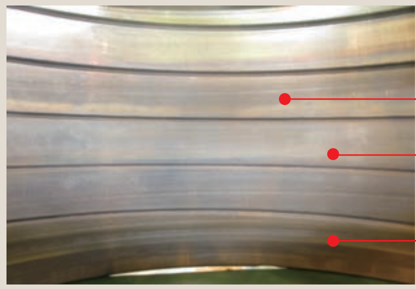


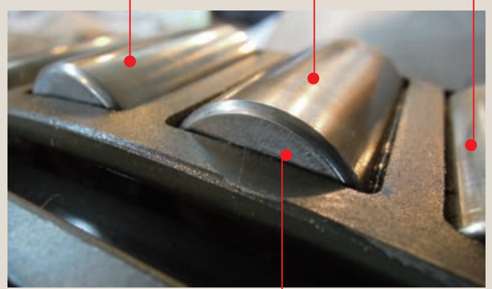
Key points for inspecting parts (1)

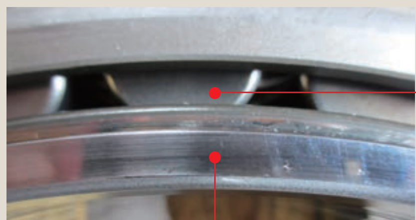
Oil seal, O-ring



Cone, rollers







Handling bearings

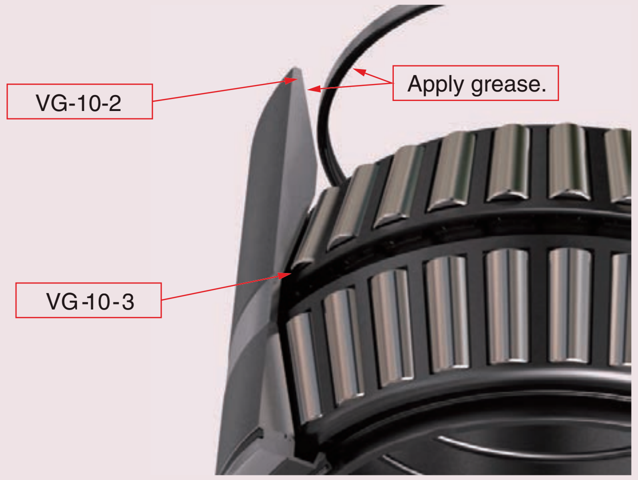
This section provides an overview of how to overhaul, assemble, and inspect bearings.
We hope this information will be of use to you in maintaining your bearings.

Bearing assembly (2)

(10) Apply a light layer of grease to the raceway of the double cup in the 2nd- and 3rd-row.

(11) Orient the part so that the 3rd row of the double cup is on the bottom, and then place this on the cone assembly. Ensure that the load zone marks of the double cup and of the single cup in the 4th-row are aligned.

(12) Attach the oil seal between the cones. Apply bearing sealing grease to the oil seal before attaching it.



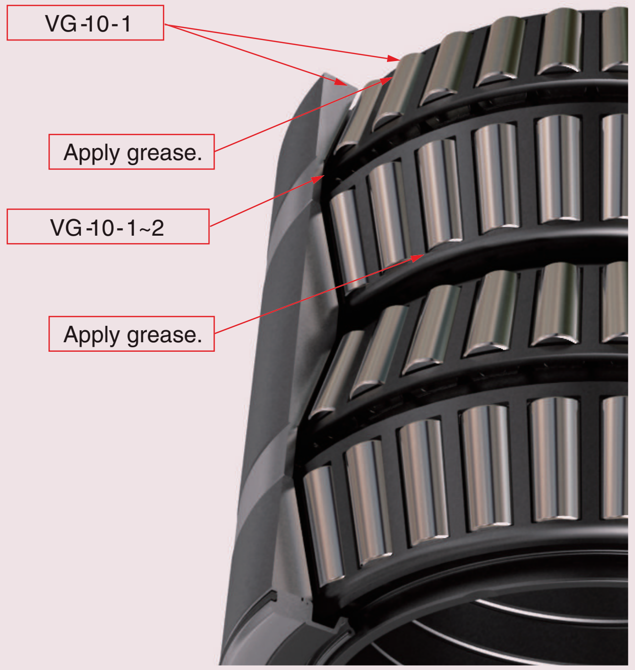
(13) In the same manner as the cone assembly of the 3rd and 4th rows, apply approximately 1/3 of the grease for the entire bearing in the space between rollers, the cage, the cone raceway and rib of the cone assembly of the 1st and 2nd rows. Apply the grease while rotating the rollers and the cage.

(14) Orient the part so that the 2nd row is on the bottom, and then place it on top of the other cone assemblies. Check that the cones are stacked so that there is no space between them.

(15) Place the 1st to 2nd-row cup spacer on top of the assembled parts on the side of the 2nd-row single cup. The cup spacer does not have a top or bottom.

(16) Apply a light layer of grease to the raceway of the single cup in the 1st-row.

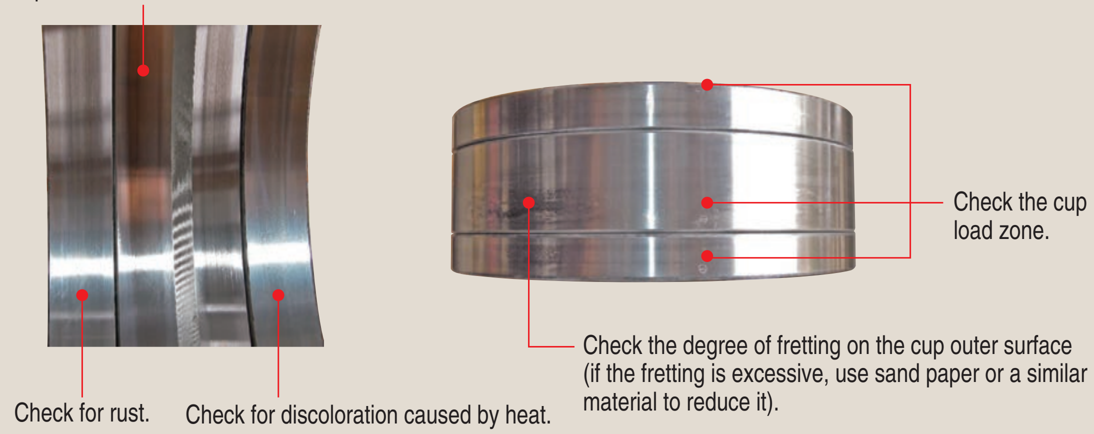
(17) Place the 1st-row single cup on top of the 1st to 2nd-row cup spacer. Ensure that the outside surface load zone mark is aligned with the same position of the three other rows.



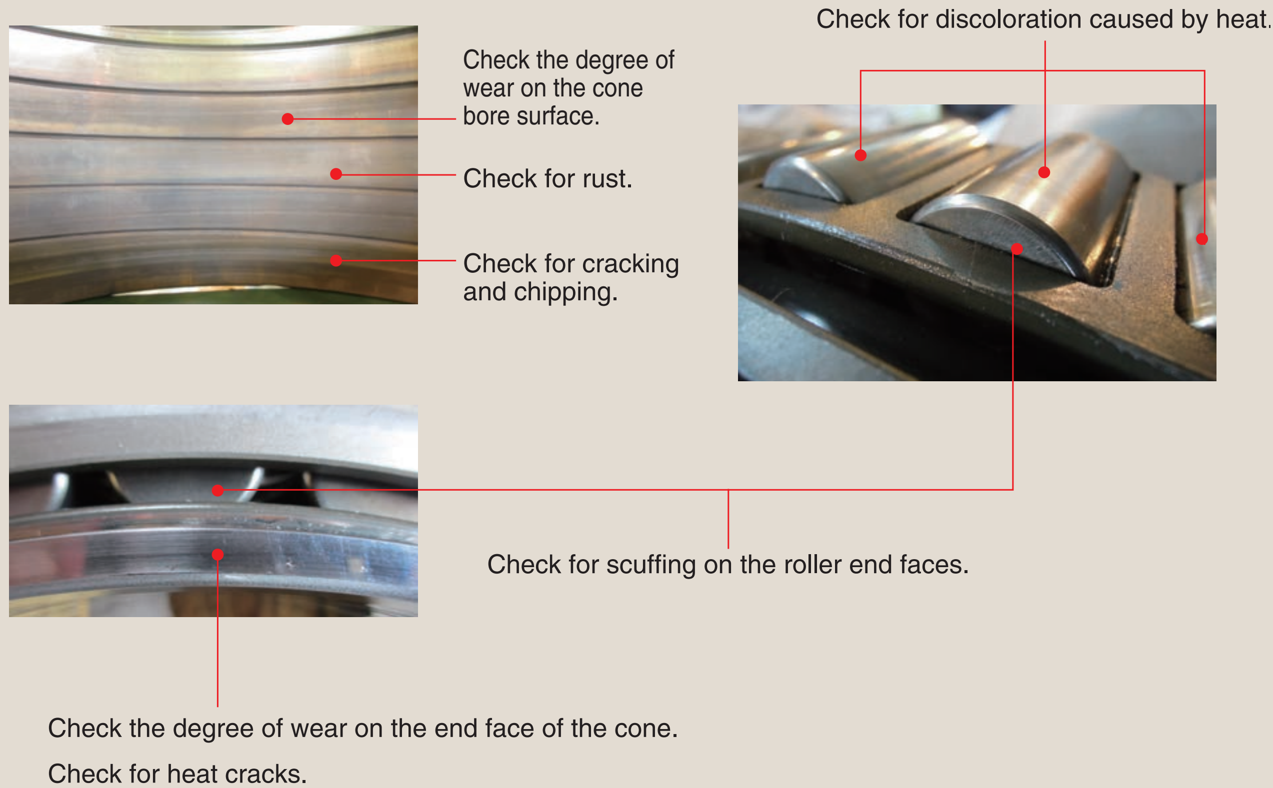
Key points for inspecting parts (2)

Cup

Check whether the roller path on the cup raceway surface is at an angle and whether there is a major difference between this path and that of other rows.



Cone, rollers



Handling bearings

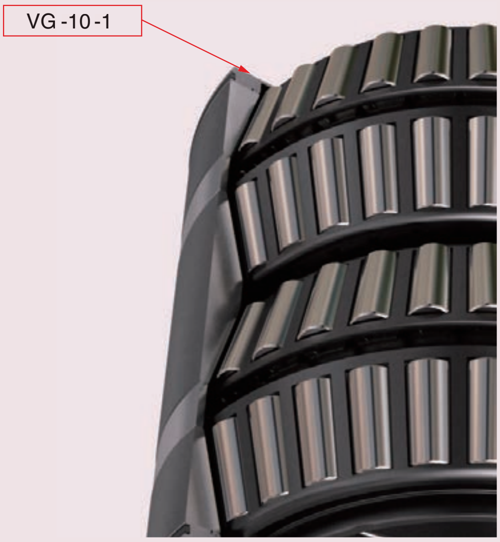
This section provides an overview of how to overhaul, assemble, and inspect bearings. We hope this information will be of use to you in maintaining your bearings.

Bearing assembly (3)

(18) Apply grease to the oil seal lip embedded in the seal cover of the 1st row.

(19) Attach the 1st-row seal cover onto the top of the 1st-row single cup.

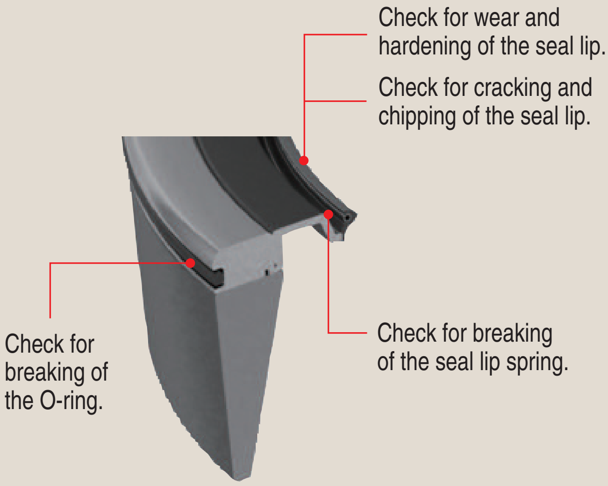
(20) Attach the prescribed O-ring to the outside groove of the 1st-row seal cover.



(21) To overhaul the bearing, perform this procedure in the reverse order.

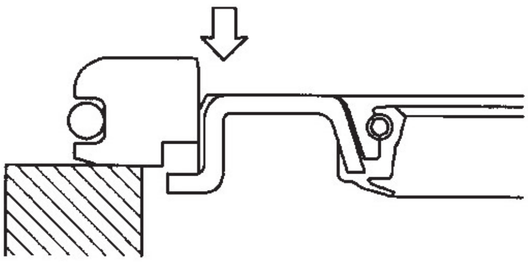
Key points for inspecting parts (3)

Oil seal, O-ring

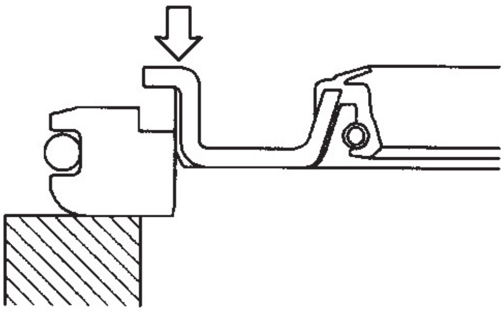


Attaching and removing the oil seal

(1) To remove the oil seal, strike the side of the oil seal with a hammer or a similar tool.



(2) To attach a new oil seal, apply grease to the outside surface of the oil seal, and then use a support ring or a similar tool to evenly push the oil seal into the seal cover.
Exercise caution when handling the oil seal at this time, as striking it with too much force may lead to deformations.



Bearing failures, causes and countermeasures

Failures	Characteristics

1 Flaking

Flaking caused by excessive axial load

(Cones of four-row tapered roller bearing)

Damages
Flaking on bearing raceway surface generated on only rows receiving axial load

Causes
1) Crossed work rolls causing excessive axial load
- Roll neck diameter is smaller than the standard one.
- Chock side liner is worn.
- Inaccuracy of mill stand.
- Rigidity of the chock is poor.
- Corrosion on liner or clearance generated between the liner and the chock.
- Failure of the keeper plate.

Countermeasures
1) Keep the correct locations of the chock and work roll.

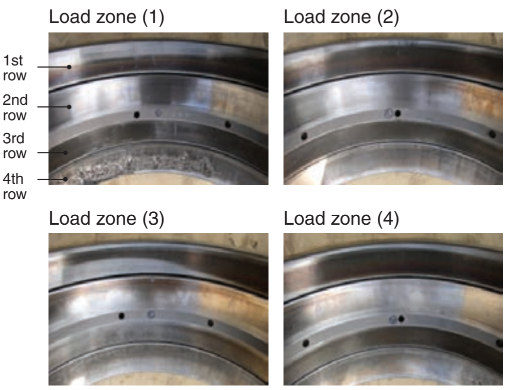
(Cup raceway of four-row tapered roller bearing)

Damages
Flaking generated and developed from raceway end face

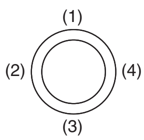
Causes
1) Looseness of chock cover/excessive axial clearance.
(As the axial clearance is increased, the loading range becomes narrower, partial load acts, and edge load is generated on the cup raceway.)
2) Excessive axial clearance is generated because of the mixed use of other bearing spacer or cup.

Countermeasures
1) Adjust shims, select thickness of shims, measure a gap, and tighten bolts correctly.
2) Use parts of the same number.

Flaking caused by improper mounting



(Cup raceway of four-row tapered roller bearing)



Damages
Flaking on raceway surface with slanted contact

Causes
1) It occurs when the chock is fixed inappropriately and slantingly.
- Failure of keeper plate
  Removal, looseness, damage, deformation, bend, unequal tightening, unequal wear, improper parallelism.
- Damaged, deformed, or bent chock flange.

Countermeasures
1) Find the cause of damage by periodic inspection of the chock and stand.

Bearing failures, causes and countermeasures

Failures	Characteristics

1 Flaking

Flaking at corroded start point

(Cup raceway of four-row tapered roller bearing)

Damages

Flaking on raceway surface started from corroded (rusted) portion

Causes

1) After the bearing was used, it has been left for a long period with moisture mixed in grease.
2) Improper rust preventive treatment after the bearing was washed.
3) Worn or damaged seal lips.
4) Corrosion on the raceway is generated due to the clearance between the roll neck and the sleeve, and flaking occurs with rust.

Countermeasures

1) Improve seal maintenance and sealing method. Periodically check for wear or damage on the seal lips.
2) Fit the "O" ring between the roll neck and the sleeve.
3) Immediately after the bearing is removed from the chock, change grease.
4) After washing the bearing, remove kerosene and water completely.

Flaking on nicks (scratch) start point

(Rolling contact surface of four-row cylindrical roller bearing)

Damages

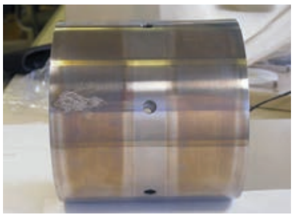
Flaking on rolling contact surface with nicks start point

Causes

1) Inappropriate handling
   · Mounting / dismounting bearing to / from chock.
   · Replacing roll.

Countermeasures

1) Proper handling jig (use of a copper hammer).
2) Prevention of impact load when replacing roll (use of soft material).
3) Improvement in mounting method.
4) Change in raceway chamfering.



(Inner ring raceway of double-row cylindrical roller bearing)

Damages

Flaking on raceway surface

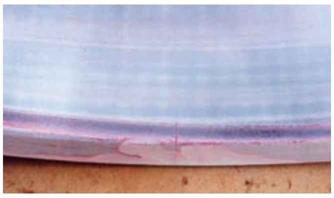
Causes

1) Low viscosity oil lubrication (improper lubrication).
2) Ingress of dusts and foreign matters.

Countermeasures

1) Improvement in viscosity of oil and oil type.
2) Improvement in seal maintenance and sealing method. Periodic check of wear or damage of seal lip.
3) Check of oil filter.

2 Cracking Chipping



(Cone side face of four-row tapered roller bearing)

Damages

Minute crack on cone side face

Causes

1) Fix the cone and the roll with a fillet ring (thrust collar).
2) Clearance between the fillet ring (thrust collar) and the cone is excessively small.
3) Area of the side face of nut/slinger contacting the cone side face is too small, the side face is worn due to cone creep, causing heat.

Countermeasures

1) Keep the clearance between the cone and the fillet ring (thrust collar) (from 0.5 mm to 1.5 mm).
2) Keep the area of the side of fillet ring (thrust collar) (to reduce pressure on the side face).
3) Apply and supply grease of adequate amount.

Failures	Characteristics

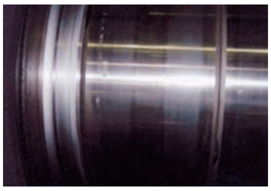
2 Cracking Chipping

(Rolling contact surface of four-row cylindrical roller bearing)

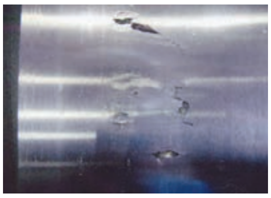
Damages Cracking on rolling elements

Causes
1) Application of load greater than bearing load rating (Load resistance of roller by use of pin type cage)
2) Secondary factor in case of damaged pin of cage (For a reversible mill, pins are broken due to fatigue caused by rapid acceleration and deceleration)
3) Other factors
   · Ingress of water due to faulty sealing.
   · Increase of axial clearance of bearing, causing application of partial and excessive load.

Countermeasures
1) Optimal design of bearing considering load and operating conditions (Examination of optimal cage type)
2) Reviewing sealing method and design of strength of cover.



(Inner ring raceway of four-row cylindrical roller bearing)

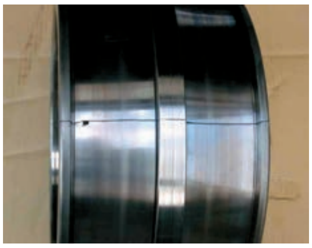


(Inner ring raceway of four-row cylindrical roller bearing)

Damages Grinding burn or crack on inner ring raceway surface

Causes
1) After fitting an inner ring into the roll neck, grinding burn occurs during grinding with the inner ring and the roll.
2) Crack occurs because rollers rolling on the raceway surface of which strength (hardness) is decreased due to grinding burn.

Countermeasures
1) Reviewing grinding conditions
   Grain size of grinding stone, grinding stone cutting amount, cutting pressure, grinding fluid amount, etc.



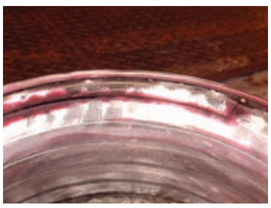
(Inner ring of spherical roller bearing)

(Fractured section of inner ring)

Damages Axial crack occurs on bore surface of inner ring and raceway surface.

Causes
1) Excessive interference between inner ring and shaft.
2) Great fit stress due to excessive difference in temperature of inner ring and that of shaft.

Countermeasures
1) Appropriate fit conditions of inner ring and shaft.
2) Appropriate difference in temperature by checking load, rotation, and temperature conditions. (appropriate fit)



(Cone bore surface of four-row tapered roller bearing)

Damages Circumferential crack occurs on bore surface and raceway surface of cone.

Causes
1) Step wear occurs on the shaft (roll neck), and the cone overrides the shaft, causing great bore surface stress.

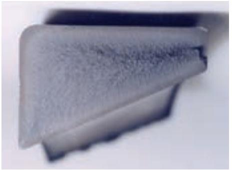
Countermeasures
1) Provide circumferential groove for the roll neck.
2) When using a bearing with different chamfers for a roll, make the chamfers identical.

Bearing failures, causes and countermeasures

Failures	Characteristics

2 Cracking Chipping


(Cup raceway of double-row tapered roller bearing)


(Fractured section of cup)

Damages
Axial crack occurs on outside surface and raceway surface of cup.

Causes
1) Excessive axial load.
2) Axial clearance between the bearing and roll is great, and excessive axial load is applied.

Countermeasures
1) Check for axial load.
2) Check the wear condition of counterpart components.
3) Reviewing thickness of the cup


(Shaft race raceway of spherical thrust roller bearing)

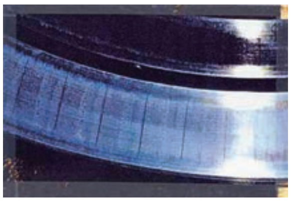

(Assembly of spherical thrust roller bearing)

Damages
Crack occurs on shaft race back face rib.

Causes
1) Excessive axial load.
2) Low holding shoulder diameter on the shaft race back face rib.

Countermeasures
1) Reviewing operating conditions.
2) Reviewing dimensions of counterpart collar. (Dimensions allowing backup of shaft race back face rib)

3 Brinelling Nicks


(Double cup raceway surface of four-row tapered roller bearing)


(Rolling contact surface of four-row cylindrical roller bearing)

Damages
1) Brinelling (Nicks) on raceway and rolling contact surfaces (scratch).
2) Brinelling on raceway surface at the same interval as rolling element spacing.

Causes
1) Nicks occur on the raceway and rollers because of improper handling.
 · Mounting / dismounting bearing to / from chock
 · Replacing roll
2) Great bending load is applied to the roll neck. (Especially, when faulty rolling occurs)

Countermeasures
1) Proper handling jig (use of a copper hammer).
2) Application of grease to raceway surface of inner and outer rings (cones and cups). (Apply oil if the bearing is the oil lubricated type)
3) Prevention of impact load when replacing roll. (Use of soft material)
4) Roll bending compared to bearing static load rating.
5) Improvement in mounting method.
6) Check for excessive load on the slant chamfer of the raceway surface.

4 Scratch Scuffing


(Roller end face of double-row cylindrical roller bearing)


(Outer ring rib of double-row cylindrical roller bearing)


(Roller large end face of double-row tapered roller bearing)

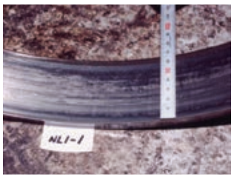
Damages
Scuffing on roller end face, rib of the raceway

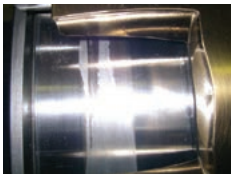
Causes
1) Improper lubrication, ingress of foreign matters.
2) Abnormal axial load caused by improper mounting or control of bearing overall thickness.
3) Excessive axial load.
4) Excessive preload.

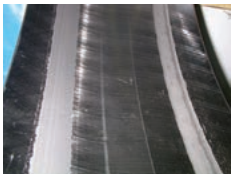
Countermeasures
1) Selection of appropriate oil type and supply of adequate lubricant.
2) Reviewing bearing mounting location.
3) Reviewing bearing overall thickness control.
4) Reviewing operating conditions.
5) Checking preload.

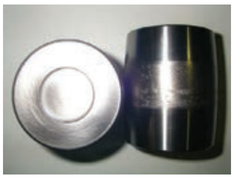
Failures	Characteristics

5 Smearing


(Cup raceway surface of four-row tapered roller bearing)


(Outer ring raceway surface of spherical roller bearing)


(Outer ring raceway surface of spherical roller bearing)


(Rolling element surface of spherical roller bearing)

Damages

Smearing on raceway or rolling contact surface

Causes

1) Improper lubrication
2) Slip of rolling elements (high speed, light load)
3) Ingress of foreign matters during maintenance

Countermeasures

1) Selection of appropriate oil type and supply of adequate lubricant
2) Setup of appropriate preload
3) Prevention of ingress of foreign matters

6 Rust Corrosion

Corrosion


(Cup of four-row tapered roller bearing)


(Cup of four-row tapered roller bearing)

Damages

Rust, corrosion on the raceway surface at the same interval as rolling element spacing

Causes

1) Worn or damaged seal lips
2) Ingress of water or corrosive materials into clearance between roll neck and sleeve

Countermeasures

1) Improve seal maintenance and sealing method. Periodically check for wear or damage on the seal lips.
2) Fit the "O" ring between the roll neck and the sleeve.

Rust


(Cup of four-row tapered roller bearing)

Damages

Rust on partial or entire surface of bearing

Causes

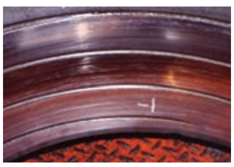
1) After the bearing was used, it has been left for a long period with moisture mixed in grease.
2) Improper rust preventive treatment after the bearing was washed.

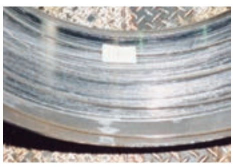
Countermeasures

1) Immediately after the bearing is removed from the chock, change grease.
2) After washing the bearing, remove kerosene and water completely.

7 Creeping


(Scuffing on rolling mill roll neck)




(Cone bore surface of four-row tapered roller bearing)

Damages

Wear, discoloration, and scuffing due to slip of fitting surface

Causes

1) Insufficient grease or oil between the cone bore surface and the roll neck outside surface
(When creep occurs between the cone and the roll neck, because of loose fit of them.)

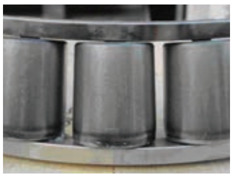
Countermeasures

1) Provide the spiral groove for bore surface of cone
2) When mounting the bearing, apply grease with molybdenum disulfide or EP grease. (Apply oil if the bearing is the oil lubricated type)

Bearing failures, causes and countermeasures

Failures	Characteristics

8 Seizure


(Rolling contact surface of double-row tapered roller bearing)


(Roller large end face of double-row tapered roller bearing)

(Cone of double-row tapered roller bearing)

Damages
Discoloration, deformation, and melting caused by heating in bearing

Causes
1) Improper lubrication (insufficient or degraded lubricant)
2) Ingress of water due to faulty sealing
3) Excessive axial load
4) Heat generated by creep of cone
5) Ingress of dusts or foreign matters
6) Excessively small bearing internal clearance

Countermeasures
1) Reviewing sealing type and conditions
2) Reviewing lubricating method and lubricant, and checking lubricated condition
3) Check for axial load
4) Reviewing bearing (type, size, etc.)
5) Reviewing clearance
6) Confirming operating conditions

9 Failure in lubrication


(Cone assembly of four-row tapered roller bearing)

Damages
Grease including large quantity of water mixed in

Causes
1) Operated at high temperature ⇒ Grease is carbonized.
2) Ingress of water due to improper sealing or wear or damage of seal lip (In this example, 20% or more of water is mixed in grease.)

Countermeasures
1) Find the cause of high temperature.
(If the temperature cannot be lowered, review the possibility of change to high temperature grease.)
2) Checking wear or damage of seal lip. Find the cause of and countermeasure against the improper sealing.


(Cone assembly of double-row tapered roller bearing)


(Cup of double-row tapered roller bearing)

Damages
Foreign matter attachment and corrosion occur because of ingress of a great deal of foreign matters (scale and water for rolling).

Causes
1) Ingress of water due to improper sealing or wear or damage of seal lip

Countermeasures
1) Checking wear or damage of seal lip. Find the cause of and countermeasure against the improper sealing.


(Four-row tapered roller bearing)

Damages
Seizure and adhesion of raceway, roller, and cage

Causes
1) Varied factors including improper lubrication, improper operation, and ingress of foreign matters occur, causing damages.

Countermeasures
1) Checking improper operation
2) Checking lubricating conditions
3) Checking degradation of peripheral parts


(Outer ring assembly of four-row cylindrical roller bearing)


(Outer ring assembly of four-row cylindrical roller bearing)

Damages
Looseness and breaking of pin

Causes
1) Abnormal load due to vibration occurs.
2) End of cage's service life because of use for a long period

Countermeasures
1) Checking abnormal vibration
2) Replace if it has been used for a long period.

[Reference]

Repair to portion flaking occurred

1. **Remove the edges of the portion flaking occurred (with a polishing grinder).**

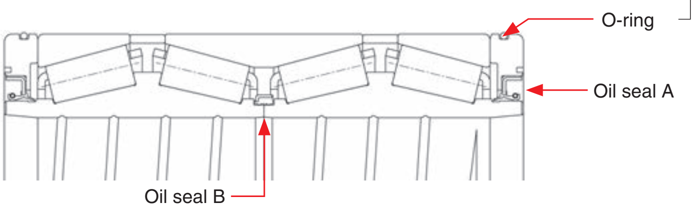
2. **Finish of the surface of the portion flaking occurred.**

3. **Finish the surface by lapping the modified portion.**

Modification may not be able to be done depending on the status of the portion flaking occurred. Consult with JTEKT.

Particular cases and damages for sealed type bearing

Checking oil seals and O-rings



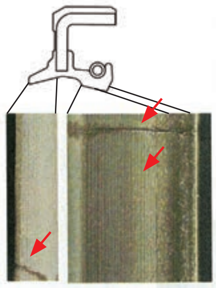
Cut, tearing, and permanent set of O-ring for seal cover

Remedy Replace with new O-rings.

Hardening of oil seal A

Remedy Replacement is recommended.

Crack, blister of oil seal A

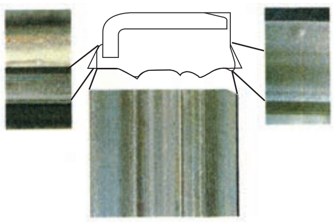


Remedy
1. Replace the oil seal. (The figure on the left side shows cracks on the sealing lip and minor lip).
2. If they occurred in a short period, reviewing operating conditions or examination of change of oil seal material are required.

Abnormal wear to lip of oil seal A

Remedy
1. If the interference is restricted, replacement is required.
2. When fitting new oil seals, apply grease to the lips generously.

Abnormal wear to side and bore surfaces of oil seal B



Remedy
1. If the interference is restricted, replacement is required.
2. When fitting new oil seals, apply grease to the side and bore surfaces generously.

Oil seals and O-rings

1. Oil seals and O-rings are very important parts to prevent intrusion of water into bearings. Periodic replacement is required, since they are consumables.
2. When attaching the oil seal after overhaul and cleaning, be sure to apply grease to the oil seal lips generously.
Service life of seals depends on the grease status.

Technical data

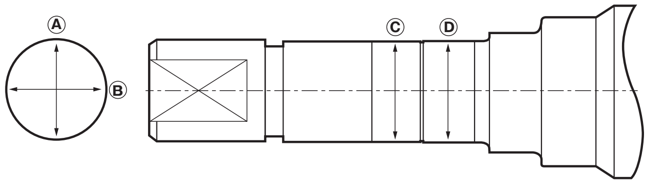
1. Recommended fits for rolling mill roll neck bearing

A roll neck bearing is subject to inner ring rotating load. Its inner ring receives the load on its entire circumference, and the load is applied to the outer ring at only one location.

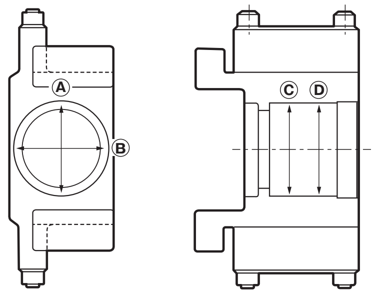
Thus, interference fit is required for the inner ring to prevent any creep, and clearance fit should be used for the outer ring, in principle. For easy attachment, clearance fit has been used for roll neck bearings (because recombination and replacement must be frequently done for roll grinding).

Clearance fit is used for the inner rings of deep groove ball bearings and angular ball bearings used as bearings receiving axial load. Between the outer ring and the chock, adequate clearance should be provided in order to prevent any radial load applied to the outer ring.

Tables 1-1 through 1-4 show the recommended fits for roll neck bearings.



Roll neck



Chock

* For Ⓒ and Ⓓ, measure the dimensions in the Ⓐ and Ⓑ directions.

Table 1-1 Recommended fits for roll neck metric series four-row tapered roller bearing

Double cone and roll neck (shaft)							Cup and chock (housing)							
Nominal bore diameter d mm		Single plane mean bore diameter deviation Δ_{dmp} μm		Roll neck diameter deviation μm		Minimum allowable roll neck diameter wear μm	Nominal outside diameter D mm		Single plane mean outside diameter deviation Δ_{Dmp} μm		Chock bore diameter deviation μm		Maximum allowable chock bore (wear) μm	Maximum roundness μm
over	up to	upper	lower	upper	lower		over	up to	upper	lower	upper	lower		
80	**120**	0	–20	–120	–150	–300	**120**	**150**	0	–20	+57	+25	+150	75
120	**180**	0	–25	–150	–175	–350	**150**	**180**	0	–25	+100	+50	+250	100
180	**250**	0	–30	–175	–200	–400	**180**	**250**	0	–30	+120	+50	+300	150
250	**315**	0	–35	–210	–250	–500	**250**	**315**	0	–35	+115	+50	+300	150
315	**400**	0	–40	–240	–300	–600	**315**	**400**	0	–40	+110	+50	+300	150
400	**500**	0	–45	–245	–300	–600	**400**	**500**	0	–45	+105	+50	+300	150
500	**630**	0	–50	–250	–300	–600	**500**	**630**	0	–50	+100	+50	+300	150
630	**800**	0	–75	–325	–400	–800	**630**	**800**	0	–75	+150	+75	+450	200
800	**1 000**	0	–100	–350	–425	–900	**800**	**1 000**	0	–100	+150	+75	+500	250
1 000	**1 250**	0	–125	–425	–500	–900	**1 000**	**1 250**	0	–125	+175	+100	+600	300
1 250	**1 600**	0	–160	–510	–600	–900	**1 250**	**1 600**	0	–160	+215	+125	+750	350
							1 600	**2 000**	0	–200	+250	+150	+750	350

Table 1-2 Recommended fits for roll neck inch series four-row tapered roller bearing

Double cone and roll neck (shaft)							Cup and chock (housing)							
Nominal bore diameter d mm (1/25.4)		Single bore diameter deviation Δ_{ds} µm		Roll neck diameter deviation µm		Minimum allowable roll neck diameter wear µm	Nominal outside diameter D mm (1/25.4)		Single outside diameter deviation Δ_{Ds} µm		Chock bore diameter deviation µm		Maximum allowable chock bore (wear) µm	Maximum roundness µm
over	up to	upper	lower	upper	lower		over	up to	upper	lower	upper	lower		
76.2 (3.0)	101.6 (4.0)	+ 25	0	− 75	−100	−250	–	304.8 (12.0)	+ 25	0	+ 75	+ 50	+150	150
101.6 (4.0)	127.0 (5.0)	+ 25	0	−100	−125	−300	304.8 (12.0)	609.6 (24.0)	+ 51	0	+150	+100	+300	150
127.0 (5.0)	152.4 (6.0)	+ 25	0	−125	−150	−350	609.6 (24.0)	914.4 (36.0)	+ 76	0	+225	+150	+450	150
152.4 (6.0)	203.2 (8.0)	+ 25	0	−150	−175	−400	914.4 (36.0)	1 219.2 (48.0)	+102	0	+300	+200	+600	300
203.2 (8.0)	304.8 (12.0)	+ 25	0	−175	−200	−450	1 219.2 (48.0)	1 524.0 (60.0)	+127	0	+375	+250	+750	350
304.8 (12.0)	609.6 (24.0)	+ 51	0	−200	−250	−600	1 524.0 (60.0)		+127	0	+450	+300	+750	350
609.6 (24.0)	914.4 (36.0)	+ 76	0	−250	−325	−800								
914.4 (36.0)	1 219.2 (48.0)	+102	0	−300	−400	−800								
1 219.2 (48.0)		+127	0	−375	−475	−800								

Table 1-3 Recommended fits for roll neck four-row cylindrical roller bearing (inner ring interference fit)

Inner ring and roll neck (shaft)					
Nominal bore diameter d mm		Single plane mean bore diameter deviation Δ_{ds} µm		Roll neck diameter deviation µm	
over	up to	upper	lower	upper	lower
80	120	0	− 20	+ 59	+ 37 (p6)
120	180	0	− 25	+ 68	+ 43 (p6)
180	250	0	− 30	+ 79	+ 50 (p6)
250	280	0	− 35	+126	+ 94 (r6)
280	315	0	− 35	+130	+ 98 (r6)
315	355	0	− 40	+144	+108 (r6)
355	400	0	− 40	+150	+114 (r6)
400	450	0	− 45	+166	+126 (r6)
450	500	0	− 45	+172	+132 (r6)
500	560	0	− 50	+194	+150 (r6)
560	630	0	− 50	+354	+310 (s6)
630	710	0	− 75	+390	+340 (s6)
710	800	0	− 75	+430	+380 (s6)
800	900	0	−100	+486	+430 (s6)
900	1 000	0	−100	+526	+470 (s6)
1 000	1 120	0	−125	+588	+520 (s6)
1 120	1 250	0	−125	+646	+580 (s6)

Outer ring and chock (housing)					
Nominal outside diameter D mm		Single plane mean outside diameter deviation Δ_{Ds} µm		Chock bore diameter deviation µm	
over	up to	upper	lower	upper	lower
120	150	0	− 18	+ 40	0 (H7)
150	180	0	− 25	+ 40	0 (H7)
180	250	0	− 30	+ 46	0 (H7)
250	315	0	− 35	+ 52	0 (H7)
315	400	0	− 40	+ 75	+ 18 (G7)
400	500	0	− 45	+ 83	+ 20 (G7)
500	630	0	− 50	+ 92	+ 22 (G7)
630	800	0	− 75	+160	+ 80 (F7)
800	1 000	0	−100	+176	+ 86 (F7)
1 000	1 250	0	−125	+203	+ 98 (F7)
1 250	1 400	0	−160	+235	+110 (F7)
1 400	1 600	0	−160	+345	+220 (E7)

[Remark] The table above shows general values. JTEKT determines recommended fit on a case by case basis according to bearing materials and operating conditions to prevent the inner ring from creeping. Consult with JTEKT when referring to this table.

Table 1-4 Recommended fits of bearing types for support of axial loading

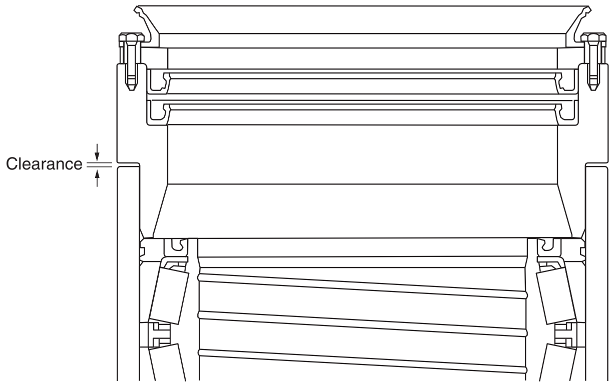
Bearing type	Inner ring and roll neck (shaft)	Outer ring and chock (housing)	
	Shaft tolerance range class	Mounted to chock	Mounted to sleeve
		Chock bore tolerance range class	Sleeve bore tolerance range class
Double row tapered roller bearing (bearings for support of axial loading) ··· TDIS type	e6 or f6	Nominal chock bore (mm) = Outer ring outer dia. + [0.5 to 1.0] H8	G7

[Remarks] 1) When installing a sleeve, clearance of 0.5 mm or more should be provided between the outer diameter of the sleeve and the bore of the chock.

2) When using an oil film bearing with a radial bearing, the information shown here does not cover all cases.

Technical data

1-1. Cork shim selection table and bolt tightening torque (reference)



Cork shim

Table 1-5 Cork shim selection table (reference)

Unit : mm

Measured clearance		Shim thickness	Shim combination
over	up to		
	0.95	1.0	1.0
0.95	1.25	1.5	1.5
1.25	1.65	2.0	2.0
1.65	2.0	2.5	1.0 + 1.5
2.0	2.4	3.0	1.0 + 2.0
2.4	2.8	3.5	1.5 + 2.0
2.8	3.2	4.0	2.0 + 2.0
3.2	3.6	4.5	1.0 + 1.5 + 2.0
3.6	4.0	5.0	1.0 + 2.0 + 2.0
4.0	4.5	5.5	1.5 + 2.0 + 2.0

Table 1-6 Bolt tightening torque (reference)

Bolt size	Interval mm	Tightening torque[1] kgf·m	Tightening torque[1] N·m
M24	3	84 ± 5	825 ± 50
M27	3	125 ± 7	1230 ± 70
M30	3.5	170 ± 10	1670 ± 100
M33	3.5	230 ± 15	2260 ± 150
M36	4	290 ± 15	2840 ± 150
M39	4	380 ± 20	3730 ± 200
M42	4.5	470 ± 30	4610 ± 300
M45	4.5	590 ± 30	5790 ± 300
M48	5	710 ± 40	6960 ± 400
M52	5	920 ± 50	9020 ± 500

[Note] 1) The values shown are those when using bolts with JIS strength classification 10.9.

2. Tolerances

2-1. Four-row cylindrical roller bearings

[Applicable tolerance for cylindrical roller bearings]

Type of cylindrical roller bearings	Applicable tolerance
Four-row cylindrical bore bearings	Class 0, class 6, class 5 of JIS B 1514
Four-row tapered bore bearings	Class 0, class 6 of JIS B 1514 (Refer to Table 2-2)

Table 2-1 Tolerances of roller set bore diameter and roller set outside diameter of interchangeable bearings

Unit : μm

Nominal bore diameter d(mm)		Roller set bore diameter deviation Δ_{Fw}		Roller set outside diameter deviation Δ_{Ew}	
over	up to	upper	lower	upper	lower
50	120	+ 20	0	0	− 20
120	200	+ 25	0	0	− 25
200	250	+ 30	0	0	− 30
250	315	+ 35	0	0	− 35
315	400	+ 40	0	0	− 40
400	500	+ 45	0	0	− 45
500	600	+ 50	0	0	− 50
600	700	+ 55	0	0	− 55
700	800	+ 60	0	0	− 60
800	900	+ 70	0	0	− 70
900	1 000	+ 80	0	0	− 80
1 000	1 250	+ 90	0	0	− 90
1 250	1 600	+100	0	0	−100
1 600	2 000	+120	0	0	−120
2 000	2 500	+150	0	0	−150

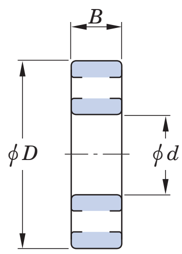
[Remark] Interchangeable bearings have an inner ring with rollers that can be matched with the outer ring, or an outer ring with rollers that can be matched with the inner ring, without affecting performance in the bearing that has the same bearing number in one category.

Table 2-2 (1) Radial bearing tolerances (tapered roller bearings excluded) = JIS B 1514-1 =

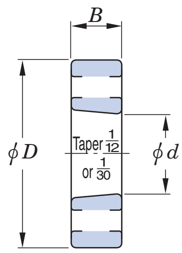
(1) Inner ring (bore diameter)

Unit : μm

Nominal bore diameter d mm		Single plane mean bore diameter deviation Δ_{dmp}						Single plane bore diameter variation V_{dsp}						Mean bore diameter variation V_{dmp}		
								Diameter series 0, 1			Diameter series 2, 3, 4					
		class 0		class 6		class 5		class 0	class 6	class 5	class 0	class 6	class 5	class 0	class 6	class 5
over	up to	upper	lower	upper	lower	upper	lower	max.			max.			max.		
120	150	0	– 25	0	–18	0	–13	31	23	10	19	14	10	19	14	7
150	180	0	– 25	0	–18	0	–13	31	23	10	19	14	10	19	14	7
180	250	0	– 30	0	–22	0	–15	38	28	12	23	17	12	23	17	8
250	315	0	– 35	0	–25	0	–18	44	31	14	26	19	14	26	19	9
315	400	0	– 40	0	–30	0	–23	50	38	18	30	23	18	30	23	12
400	500	0	– 45	0	–35	*0*	*–28*	56	44	21	34	26	*21*	34	26	*14*
500	630	0	– 50	0	–40	*0*	*–35*	63	50	*26*	38	30	*26*	38	30	*18*
630	800	0	– 75	*0*	*–50*	*0*	*–45*	*94*	*63*	*34*	*56*	*38*	*34*	*56*	*38*	*23*
800	1 000	0	–100	*0*	*–60*	*0*	*–60*	*125*	*75*	*45*	*75*	*45*	*45*	*75*	*45*	*30*
1 000	1 250	0	–125	*0*	*–75*	*0*	*–75*	*156*	*94*	*56*	*94*	*56*	*56*	*94*	*56*	*38*
1 250	1 600	0	–160	–	–	–	–	*200*	–	–	*120*	–	–	*120*	–	–
1 600	2 000	0	–200	–	–	–	–	*250*	–	–	*150*	–	–	*150*	–	–



Cylindrical bore



Tapered bore

(2) Inner ring (running accuracy and width)

Unit : μm

Nominal bore diameter d mm		Radial runout of assembled bearing inner ring K_{ia}			S_d	Single inner ring width deviation Δ_{Bs}						Single inner ring width deviation Δ_{Bs} 1)						Inner ring width variation V_{Bs}		
		class 0	class 6	class 5	class 5	class 0		class 6		class 5		class 0 2)		class 6 2)		class 5 2)		class 0	class 6	class 5
over	up to	max.			max.	upper	lower	upper	lower	upper	lower	upper	lower	upper	lower	upper	lower	max.		
120	150	30	18	8	10	0	– 250	0	– 250	0	– 250	0	–500	0	–500	0	–380	30	30	8
150	180	30	18	8	10	0	– 250	0	– 250	0	– 250	0	–500	0	–500	0	–380	30	30	8
180	250	40	20	10	11	0	– 300	0	– 300	0	– 300	0	–500	0	–500	0	–500	30	30	10
250	315	50	25	13	13	0	– 350	0	– 350	0	– 350	0	–500	0	–500	0	–500	35	35	13
315	400	60	30	15	15	0	– 400	0	– 400	0	– 400	0	–630	0	–630	0	–630	40	40	15
400	500	65	35	*20*	*18*	0	– 450	0	– 450	*0*	*– 450*	–	–	–	–	–	–	50	45	*18*
500	630	70	40	*25*	*25*	0	– 500	0	– 500	*0*	*– 500*	–	–	–	–	–	–	60	50	*20*
630	800	80	*50*	*30*	*30*	0	– 750	*0*	*– 750*	*0*	*– 750*	–	–	–	–	–	–	70	*60*	*23*
800	1 000	90	*60*	*40*	*40*	0	–1 000	*0*	*–1 000*	*0*	*–1 000*	–	–	–	–	–	–	80	*60*	*35*
1 000	1 250	100	*70*	*50*	*50*	0	–1 250	*0*	*–1 250*	*0*	*–1 250*	–	–	–	–	–	–	100	*60*	*45*
1 250	1 600	120	–	–	–	0	–1 600	–	–	–	–	–	–	–	–	–	–	120	–	–
1 600	2 000	140	–	–	–	0	–2 000	–	–	–	–	–	–	–	–	–	–	140	–	–

S_d : perpendicularity of inner ring face with respect to the bore

[Notes] 1) These shall be appplied to individual bearing rings manufactured for matched pair or stack bearings.

2) Also applicable to the inner ring with tapered bore of $d \geqq 50$ mm.

[Remark] Values in Italics are prescribed in JTEKT standards.

Table 2-2 (2) Radial bearing tolerances (tapered roller bearings excluded)

(3) Outer ring (outside diameter)

Unit : µm

Nominal outside dia. D mm		Single plane mean outside diameter deviation Δ_{Dmp}						Single plane outside diameter variation V_{Dsp}						Mean outside diameter variation V_{Dmp}		
								Diameter series 0, 1			Diameter series 2, 3, 4					
		class 0		class 6		class 5		class 0 1)	class 6 1)	class 5	class 0 1)	class 6 1)	class 5	class 0 1)	class 6 1)	class 5
over	up to	upper	lower	upper	lower	upper	lower	max.			max.			max.		
150	**180**	0	– 25	0	– 18	0	–13	31	23	10	19	14	10	19	14	7
180	**250**	0	– 30	0	– 20	0	–15	38	25	11	23	15	11	23	15	8
250	**315**	0	– 35	0	– 25	0	–18	44	31	14	26	19	14	26	19	9
315	**400**	0	– 40	0	– 28	0	–20	50	35	15	30	21	15	30	21	10
400	**500**	0	– 45	0	– 33	0	–23	56	41	17	34	25	17	34	25	12
500	**630**	0	– 50	0	– 38	0	–28	63	48	21	38	29	21	38	29	14
630	**800**	0	– 75	0	– 45	0	–35	94	56	26	55	34	26	55	34	18
800	**1 000**	0	–100	0	– 60	*0*	*–50*	125	75	*38*	75	45	*38*	75	45	*25*
1 000	**1 250**	0	–125	*0*	*– 75*	*0*	*–63*	*156*	*94*	*47*	*94*	*56*	*47*	*94*	*56*	*31*
1 250	**1 600**	0	–160	*0*	*– 90*	*0*	*–80*	*200*	*113*	*60*	*120*	*68*	*60*	*120*	*68*	*40*
1 600	**2 000**	0	–200	*0*	*–120*	–	–	*250*	*150*	–	*150*	*90*	–	*150*	*90*	–
2 000	**2 500**	0	–250	–	–	–	–	*313*	–	–	*188*	–	–	*188*	–	–

(4) Outer ring (running accuracy and width)

Unit : µm

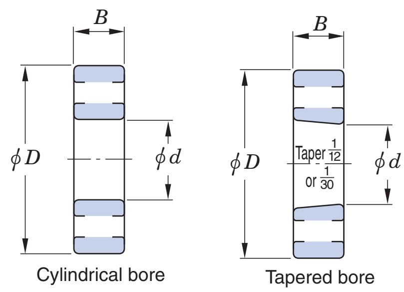
Nominal outside dia. D mm		Radial runout of assembled bearing outer ring K_{ea}			S_D 2)	S_{ea} 2)
		class 0	class 6	class 5	class 5	class 5
over	up to	max.			max.	max.
150	**180**	45	23	13	10	14
180	**250**	50	25	15	11	15
250	**315**	60	30	18	13	18
315	**400**	70	35	20	13	20
400	**500**	80	40	23	15	23
500	**630**	100	50	25	18	25
630	**800**	120	60	30	20	30
800	**1 000**	140	75	*40*	*23*	*40*
1 000	**1 250**	160	*85*	*45*	*30*	*45*
1 250	**1 600**	190	*95*	*60*	*45*	*60*
1 600	**2 000**	220	*110*	–	–	–
2 000	**2 500**	250	–	–	–	–

S_D : perpendicularity of outer ring outside surface with respect to the face
S_{ea} : axial runout of assembled bearing outer ring

[Notes]

1) Shall be applied when locating snap ring is not fitted.
2) These shall not be applied to flanged bearings.

[Remark]
Values in Italics are prescribed in JTEKT standards.



d : nominal bore diameter
D : nominal outside diameter
B : nominal assembled bearing width

2-2. Tapered roller bearings

[Applicable tolerance for tapered roller bearings]

Type of tapered roller bearings			Applicable tolerance[1]
Double-row · Four-row	Metric series	45200, 45300, 46200 (A), 46300 (A) 46T30200JR, 46T32200JR, 46T30300JR, 46T32300JR 37200, 47200, 47300	Class 0 of BAS 1002 (Refer to Table 2-3 on page 30)
	Inch series	[LM377449D/LM377410, 67388/67322D EE127094D/127138/127139D etc.]	Class 4 of ABMA 19 (Refer to Table 2-4 on page 31)
	The others	45T···, 46T···, 47T···, 2TR···, 4TR···	Special tolerances for required are used in many cases. Consult with JTEKT.

[Note] 1) Consult with JTEKT if a higher tolerance class than that shown in this table is necessary.

Table 2-3 Tolerances for metric series double-row and four-row tapered roller bearings (class 0)

= BAS 1002 =

(1) Cone, cup width and overall width

Unit : μm

Nominal bore diameter d mm		Single plane mean bore diameter deviation Δ_{dmp}		Single plane bore diameter variation V_{dsp}	Mean bore diameter variation V_{dmp}	K_{ia}	Single cup or cone width deviation Δ_{Bs}, Δ_{Cs}		Actual overall cones/cups width deviation: Double-row Δ_{Ts}		Four-row Δ_{Ts}, Δ_{Ws}	
over	up to	upper	lower	max.	max.	max.	upper	lower	upper	lower	upper	lower
120	**180**	0	– 25	25	19	35	0	– 250	+ 500	– 500	+ 600	– 600
180	**250**	0	– 30	30	23	50	0	– 300	+ 600	– 600	+ 750	– 750
250	**315**	0	– 35	35	26	60	0	– 350	+ 700	– 700	+ 900	– 900
315	**400**	0	– 40	40	30	70	0	– 400	+ 800	– 800	+1 000	–1 000
400	**500**	0	– 45	45	34	80	0	– 450	+ 900	– 900	+1 200	–1 200
500	**630**	0	– 60	60	40	90	0	– 500	+1 000	–1 000	+1 200	–1 200
630	**800**	0	– 75	75	45	100	0	– 750	+1 500	–1 500	–	–
800	**1 000**	0	–100	100	55	115	0	–1 000	+1 500	–1 500	–	–

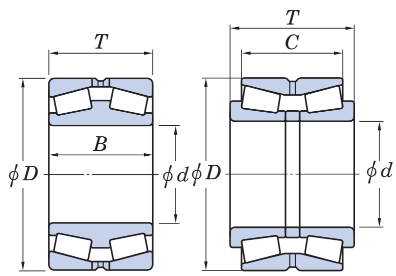
K_{ia} : radial runout of assembled bearing cone

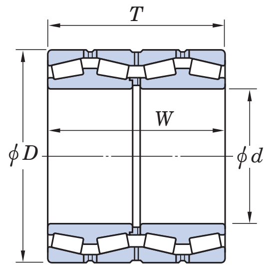
(2) Cup

Unit : μm

Nominal outside diameter D mm		Single plane mean outside diameter deviation Δ_{Dmp}		Single plane outside diameter variation V_{Dsp}	Mean outside diameter variation V_{Dmp}	K_{ea}
over	up to	upper	lower	max.	max.	max.
150	**180**	0	– 25	25	19	45
180	**250**	0	– 30	30	23	50
250	**315**	0	– 35	35	26	60
315	**400**	0	– 40	40	30	70
400	**500**	0	– 45	45	34	80
500	**630**	0	– 50	60	38	100
630	**800**	0	– 75	80	55	120
800	**1 000**	0	–100	100	75	140
1 000	**1 250**	0	–125	130	90	160
1 250	**1 600**	0	–160	170	100	180

K_{ea} : radial runout of assembled bearing cup





d : nominal bore diameter
D : nominal outside diameter
B : nominal double cone width
C : nominal double cup width
T, W : nominal overall width of cups (cones)

Table 2-4 Tolerances and permissible values for inch series tapered roller bearings = ABMA 19 =

(1) Cone

Unit : μm

Applied bearing type	Nominal bore diameter d, mm (1/25.4)		Deviation of a single bore diameter Δ_{ds}							
			Class 4		Class 2		Class 3		Class 0	
	over	up to	upper	lower	upper	lower	upper	lower	upper	lower
All types	–	**76.2** (3.0)	+ 13	0	+13	0	+13	0	+13	0
	76.2 (3.0)	**266.7** (10.5)	+ 25	0	+25	0	+13	0	+13	0
	266.7 (10.5)	**304.8** (12.0)	+ 25	0	+25	0	+13	0	+13	0
	304.8 (12.0)	**609.6** (24.0)	+ 51	0	+51	0	+25	0	–	–
	609.6 (24.0)	**914.4** (36.0)	+ 76	0	–	–	+38	0	–	–
	914.4 (36.0)	**1 219.2** (48.0)	+102	0	–	–	+51	0	–	–
	1 219.2 (48.0)	–	+127	0	–	–	+76	0	–	–

(2) Cup

Unit : μm

Applied bearing type	Nominal outside diameter D, mm (1/25.4)		Deviation of a single outside diameter Δ_{Ds}							
			Class 4		Class 2		Class 3		Class 0	
	over	up to	upper	lower	upper	lower	upper	lower	upper	lower
All types	–	**266.7** (10.5)	+ 25	0	+25	0	+13	0	+13	0
	266.7 (10.5)	**304.8** (12.0)	+ 25	0	+25	0	+13	0	+13	0
	304.8 (12.0)	**609.6** (24.0)	+ 51	0	+51	0	+25	0	–	–
	609.6 (24.0)	**914.4** (36.0)	+ 76	0	+76	0	+38	0	–	–
	914.4 (36.0)	**1 219.2** (48.0)	+102	0	–	–	+51	0	–	–
	1 219.2 (48.0)	–	+127	0	–	–	+76	0	–	–

(3) Radial runout of assembled bearing cone/cup

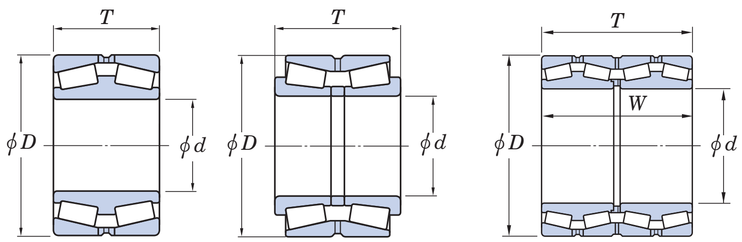
Unit : μm

Applied bearing type	Nominal outside diameter D, mm (1/25.4)		Radial runout of cone/cup K_{ia} , K_{ea}			
			Class 4	Class 2	Class 3	Class 0
	over	up to	max.	max.	max.	max.
All types	–	**266.7** (10.5)	51	38	8	4
	266.7 (10.5)	**304.8** (12.0)	51	38	8	4
	304.8 (12.0)	**609.6** (24.0)	51	38	18	–
	609.6 (24.0)	**914.4** (36.0)	76	51	51	–
	914.4 (36.0)	**1 219.2** (48.0)	76	–	76	–
	1 219.2 (48.0)	–	76	–	76	–

(4) Assembled bearing width and overall width

Unit : μm

Applied bearing type	Nominal bore diameter d, mm (1/25.4)		Nominal outside diameter D, mm (1/25.4)		Deviation of the actual bearing width and overall width of cones/cups Δ_{Ts}, Δ_{Ws}							
					Class 4		Class 2		Class 3		Class 0	
	over	up to	over	up to	upper	lower	upper	lower	upper	lower	upper	lower
Double-row	–	**101.6** (4.0)	–	–	+ 406	0	+ 406	0	+ 406	– 406	+ 406	– 406
	101.6 (4.0)	**266.7** (10.5)	–	–	+ 711	– 508	+ 406	– 203	+ 406	– 406	+ 406	– 406
	266.7 (10.5)	**304.8** (12.0)	–	–	+ 711	– 508	+ 406	– 203	+ 406	– 406	+ 406	– 406
	304.8 (12.0)	**609.6** (24.0)	–	**508.0** (20.0)	–	–	+ 762	– 762	+ 406	– 406	–	–
	304.8 (12.0)	**609.6** (24.0)	**508.0** (20.0)	–	–	–	+ 762	– 762	+ 762	– 762	–	–
	609.6 (24.0)		–	–	+ 762	– 762	–	–	+ 762	– 762	–	–
Double-row (TNA type)	–	**127.0** (5.0)	–	–	–	–	+ 254	0	+ 254	0	–	–
	127.0 (5.0)		–	–	–	–	+ 762	0	+ 762	0	–	–
Four-row	Total dimensional range		–	–	+1 524	–1 524	+1 524	–1 524	+1 524	–1 524	+1 524	–1 524



d : nominal bore diameter
D : nominal outside diameter
T, W : nominal assembled bearing width and nominal overall width of cups (cones)

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