

Koyo

***INSTALLATION AND MAINTENANCE MANUAL
FOR ROLLING MILL BEARINGS***

(3)

SEALED TYPE FOUR ROW TAPERED ROLLER BEARINGS



CAT.NO. B3007E

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1. INTRODUCTION

We, JTEKT developed the sealed type four row tapered roller bearing for steel mill roll neck application in order to meet the request from the steel makers in Japan. The main purpose of the development was come from the following three items, which are prolongation of the actual life, maintenance interval and saving of the grease consumption.

It is very commonly known that the cause of premature life of conventional bearing is almost due to excessive operating condition which is induced by entry of water into the bearing because of poor sealing performance of the chock seals.

However, to improve the chock sealing performance is a very expensive matter. Therefore, tapered roller bearing should have its own seals to protect the bearing itself and as the results of these facts, Koyo sealed type four row tapered roller bearing has been designed so well.

From the actual operation of the developed bearing, the following performance was obtained,

- The bearing actual life was prolonged by 1.3-1.5 times.
- The maintenance interval can be extended to every 4-6 months. From this reason, the big reduction of maintenance cost could be done.
- The big reduction in grease consumption could also be done. For instance, in case of Nippon Steel Corp. Hirohata Plant, 7.2 ton of the grease consumption per year could be reduced for their 5 Tandem Cold Strip Mill.
- Because of longer interval of maintenance, the work shop and environment of mill are kept clean.

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2. THE FEATURES OF KOYO SEALED TYPE BEARING

2-1 Structure

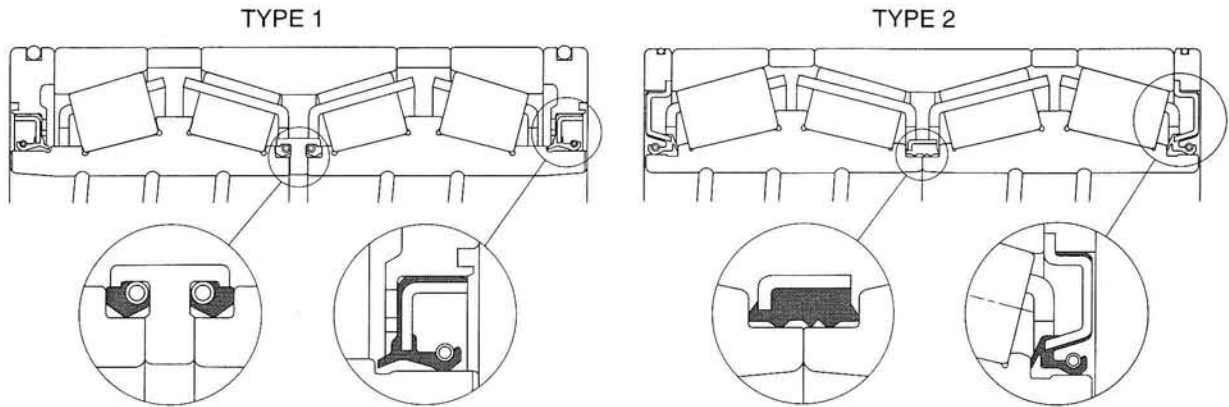


Fig.1 Types of the bearing

The structural features of the developed bearing are mainly to prevent the entry of water into the bearing and grease leakage from the bearing, that is to say;

1. O rings are applied on bearing outside for preventing the entry of water through the clearance between the chock bore and bearing outside.
2. The grease hole and groove are eliminated from the cup and cone spacers.
3. The grease seals are equipped into the both seal cover.
4. The special spiral groove is prepared on bore wall for retaining the grease between the roll neck and bearing bore.

Since the developed bearing is designed with above features, it is able to prevent the entry of water into the bearing even if the water comes into the chock inside. However, it is better to drain water out from chock inside, we would like to recommend you to make two drain holes in the chock and chock cover as follows.

Also the chock and chock cover can be plugged and used again for the conventional bearing when you use the conventional bearing in the same chock. In this case, the following plug dimension is recommendable.

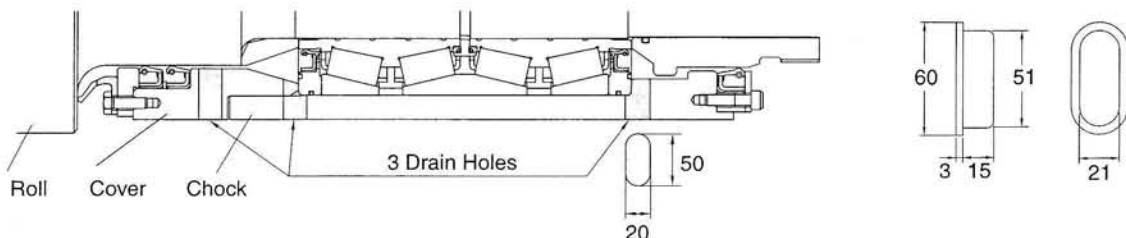


Fig.2 Recommended drain holes and the plug

2-2 Features

- 1) The bearing is prevented from the entry of water and the leakage of grease by the fixed O ring on the outside of seal cover.
- 2) To prevent the entry of water and the leakage of grease, the oil groove on the cup spacer is eliminated.
- 3) The bearing has two double lipped oil seal assemblies which are incorporated in the bore of seal cover for preventing the entry of water and the leakage of grease.
- 4) The special spiral groove is provided on the cone bore for retaining the grease between the roll neck and bearing bore.
- 5) The special seal is set on the cone spacer for prevention of such entry of water into the bearing from roll neck.
- 6) The tapped holes are provided on the side face of the single cup for easy handling of the bearing.
- 7) The grease is already packed in the bearing.
(The grease name is "ADLEX" or "PALMAX RBG", KYODO YUSHI Co., Japan)
Therefore, no any work for bearing inside is required at first installation except for taking vinyl sheets off from bearing inside.

We are enclosing herewith the handling manual of Koyo Sealed Type Four Row Tapered Roller Bearing and the reference drawing of clamping tool for the bearing. Please prepare this tool at your side.



Fig.3 Bearing component



Fig.4 Side seal

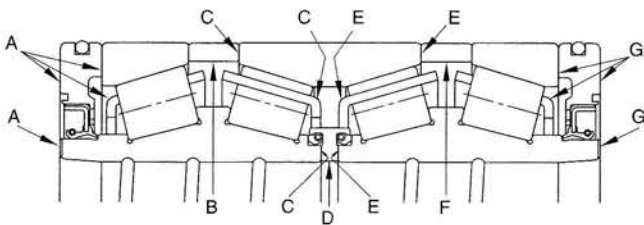


Fig.5 Type1 Central seal

3. THE PREPARATION OF THE BEARING INSTALLATION

- 1) The bearing should never be unpacked prior to installation.
- 2) Removing the rust preventive oil from the bearing by wiping is ideal. However, the bearing may be used with the rust preventive oil, as it is coated, because it has no influence on the bearing performance when it is combined with the grease.
- 3) The serial number and the row number are indicated on each bearing component.

Example; VG-10 - 1
 Row number
 Serial number



A	VG-10-1
B	VG-10-1~2
C	VG-10-2
D	VG-10-2~3
E	VG-10-3
F	VG-10-3~4
G	VG-10-4

Fig.6 Serial No. and row No.

Though it does not matter to install the row number 1 to barrel side or opposite side, it is recommendable to install row number 1 to the barrel side for the purpose of easier control.

- 4) The load zone numbers ① to ④ are indicated on the cup outside face at equally spaced intervals. These load zone numbers must be put in order through the four rows, and also each component must be assembled in accordance with row numbers. As a general rule, load zone number ① is to be matched up at the load zone with the first position (in case of the top roll, it is the top in the top chock, in

case of the bottom roll, it is the bottom in the bottom chock), then after a certain period of operation time (at each maintenance time), the zone number at the loading position must be changed and installed into the chock in the following order ① → ③ → ② → ④ → ①.

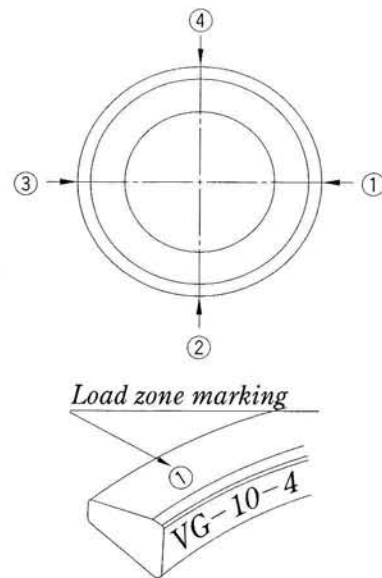


Fig.7 Load zone marking

- 5) The weight of the grease to be packed into the bearing should be checked in advance in accordance with the specified amount and the grease should be kept near to the bearing.
- 6) The dents, nicks, rust and roughness on the roll neck surface affect the oil film between the bearing bore and the roll surface resulting in seizure, scoring and cracks. Remove the dents, nicks and rust with the oil stone and the emery cloth.
- 7) The dents, nicks and rust on the chock bore surface may hinder the installation of the bearing. Remove the dents, nicks and rust with the oil stone and the emery cloth.

4. THE PROCEDURES OF MOUNTING AND DISMOUNTING

- 1) Unwrap the bearing from the wooden box and take vinyl sheets off, which sheets protect bearing damage during transportation, and collect grease on the sheet and return such grease to the bearing inside, then adjust line which is marked on the bearing outside as sketched below in order to match load zone mark.

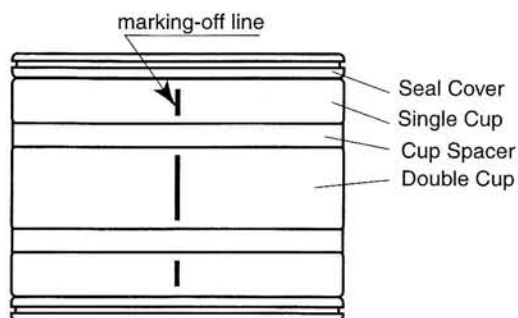


Fig.8 Load zone line

- 2) Make sure if seals seat proper place.
- 3) Clamp the bearing unit by the clamp lifting tool as shown Fig.10.



Fig.9 Packing off the bearing

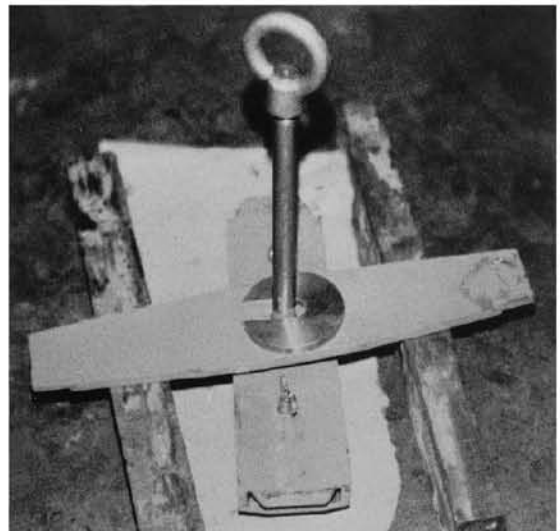


Fig.10 Clamp lifting tool

- 4) Coat the grease or oil on the chock bore as Fig.11 for easy installation of the bearing assembly.



Fig.11 Chock bore before installing

5) Install the bearing assembly into the chock by using the hoist after indicating the load zone as Fig.12.

At this time, pay attention to O ring fixed on seal cover outside to avoid damage.

6) Assemble chock and chock cover in same process as conventional method.

7) Before mounting the chock and bearing assembly on the roll neck, coat the grease on the cone bore and the Molycoat (Molybdenum Dersulfied and grease mixture) on the roll neck. This is very important work in order to prevent trouble such as seizure on roll neck.

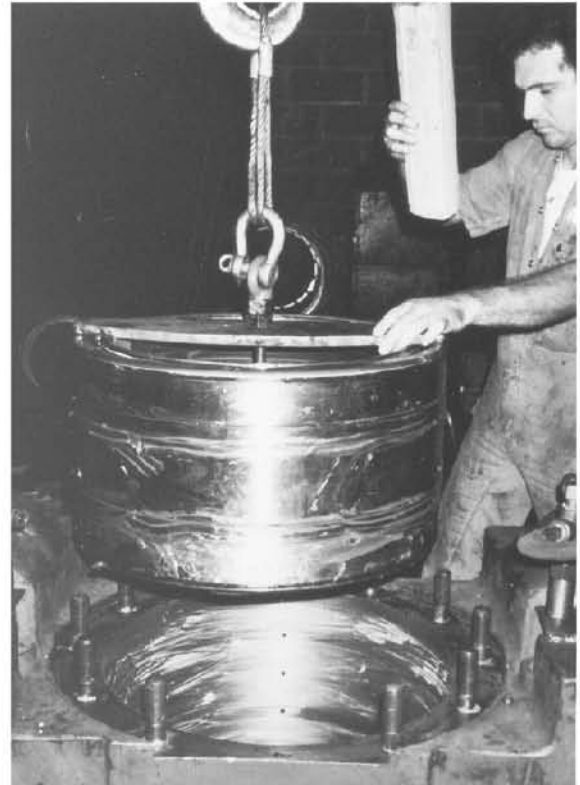
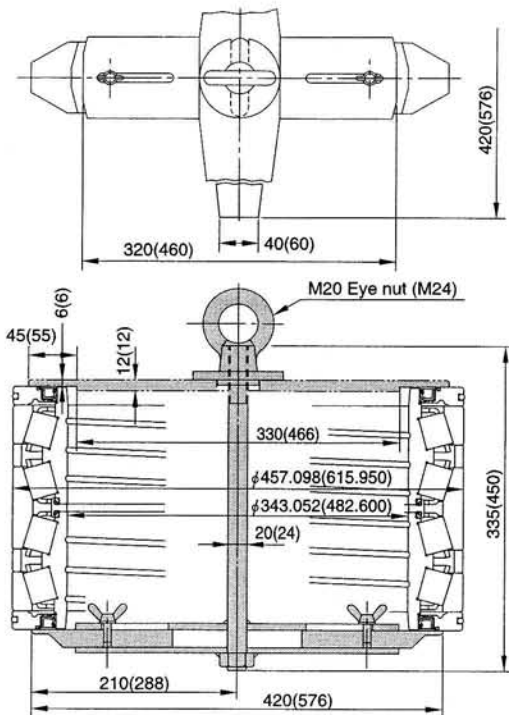


Fig.12 Installing into the chock



Dimensions show the tool for the bearing No. 47TS694625, and dimensions in () shows the tool for the bearing No. 4TRS19.

Fig.13 Recommended clamp lifting tool

5. DISMOUNTING, INSPECTION AND REFRESHMENT

- 1) In case of dismantling the bearing from the chock, use the tool (Fig.14 ... same tool with Fig.11) and pull the bearing assembly out.
- 2) After the washing and cleaning the bearing, take a visual inspection to each component and seals.
- 3) Record the load zone number used in service at every load zone changing as usual.

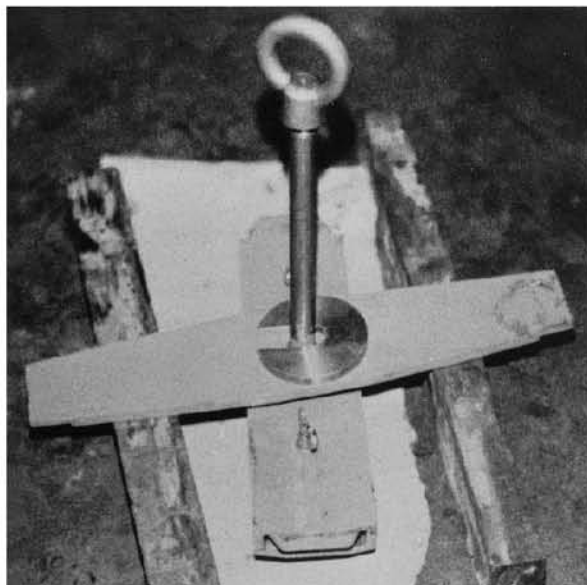


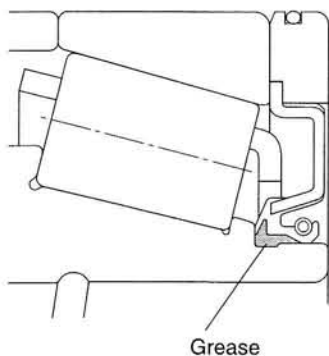
Fig.14 Clamp lifting tool

(Assembly the bearing)

- 4) Prepare two timbers and lay the seal cover (row number 4) on the timbers by indicating the load zone number ① at a certain location (Fig.15).
- 5) Fit the O ring on the outside of the seal cover.
- 6) Lay the single cup of row number 4 on the seal cover of row number 4.
- 7) Fill the grease in the space of oil seal lip incorporated in the seal cover.



Fig.15 Coat the grease on cup raceway



- 8) Coat the single cup raceway surface with the grease.

- 9) Fill the grease approx. a quarter of specified grease amount per row in the space between rollers, cage, cone raceway and cone rib of row number 4 while rotating the cage and rollers. (Fig. 16)



Fig.16 Fill the grease in cone assembly.

- 10) Fill the grease approx. a quarter of specified grease amount per row in space between rollers, cage, cone raceway and cone rib of row number 3 while rotating the case and rollers.
- 11) Place the cone assembly on the cup (row number 4) by matching the row number i.e.; row number 4 roller side must be bottom. At this time, the placing must be done carefully by aligning the center line to avoid seal lip inversion.
- 12) Place the cup spacer (row number 4-3) on the single cup (row number 4).
- 13) Place the double cup (row number 3-2) on the cup spacer with double cup row number 3 side down and to make sure the load zone number on the double cup is same position as those on the single cup (row number 4).
- 14) Type1 only;
Coat the grease on the both side face of the cone spacer and the cone side face (row number 3) and both oil seal lips.
- 15) Type1 only;
Place the cone spacer on the cone side face (row number 3).
- 16) Type2 only;
Place the oil seal on the cone side face (row number 3) after coating the grease on oil seal lips.
- 17) Fill the grease approx. a quarter of specified amount per row in the space between rollers, cage, cone raceway and cone rib of row number 2 only as same way as procedure 9).
- 18) Fill the grease approx. a quarter of specified amount per row in the space between rollers, cage, cone raceway and cone rib (row number 1) while rotating the cage and rollers.
- 19) Place the cone assembly in the double cup (row number 2) with the cone assembly row number 2 side down.
- 20) Place the cup spacer (row number 1-2) on the double cup side face.
- 21) Place the single cup (row number 1) on the cone with setting the load zone number position to meet same number of other row.
- 22) Coat the seal lip incorporated in the seal cover (row number 1) with the grease.
- 23) Mount the seal cover (row number 1) on the single cup (row number 1).
- 24) Fit the O ring on the outside of the seal cover.
- 25) Mount the bearing as same procedure as 4-1), 2), 3) and 4) on page 5.

6. THE RECOMMENDABLE GREASE AND AMOUNT

The following characteristics are required as the grease for sealed type four row tapered roller bearing for roll neck application.

- 1) High water proof and high mechanical stability under condition of water inclusion.
- 2) High rust resistance.
- 3) High oxidation stability.

- 4) High extreme pressure and anti abrasion.
- 5) Less penetration value change, oil separation and leakage at the high temperature condition.

Recommendable grease amount:

1.0 kg per bearing for the bearing No. 47TS694625 and 2.3 kg per bearing for the bearing No. 4TRS19.

7. THE RE-GREASING INTERVAL

The routine inspection and overhaul is shown Fig. 17

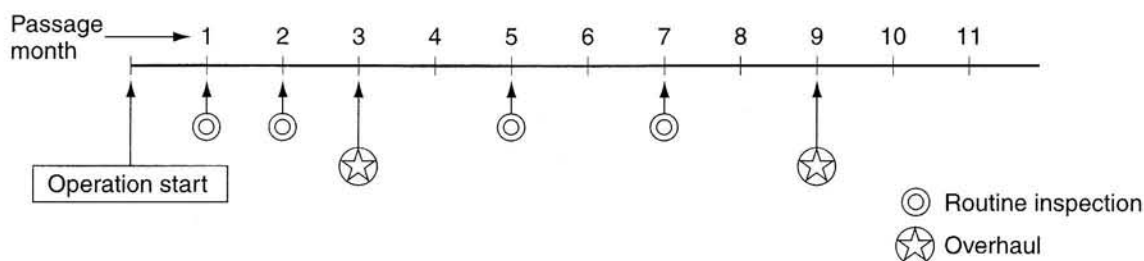


Fig.17 Intervals of routine inspection and overhaul.

- 1) Coat the grease on the seal lip area the Molycoat (Molybdenum Dersulfied and grease mixture) on the roll neck and bearing bore at every roll change. This is very important work in order to prevent trouble on roll neck.
- 2) Fill the grease into the bearing at every overhaul (maintenance-refreshing time).

After 9 months operation, the intervals of inspection and overhaul for future are determined by dischssion based on the service record past and bearing condition (grease condition).

8. OTHER RECOMMENDATION

- 1) Please do not mount the bearing part by part as previous method which is applied for the conventional bearing because there is a risk to damage seal lip.
Bearing assembly should be installed into chock at once by using the tool.
- 2) O rings and seals are damaged and should be serapped at several cases, so that for the spare, some quantity of stock shall be recommended.

9. MAINTENANCE

Great advantages and merits depending on the adoption and employment of the various kinds of Koyo four row sealed bearings have been recognized in many customers.

- 1) Much reduction of grease consumption especially in the hot mill.
- 2) Improvement of bearing life.
- 3) Beautification of work and maintenance shop.

However in order to expect and obtain the good results in longer bearing life, we have to keep in our mind that the careful observation, inspection and maintenance of the chock seals, chock and bearing itself in the customers themselves may be required. In other words, some efforts to the bearing maintenance in the customer might elongate the bearing life.

Following are the main points of maintenance at the customers.

- 1) On every roll change, providing the same observation and treatment, especially for bearing and chock seal as we are doing for the common and regular bearing until at least maintenance interval is decided.
- 2) The careful checking of chock seals to confirm their proper work and effect.
- 3) The careful observation of drain holes to prevent them from being plugged with the excess grease.

9-1 Procedures before bearing installation

- 1) Setting-up the installation date with the customer for the attendance of JTEKT engineer.
- 2) Meeting with engineering and maintenance people in the customer-guidance and explanation as to installation and maintenance points.
- 3) Determination of date for second and third inspection and dismount of bearings according to the attached.
- JTEKT Engineer attendance might be considered.

9-2 Points of daily observation and maintenance – in the customer

- 1) To check the condition of chock seal
 - wear
 - crack
 - to put grease on seal lip at every installation.
- 2) To take out the excess grease in the chock through drain holes.
- 3) To put the adequate grease on the roll neck.
 - the adequate grease amount will be advised by JTEKT Engineer.
- 4) To check the condition of the chock, fillet ring and chock covers to maintain adequate shape and dimension tolerance at every dismount.
- 5) To check the clearance among bearing, chock side face and chock covers at every mounting.
- 6) To check water content of grease at every disassembling of bearing itself in order to find the effects of the chock seals, bearing seals and drain holes until the maintenance interval is decided.
Maximum allowable water content – 10 %

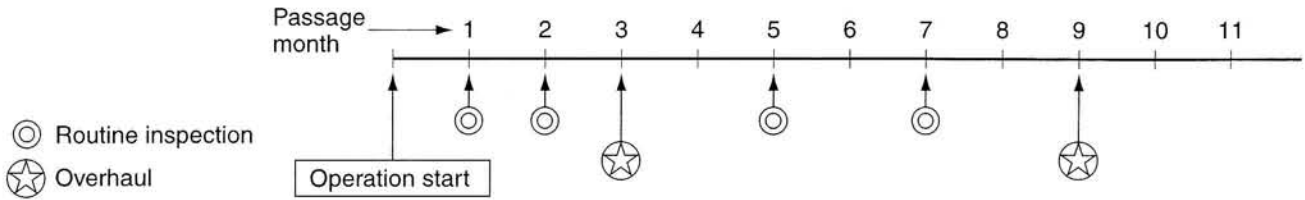
9-3 Inspection interval at the customer

Two kinds of inspection are required at the customers.

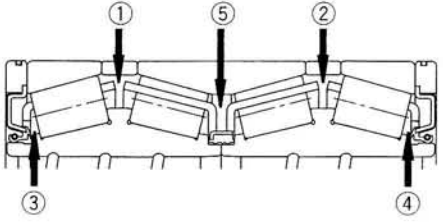
- 1) Disassembling and washing of all bearing parts – overhaul inspection
- 2) Appearance observation and inspection – routine inspection

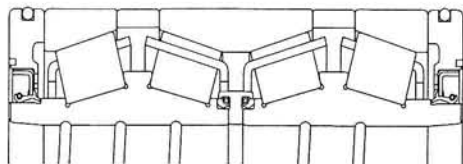
All details and proposal interval as to the above inspection is attached.

9-4 The Routine Inspection and Overhaul (Maintenance-refreshing)

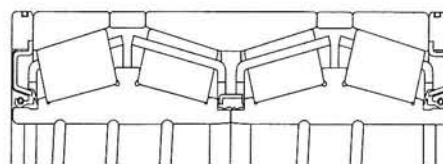


After 9 months operation, the intervals of inspection and overhaul for future are determined by discussion based on the service record past and bearing condition (grease condition).

Kind of Inspection	Inspection Items and Parts	Points of
<p>☆ Overhaul Inspection (with washing of all bearing parts) (Note) within 1 or 2 days after dismount bearing from roll, this inspection should be done for sure analysis.</p>	<p>Grease - water content and contamination.</p> <p>(Note) Grease taken out must be kept into vinyl bag or small bottle to prevent water from evaporating until inspection.</p> <ol style="list-style-type: none"> 1. Water content check. 2. Contamination check in grease. 	<ol style="list-style-type: none"> 1. Water content should be checked by the specialist or JTEKT engineering dept. 2. Sampling position of grease. 
<p>The purpose of the first overhaul</p> <ol style="list-style-type: none"> 1. To check and analyze the effect of <ul style="list-style-type: none"> - chock seal - drain holes (size) - bearing seal through inside grease inspection. 2. To confirm if the bearing clamping is adequate or not by checking contact zone of bearing with the chock bore and fillet ring. <p>The purpose of the second and third overhaul</p> <ol style="list-style-type: none"> 1. To determine the interval and term for maintenance free. 	<p>Bearing</p> <ol style="list-style-type: none"> 1. Cup, cone, rollers, cage and spacer- abnormality, wear, damage and creeping etc. 	<p>Following condition has to be observed carefully for finding abnormality:</p> <p>Cup</p> <ol style="list-style-type: none"> 1. To check load zone on a cup raceway. 2. Contact condition between raceway and rollers. 3. Wear of bearing rib and roller's ends. 4. Cup O.D. and side face for creeping, color change and seizure etc. 5. Wear of axial contact surface for cup, cone and spacer.




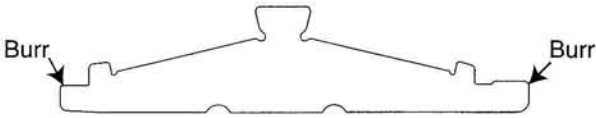
Type 1



Type 2

Inspection	Measurements for unusual of abnormality
<p>Judgement</p> <p>water content: less than 10%; contamination (and others): less than 1%.</p>	<ol style="list-style-type: none"> 1. If water content at ①, ② and ⑤ position were higher than other position, clamping force and method have to be reviewed and reconsidered. 2. If at every position water content in grease was over 10%, chock and bearing seal has to be checked, besides reconsidering of removal method of excess grease out of chock, and amount of grease on roll neck and bearing bore.
	<p>(Note) Water stain and rust should be removed whenever they were found.</p> <ol style="list-style-type: none"> 1. When the abnormality of load contact condition were found, the accuracy of chock and stand has to be checked and modified. 2. If creeping on O.D. and side face was observed, the clamping method and means against the cup have to be reconsidered and modified properly. 3. On finding small spalling and pitting, they have to be corrected with an oil stone or emery cloth. In case of large size spalling, please discuss with JTEKT -engineer for re-using.

Kind of Inspection	Inspection Items and Parts	Points of
<p> Overhaul Inspection (with washing of all bearing parts) (Note) within 1 or 2 days after dismount bearing from roll, this inspection should be done for sure analysis.</p>	<p>(Bearing)</p> <ol style="list-style-type: none"> 2. Bearing seal and cone spacer seal-hardening, wear, cracks and damage. 3. O-ring cutting, crack and damage. 	<p>Cone</p> <ol style="list-style-type: none"> 1. Before and side face of cone <ul style="list-style-type: none"> - for abnormality such as creeping and seizure etc. 2. Contact zone or area on rollers for abnormality such as wear. <p>Cage</p> <ul style="list-style-type: none"> - deformation - contact trace with other parts - lossing of pin.
	<p>Chock and chock seal</p> <ol style="list-style-type: none"> 1. Drain holes – effect and size. 2. Chock seal – crack, damage and condition of existing grease. 3. Chock dimension and tolerance – whenever necessity was found for analysing abnormality. 	<ol style="list-style-type: none"> 1. Before washing, to check if the excess grease plugged the drain holes or not. 2. As to chock seal, the same as bearing seal. 3. Tolerance and out-of-roundness of chock bore based on customers inspection term. 4. Wear and contact condition of chock bore and chock face. To review clamping.

Inspection	Measurements for unusual of abnormality
<p>Seal - contact condition with seal rubbing surface of cone.</p> <ol style="list-style-type: none"> 1. Hardening, cracks, damage and wear of seal lips. 2. Damage and cutting of seal spring. 3. Damage of O-ring. 4. The same as the above 1. for central seal. (Type 1 only) 	<ol style="list-style-type: none"> 1. If temper-color or seizure due to creeping was observed on bore, grease q'ty on roll neck and bearing bore or lubrication method have to be reviewed to prevent from creeping. 2. Regarding spalling and pitting rollers, the same as cup and cone. 3. To remove the burr on the edge of cone with emery paper. <div style="text-align: center;">  </div> <p>(None) Heat cracks were found on the face of bearing and D.P., no reuse is accepted. If the damage on seal and O-ring were found, to install new one is required.</p>
	<ol style="list-style-type: none"> 1. To take excess grease completely out from chock by some certain tool like wire. 2. In case of heavy damage, to put new one. (Note) To put grease on seal lips at every installation. 3. JTEKT recommendation for control limit of chock bore and roll neck O.D. are shown in Tables 1 and 2.

Kind of Inspection	Inspection Items and Parts	Points of
<p>◎ Routine Inspection</p> <p>Without disassembly from the chock-but chock cover and the cup of the first row be taken out for inspection until the intervals of inspections and overhaul for future is determined.</p>	<ol style="list-style-type: none"> 1. The observation of the condition of the bearing inside. <ol style="list-style-type: none"> 1) Raceway-load zone, contact conditions with rollers. 2) Inside grease for abnormality 3) Bearing seal and O-ring for weaving, damage and other abnormality. 4) Roller- the same as the cup raceway. 5) Cage for abnormality. 2. Cone bore and side face. 3. Chock seal lip and spring. 4. Chock cover. 	<p>To take out the chock from roll neck and the cover from the chock and then the cup of the first row would be pulled out from the chock.</p> <ol style="list-style-type: none"> 1. The same and the overhaul inspection. 2. 1) To confirm the existing of grease. 2) To confirm sizes of color change of critical creeping on bore. 3) To check if heat crack occurred the side face.

Inspection	Measurements for unusual of abnormality
<p>3. Seal</p> <ul style="list-style-type: none">1) Seal lip-hardening, crack, wear.2) Spring damage, wear and damage.	<ul style="list-style-type: none">1. If any abnormality was found, the overhaul inspection has to be conducted.2. The same as above, and if seal lips as little existing grease of dry, the review of greasing interval of seal has to be considered.3. If heavy wear of damage was found, new seal has to be installed.

10. FITS AND WEAR LIMITS

Table 1 Recommended Chock Bore Dimensions

a) For Metric Series Bearings

Unit : μm

Brg. O. D. (mm)		Chock Bore Standard Tolerance		Fitting Clearance		Max. Chock Bore Out of Roundness	Allowable Max. Chock Bore
over	incl.	over	incl.	over	incl.		
120	150	+25	+57	25	75	75	150
150	180	+50	+100	50	125	100	250
180	250	+50	+120	50	150	150	300
250	315	+50	+115	50	150	150	300
315	400	+50	+110	50	150	150	300
400	500	+50	+105	50	150	150	300
500	630	+50	+100	50	150	150	300
630	800	+75	+150	75	225	200	450
800	1000	+75	+150	75	250	250	500
1000	1250	+100	+175	100	300	300	600
1250	1600	+125	+215	125	375	350	750
1600	2000	+150	+250	150	450	400	900

b) For Inch Series Bearings

Unit : μm

Brg. O. D. (mm)		Chock Bore Standard Tolerance		Fitting Clearance		Max. Chock Bore Out of Roundness	Allowable Max. Chock Bore
over	incl.	over	incl.	over	incl.		
---	304.8	50	75	25	75	150	150
304.8	609.6	100	150	49	150	150	300
609.6	914.4	150	225	74	225	250	450
914.4	1219.2	200	300	98	300	300	600
1219.2	1524.0	250	375	123	375	350	750

Table 2 Recommended Roll Neck O.D.

a) For Metric Series Bearings

Nominal bore diameter (mm)		Roll Neck Dia. Tolerance (μm)		Fitting Clearance (μm)		Roll Neck Dia. Undersize (μm)
Over	Up to	Lower	Upper	Min.	Max.	Min.
80	120	-150	-120	100	150	-300
120	180	-175	-150	125	175	-350
180	250	-200	-175	145	200	-400
250	315	-250	-210	175	250	-500
315	400	-300	-240	200	300	-600
400	500	-300	-245	200	300	-600
500	630	-300	-250	200	300	-600
630	800	-400	-325	250	400	-800
800	1000	-425	-350	250	425	-900

b) For Inch Series Bearings

Nominal bore diameter (mm)		Roll Neck Dia. Tolerance (μm)		Fitting Clearance (μm)		Roll Neck Dia. Undersize (μm)
Over	Up to	Lower	Upper	Min.	Max.	Min.
101.6	127	-125	-100	100	150	-300
127	152.4	-150	-125	125	175	-350
152.4	203.2	-175	-150	150	200	-400
203.2	304.8	-200	-175	175	225	-450
304.8	609.6	-250	-200	200	301	-600
609.6	914.4	-325	-250	250	401	-800

11. CHARACTERISTICS OF RECOMMENDED GREASES

Name	(Kyodo yushi Made) ADLEX	(Kyodo yushi Made) PALMAX RBG
Thickener	Lithium soap	Special-lithium complex
Base Oil	Mineral oil	Mineral oil
Viscosity, mm ² /s (100°C)	15.7	17.2
Appearance	Yellow Buttery like	Yellow Buttery like
Penetration (60 worked)	300	300
Dropping Point, °C	200	215
Oil Separation, mass % (100°C x 24h)	3.0	2.9
Oxidation Stability, Pa (99°C x 100h)	29000	39000
Working Stability	325	350
Usage temperature range, °C	-20 to 130	-10 to 150

Value & Technology

JTEKT CORPORATION

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