

Mounting and maintenance instructions

# Four-row cylindrical roller bearings



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# Introduction

## Design features and benefits

With a separable design that features a movable inner ring, four-row cylindrical roller bearings from SKF are available in a range of designs. Essentially, these designs differ in the number of inner and outer rings and in the number of loose or integral flanges on the outer ring.

Offering mills a proven solution for the high radial and axial forces that act on roughing and intermediate stands, four-row cylindrical roller bearings from SKF deliver:

- Higher load-carrying capacity
- Longer service life
- Easier maintenance and inspection
- Improved sealing

## Handling, mounting and maintenance

Four-row cylindrical roller bearings are precision mechanical components. If they are to achieve their potential service life, they must be handled, mounted, operated and maintained with care.

During mounting and dismounting, the bearings should be handled, lifted and mounted using the appropriate tools and according to the instructions in this guide; doing so will help prevent damage to shafts and housings.

During operation, four-row cylindrical roller bearings must be properly lubricated and protected from contamination. Periodic maintenance inspections are also essential, and are facilitated by the bearing's separable cage and seal, which makes disassembly, inspection and re-installation easier than ever.



## Additional steps and support

The mounting and maintenance instructions in this guide are generic to four-row cylindrical roller bearings in typical rolling mill applications in the metalworking industry. Depending on the availability of tools, or the design, size and weight of the bearings and other components, it may be necessary to deviate from the methods described within. Experts in the SKF Industrial Service Centre can support your team in these or similarly challenging installation procedures.

- For additional information about SKF mounting tools, including mechanical tools, hydraulic tools, heating equipment and gloves, visit [www.mapro.skf.com](http://www.mapro.skf.com).
- SKF Training Solutions offers a comprehensive range of training courses in mounting. Contact your local SKF representative for additional information, or visit [www.skf.com](http://www.skf.com).

# Design, designation and marking

Generally, four-row cylindrical roller bearings above 300 mm bore have a pair of outer rings, each with two roller tracks separated by a fixed flange. A loose outer ring flange separates the outer rings and the two middle rows of rollers. Loose out-board flanges retain the outer sets of rollers. Inner rings are normally supplied as a pair with two roller tracks on each. These features permit separation of components making handling, assembly, disassembly and inspection easier.

Smaller bearings typically have integral outer ring flanges and often have one-piece inner rings. Bearings up to 400 mm bore diameter are usually manufactured with roller-centered, double-pronged machined cages made from brass or steel. Larger bearings normally have a steel pin-type cage for each of the four rows of rollers.

Four-row cylindrical roller bearings are also available with a variety of heat-treatment options to suit different operating conditions. It is important that any replacement bearings, or parts of bearings, are of the same specification as originals.

## Four-row cylindrical roller bearing component designations

Very few of these bearings are delivered complete – inner rings (designation prefix L) and outer rings with roller sets and cages (designation prefix R) are usually supplied separately, as shown in the example (fig. 1). For example, bearing 326119 is a drawing number with no reference to product dimensions. Complete bearing assemblies may have inner and outer ring numbers that do not match.

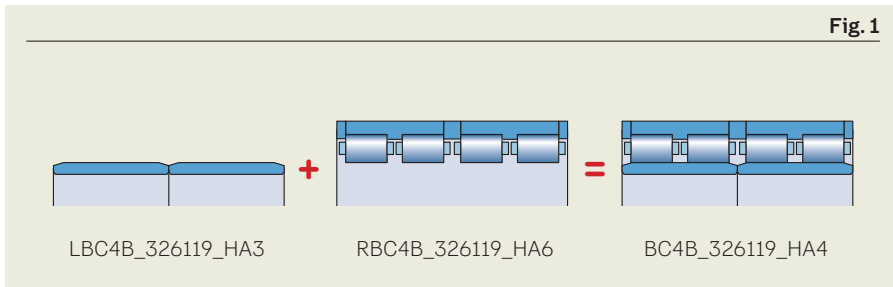
## Bearing serial number and component marking

Outer rings and roller sets share the same serial number and should be assembled together. Inner rings of the same part number are interchangeable and can be combined with outer ring sets of a different serial number (fig. 3).

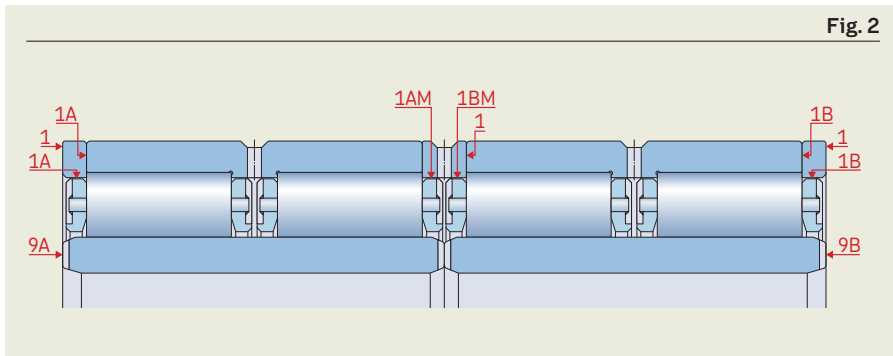
Individual bearing components are further marked by letters and the appropriate serial number (fig. 2) and should be mounted in the indicated order.

The side faces of the outer rings are divided into four zones marked I to IV. The markings indicating load zone I are also indicated by lines extending across the whole width on each outer ring (fig. 4). When mounting for the first time, it is customary to install the bearing so that the zone I lies in the direction of the load.

After each inspection, the outer rings should be turned so that another zone becomes the loaded zone. The order I, III, II, IV is recommended.



Example of markings on inner ring and rollers; bearing serial number 1



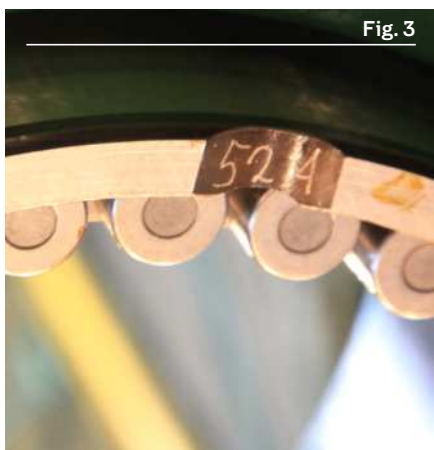
Example of markings on outer ring and inner ring and rollers; bearing serial number 1

## Execution VU001

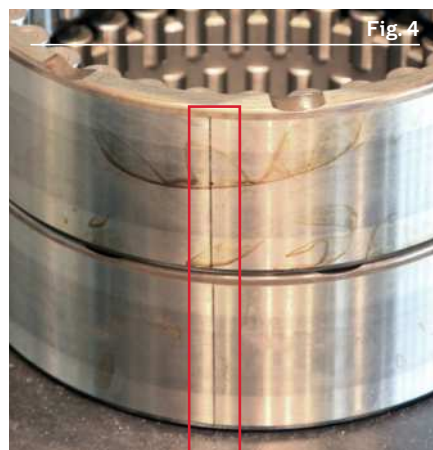
The majority of SKF four-row cylindrical roller bearings are supplied finish-machined and ready to mount. However, when the bearing designation includes suffix VU001, the inner rings are supplied with a machining allowance on the outside diameter and must be finish-ground after they are mounted on the roll neck journal (with interference fit).

Finish-grinding the inner rings and the roll body in the same setup allows closer control of bearing internal clearances, improving roll running accuracy and in turn, rolled product quality. Should the VU001 inner rings start to show minor wear or damage, it is usually possible to regrind them and the roll body at the same machine setting.

Instructions for finish-grinding VU001 inner rings are specific to each application and can be requested via your local SKF representative.



Bearing serial number and component marking



Loaded zone marking

# Preparation for mounting

## General concerns

Prior to mounting four-row cylindrical roller bearings, carefully review this guide and any related drawings or instructions to determine:

- the correct bearing type, size and variant
- the correct order in which to assemble components
- the appropriate lubricant and quantity to be used
- the appropriate mounting method
- the appropriate mounting tools

For future reference, installers should also note the bearing, chock and roll number plus the actual loaded zone on the “Bearing position” report sheet (Appendix 1, page 18).

SKF also recommends mounting (and dismounting) the inner ring(s) using SKF TIH or EAZ electrical induction heaters and a specially made mounting sleeve. Inner rings can also be heated in oil baths or, for smaller rings, with the SKF TMBR series of aluminium rings. If oil bath heating is used, excess oil should be wiped off the ring bore before mounting on the roll neck.

For more information about SKF mounting tools, including mechanical tools, hydraulic tools, heating equipment and gloves, visit [www.mapro.skf.com](http://www.mapro.skf.com).

## Bearings

SKF bearings are supplied in protective packaging and should remain in their original wrapping until they are to be installed. SKF recommends storing packaged bearings in a dry room at a constant temperature. During mounting – and particularly for bearings that will be remounted – SKF recommends checking the bearing and component serial numbers and preparing components in the order in which they will be mounted.

## Roll necks

In most cases, inner rings of four-row cylindrical roller bearings in back-up and work roll applications are mounted on the roll neck with an interference fit. Recommended roll neck diameter tolerances are shown in **table 1**. For a good fit, SKF recommends aiming for the upper limits of the tolerance range (maximum metal condition). Certain applications require loose fit on the roll neck. Recommended roll neck tolerance for such case are in **table 2**.

**NOTE:** Specific applications may require roll neck diameter tolerances that differ from the recommendations in **tables 1** and **2**. Accordingly, SKF strongly recommends checking roll neck form and dimensional tolerance requirements against the machine manufacturer’s specifications. If those tolerances differ from those in **tables 1** and **2**, installers should follow the machine manufacturer’s recommendations instead.

**Table 1**

### Recommended roll neck tolerances

Roll neck diameter from	up to (incl.)	Diameter tolerance
mm		mm
0	250	p6
250	400	r6
400	≥	s6

Please contact SKF for fit recommendations for rolling mills running with very high load or large speed, i.e. mill running under equivalent load (see RB 10000 for definition) larger than 0.5 dynamic load carrying capacity C of the bearing ( $C/P < 2$ ), or linear rolling speed more than 1500 m/min

**Table 2**

### Recommended roll neck tolerances in case of loose fit (e.g. some section mills)

Roll neck diameter from	up to (incl.)	Diameter tolerance
mm		mm
0	315	d7
315	≥	e7

**Table 3**

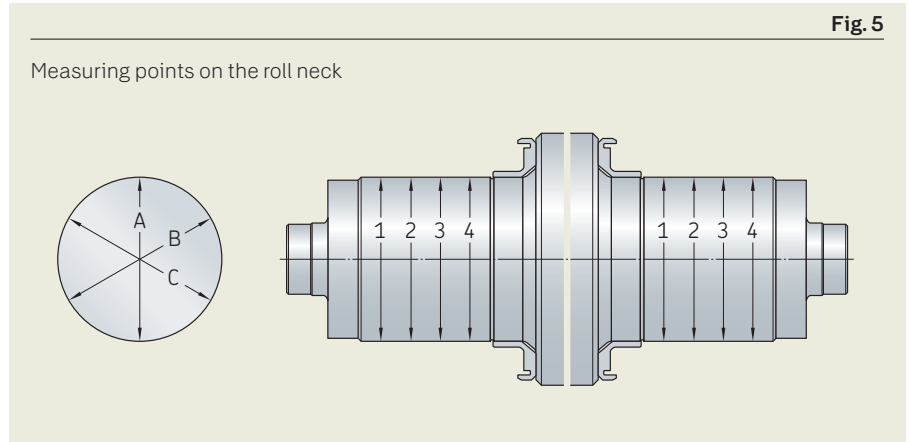
### Recommended surface roughness of bearing seating

Seat diameter d (D)		Recommended Ra value for ground seating
over	incl.	
mm		µm
80	500	1,6
500	1 250	3,2

To check the roll neck, diameter measurements should be taken in several planes (e.g., 1, 2...7) and in several angular directions (e.g., A, B, C) (fig. 5). SKF recommends taking a minimum of three angular measurements in four planes. Diameter measurements should be within machine manufacturer's specified tolerances (if not available, see tables 1 and 2). The maximum difference between all measurements should not exceed the form tolerance stated in the machine manufacturer's specification (if not available, see table 4).

All roll neck diameter measurements should be recorded along with the date, roll serial number, roll temperature, corresponding target tolerance and name of the person taking the measurements. Such records can help to track the components, their service life and their influence on production quality.

Table 3 lists the recommended surface roughness of the roll neck bearing seat. All seating surfaces must be free from burrs, score marks or bruises. The fillet (labyrinth) rings must be free from turning grooves. SKF also recommends a thorough cleaning and visual inspection of the surface.



**Table 4**

Geometrical tolerances for bearing seats on shafts and in housings

Surface Characteristic	Symbol for geometrical characteristic	tolerance zone	Permissible deviations Bearings of tolerance class			
			Normal, CLN	P6	P5	
Cylindrical seat Total radial run-out		$t_3$	IT5/2	IT4/2	IT3/2	IT2/2
Flat abutment Total axial run-out		$t_4$	IT5	IT4	IT3	IT2

**Explanation**

For normal demands

For special demands with respect to running accuracy or even support

# Preparation for mounting

## Chocks

The outer rings of both inch and metric four-row cylindrical roller bearings are usually mounted with a clearance (loose) fit. SKF-recommended values for chock bore diameter tolerance are shown in **table 5**; however, machine manufacturer's specifications should always be checked and adhered to if they differ. Lubrication holes in the chock must be clean and free of any foreign particles.

To avoid fretting corrosion in operation, a thin coat of an anti-fretting agent such as SKF LGAF3 should be applied to the housing bore surface. All chock assembly parts should be checked for completeness and for correlation with drawing documentation.

The bearing seating should be checked for diameter tolerance and form tolerance by measuring at different positions in several planes according (**fig. 6**). SKF recommends measuring the diameter in at least four positions in each plane.

All diameter measurements should be within the machine manufacturer's specified tolerances (if these are not available, then refer to those in **table 5**). The difference between the maximum and minimum values should not be larger than the form tolerance stated in the machine manufacturer's specification (if this is not available, see **table 4**).

All measurements should be recorded along with the date, roll serial number, roll temperature, corresponding tolerance and name of the person taking the measurements. Such records can help to track the components, their service life and their influence on production quality.

**Table 5**

Recommended diameter tolerances for chock bore for metric bearings

Outer diameter of the bearing	Chock bore tolerance
-------------------------------	----------------------

mm	–
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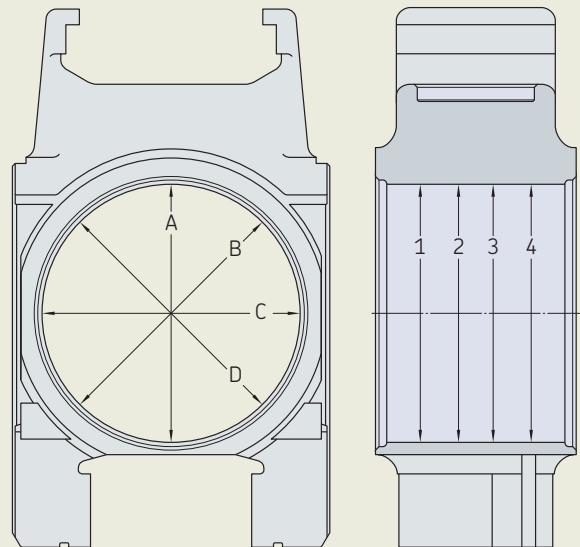
D < 800	G7 $\epsilon$
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D $\geq$ 800	F7 $\epsilon$
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For used chocks tolerance H10 can be accepted  
For tolerance for inch sizes please contact SKF

**Fig. 6**

Measuring points on the chock





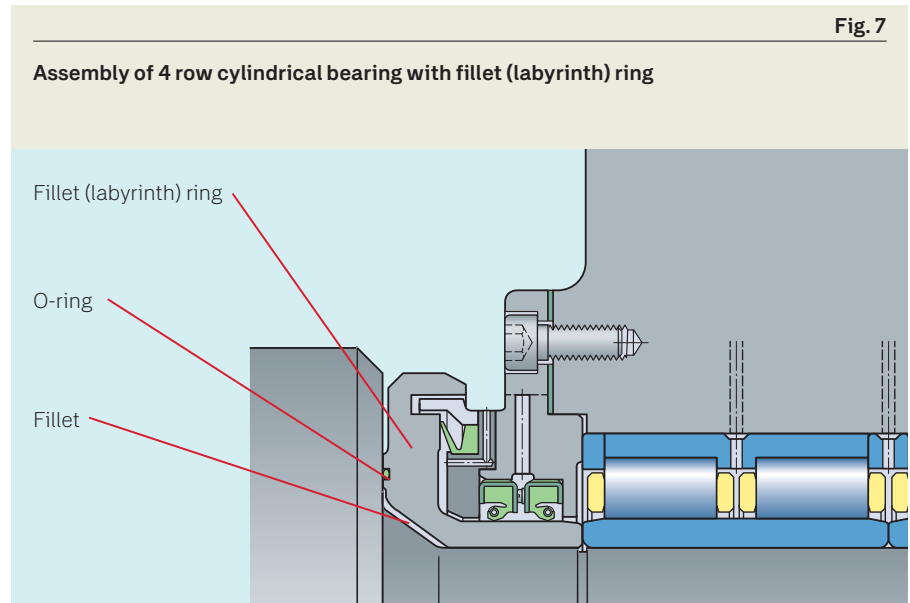


*Measuring the chock*

# Inner ring mounting

## Basic instructions

- Prior to mounting, the roll body side labyrinth ring should be shrink-fitted on the shaft by means of heating.
- Fillets (or labyrinth) rings († fig. 7) at the roll neck transition should be coated with anti-corrosive paint.
- As the labyrinth rings cool they should be clamped tightly in the axial direction, in contact with the roll face all around.
- If O-rings are also being used, make sure that they are properly seated in their grooves and compressed against the roll body.



## Inner rings with cylindrical bores and tight fits

- Check that the inner rings are marked with the same serial number (*Bearing serial number and marking of components, page 5*) and prepare them for mounting with their marked side faces outboard.
- Heat the inner rings to between 100 to 120 °C (212 to 248 °F), using one of the heating methods described in *Preparations for mounting: General concerns, page 6*. Inner rings are dimensionally stable up to 160 °C, but for mounting purposes they should never be heated above 140 °C.
- Carefully push each heated inner ring onto the roll neck up to its abutment; use suitable lifting / handling equipment and a crane if necessary. Inner rings of larger 4-row cylindrical roller bearings are made up of two or four inner rings; each should be heated and pushed onto the roll one after another. For large rings, SKF recommends using a spring on the hoist to allow fine adjustment.

- Once the rings are in the roll neck, hold them against their abutment on the roll neck to cool down and shrink on. Do not attempt to adjust the axial position of an inner ring as it cools. A small gap of approximately 0,5 mm between abutment shoulder and inner ring or between inner rings due to shrinkage after cooling down is normal.
- If mounting bearings with VU001 inner rings, the inner rings and roll body can be finish-ground after they have completely cooled. First, grind the inner rings to their finished dimensions according to SKF grinding recommendations, then finish-ground the roll body at the same setting. **NOTE:** Specific VU001 inner ring applications will require specific grinding recommendations from SKF – please contact your local SKF representative for more information.

### Inner rings with cylindrical bores and loose fits

- Check that the inner rings are marked with the same serial number (*Bearing serial number and marking of components*, page 5) and prepare them for mounting with their marked side faces outboard.
- Inner rings with cylindrical bores and loose fits require case-hardened inner rings with a helical groove in the bore. There are no special requirements for mounting such rings; installers should follow general recommendations in the *SKF bearing maintenance handbook* (publication number 10001).
- Maintaining proper lubrication between the inner ring bore and roll neck is essential – installers should review *Lubrication recommendations* on page 6 of this guide.

### Inner rings with tapered bores and tight fits

- Check that the inner rings are marked with the same serial number (*Bearing serial number and marking of components*, page 5) and prepare them for mounting with their marked side faces outboard.
- SKF recommends using the SKF Oil injection method for mounting and dismounting inner rings with tapered bores – installers should follow related recommendations in the SKF rolling bearings catalogue, or contact an SKF representative for more information.
- Once the inner rings are in their final mounted position (set by the spacer width), they should be held securely for at least ten hours to let the oil escape from the contact area between the shaft and the bearing bore.
- Complete the final assembly of the bearing arrangement; spacer dimensions should follow the machine manufacturer's recommendations.

# Outer ring and rollers – assembly and mounting

Depending on machine design and the availability of installation tools, assembly and mounting procedures for outer rings and rollers can vary. Accordingly, the following instructions cover the required steps involved both with and without specially designed lifting tools.

The TMMH bearing handling tool from SKF offers one such option to facilitate the handling, mounting and dismounting of bearings on shafts – for more information about SKF TMMH tools, visit [www.mapro.skf.com](http://www.mapro.skf.com).

## Prior to assembly

Whether or not the installer uses lifting tools, roller sets with pin-type cages require lubrication prior to assembly. Such roller cages must be dipped in the same type of oil that will lubricate the bearing (for grease-lubricated bearings, the oil must be compatible with the grease). This step is key for the initial lubrication of the pin inside the roller; neglecting it can lead to premature bearing failures.

## Assembly and mounting with tools

- Turn the chock and support it securely with its axis vertical and the open end up, ready for the bearing to be inserted into its bore.
- Apply an anti-fretting agent such as SKF LGAF3 to the housing bore surface.
- Assemble the bearing on a clean support surface with its axis vertical, ensuring that all parts are marked with the same serial number, assembled in the correct order, and correctly orientated and aligned (*Bearing serial number and marking of components*, page 5).
- Using a hoist and special lifting tool, lift the complete bearing except for the lower loose end flange.
- Place the loose end flange in position in the chock bore, against the abutment with the next load zone marking (zone I for a new bearing) aligned with the radial load direction.
- Lower the bearing assembly into the chock bore, aligning the appropriate load zone marking with the direction of the radial load, until it rests on the loose end flange.
- Record the load zone position for future reference.





### Assembly and mounting without tools

If a special lifting tool is not available, outer rings and roller sets of bearings with loose flanges and fabricated steel pin-type cages can be assembled to the chock bore as individual components.

- Make sure that all parts are marked with the same serial number, assembled in the correct order, and correctly orientated and aligned (Fig.8 and *Bearing serial number and marking of components*, page 5).
- Place the loose end flange in position in the chock bore, against the abutment with the next load zone marking (zone I for a new bearing) aligned with the radial load direction.
- Assemble the first roller set with the appropriate outer ring half, keeping its axis vertical and the roller set lowermost.
- Lift the outer ring half and roller set assembly using three off eye bolts inserted into the tapped holes in the side flange of the cage, then lower it into the chock bore, aligning the appropriate load zone with the direction of the radial load so it rests on the loose flange.
- Continuing to align the appropriate load zone, lift the second roller set using eye bolts in its side flange, then lower it into place in the outer ring track.
- Place the central flange in position and continue the assembly with the remaining roller sets and outer rings.
- Whichever method is used, installers should make sure that the load zone position used is recorded every time a bearing is mounted.
- Record the load zone position for future reference.

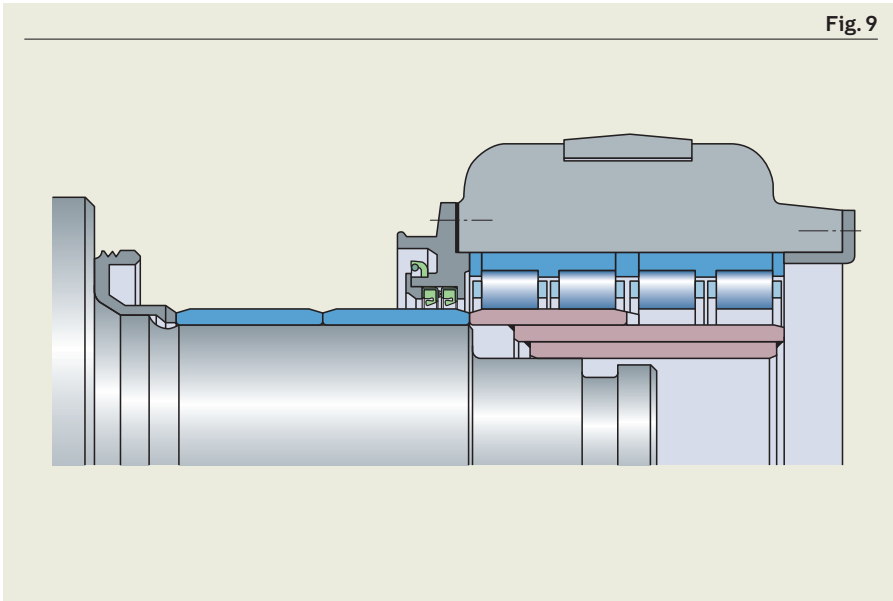
# Chocks

## Installing seals and chock end covers

- Make sure that seal lip orientation is completed according to the seal manufacturer's recommendations.
- Apply the same type of oil or grease that will be used to lubricate the bearings to the seal lip in preparation for mounting the assembled chock to the roll neck.
- Tighten the end cover screws, making sure that all parts of the outer rings are clamped axially.
- Tighten bolts to the machine manufacturer's specified torque.
- During tightening, make sure that gasket seals between the chock end cover and the chock are compressed to seal manufacturer's recommendations.

## Mounting assembled chocks to the roll neck

- An assembled chock should be securely supported with its axis horizontal. Apply a little of the bearing lubricant to the bearing inner rings and to seal lands to assist when mounting the chock assembly.
- Typically, assembled chocks are aligned and mounted to roll necks with the help of a special rail-mounted device on a horizontally and vertically movable table. Thereafter, the bearing assembly will be axially located on the roll neck.
- Alternatively, an assembled chock can be lifted and pushed onto the roll neck using a hoist, eye bolts and an adjustable three-point suspension system. The length of the suspension system's third rope should be adjustable, so that the chock can be positioned in an exactly horizontal position before mounting; this can be verified using a spirit level.
- If possible, rotate the roll during assembly or removal to avoid scratches on the bearing components, guiding the assembled chock onto the roll neck / inner rings and engaging any seals on their lands without damage.
- Four-row cylindrical roller bearings are designed so that the rollers have clearance in their cage. During mounting, this design feature can allow rollers to damage the inner ring by impacting the ring's side face or scraping across its track surface. Accordingly, SKF recommends using a guiding device to lift and align the rollers as the chock assembly is mounted (fig. 9, 10 and 11). Exact execution depends on the rolling mill design – for assistance, please contact your local SKF representative.
- After mounting the outer cover, fill the bearing with the recommended volume of lubricant (see the *Lubrication recommendations* section of this guide).
- To dismount bearings, simply follow the above steps in reverse.



A depiction of how to mount the chock/outer ring assembly over a guiding sleeve and onto the roll neck/ inner rings.

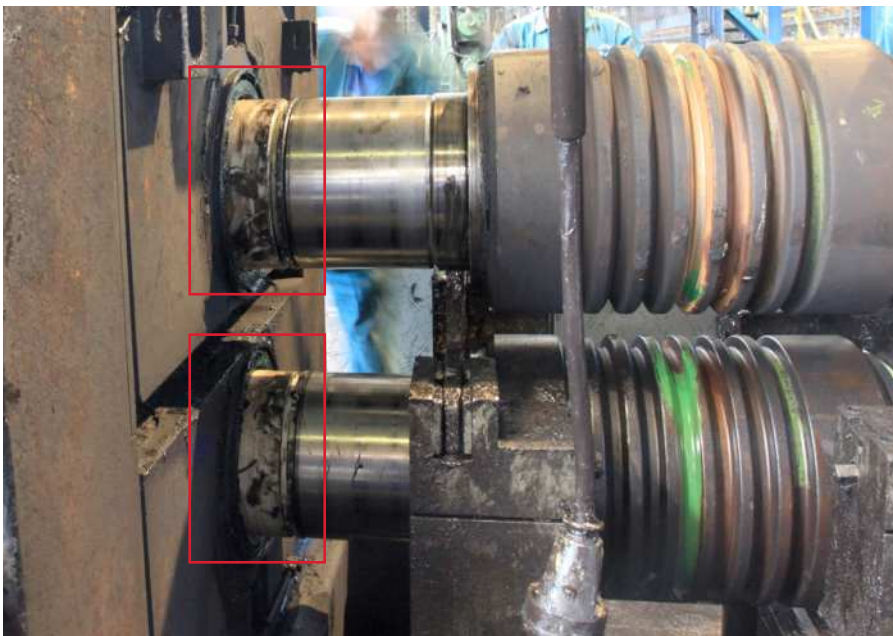


Fig. 10 Installing chocks with guiding sleeves (in red)



Fig. 11 Close-up of guiding sleeve

# Lubrication recommendations

Using the correct lubricant type and quantity are essential for good bearing performance. Both should be selected based on specific mill application and operating conditions. For assistance, please contact your local SKF representative.

## Initial filling

### Grease lubrication

Initial filling [kg] = mass of the bearing [kg] / 40

### Oil lubrication

Whether the oil lubrication method employed is oil circulation, oil air or oil mist, supplying the adequate quantity of oil after assembly is key. An oil bath level, for example, should always be above the center of the lowest roller.

## Lubrication between the roll neck and inner ring with loose fits

When the bearing inner rings are mounted on roll necks with loose fits, it is essential to use case-hardened inner rings with a helical groove in their bores and to maintain good lubrication between the inner ring bores and the roll neck. Doing both will help prevent excessive wear. Lubricating the contact between inner ring bores and the roll neck can be accomplished in one of the following ways:

- **Bearings lubricated with oil, circulating oil, oil air or oil mist:**  
In addition to having helical grooves in their bores, inner rings should also have lubrication grooves in their side abutment faces. The contact between inner ring bore and roll neck will then be lubricated with oil seepage from the normal bearing lubrication.

- **Bearings lubricated with grease:**  
In open or sealed bearing variants, grease seepage from the bearing will not be sufficient to provide reliable lubrication between the inner ring bore and roll neck. In such cases, if the inner rings are to stay on the roll neck for any length of time (longer than one shift), then additional grease must be supplied. SKF recommends the use of lubrication drillings in the roll journal side face that will allow re-greasing between the inner ring bore and roll neck journal during stops for regrinding or other maintenance.

If the inner rings are to be dismounted from the roll neck after a short time period (less than one shift), then it should be sufficient to clean and lubricate the bore of the bearing or the roll neck with grease before assembly of the inner rings and chocks to the roll neck.



Outer ring and rollers assembly mounted and filled with grease



# Bearing maintenance

## Bearing inspections

During operation, bearings should be checked periodically for unusual noises or high running temperatures. After 1 200 hours of operation or one year (whichever occurs first) bearings should be removed, cleaned and inspected visually.

To do so, SKF recommends removing the chocks and disassembling the bearing outer ring. After cleaning, the outer ring components should be checked for wear and other damage. Inner rings that are mounted with an interference fit (including tapered bore inner rings) should be inspected in situ on the roll neck. Inner rings that are mounted with a loose fit should be dismantled and inspected; inner ring bores, the roll neck journal and all abutment faces should be checked as well.

## Bearing remounting

When remounting the outer ring assembly of four-row cylindrical roller bearings to the chocks, the next outer ring load zone should be aligned with the direction of the radial load. To facilitate the process, the bearing outer rings are marked with four different loaded zones: I, II, III and IV.

## Bearing cleaning

Used or dirty bearings should be cleaned using acid-free solvents. If highly volatile detergents are used, then a small quantity of mineral oil should be added to the detergent to protect the quick drying, degreased bearing against corrosion. If the bearings are to be stored for a longer period of time, they should be treated with a rust-inhibiting agent, then wrapped in oiled paper.

## Bearing maintenance record keeping

Mill maintenance teams should keep detailed maintenance records that include data on bearing position, hours of operation, rolled material in tons, plus remarks on possible damage, repairs and failure causes (Appendix 2, page 19). Over time, such records can quantify mill train bearing consumption precisely, which can help optimize stock planning.

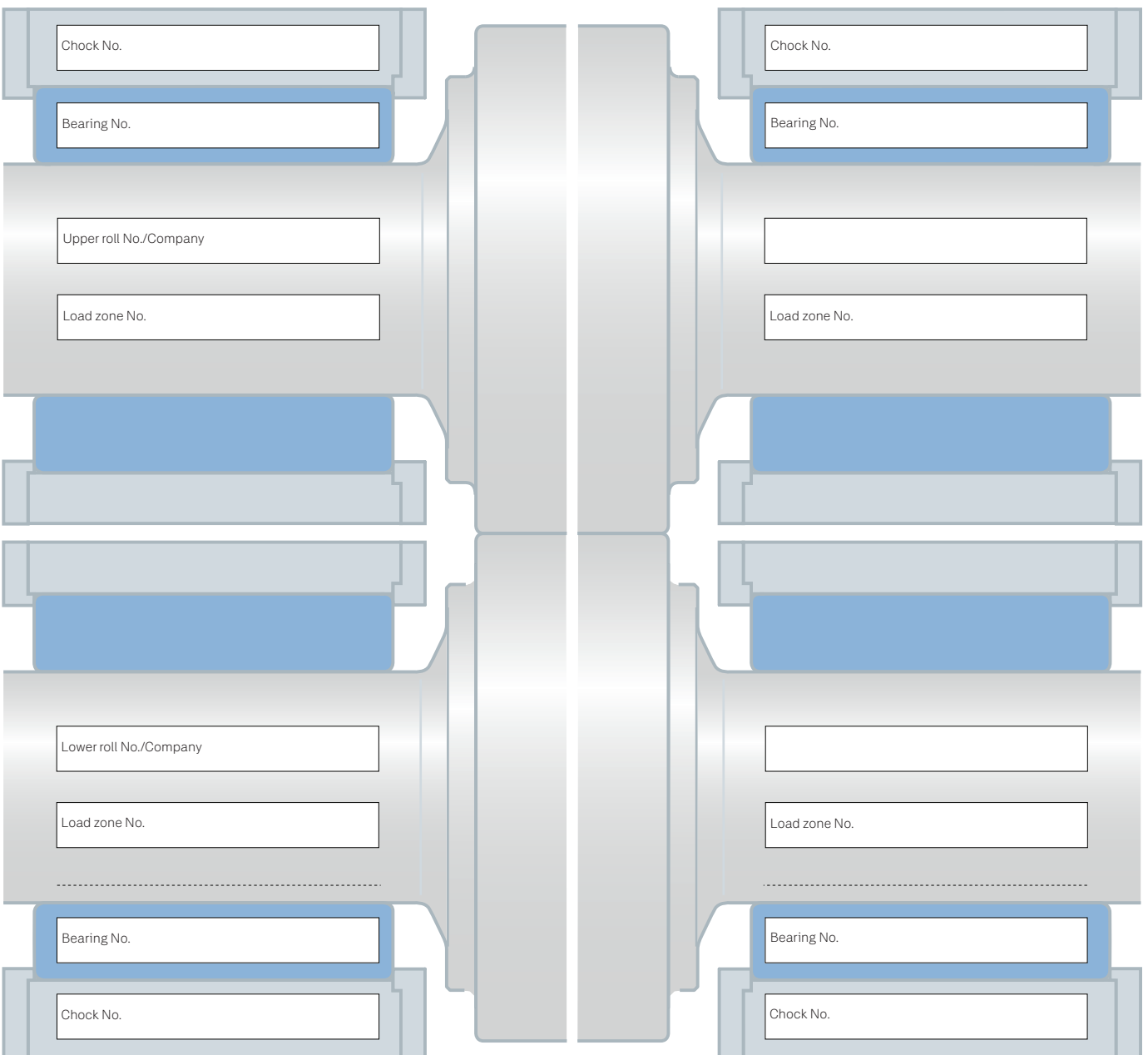
## SKF remanufacturing services

SKF recommends sending used bearings to an SKF Solution Factory where they can often be serviced and reconditioned. Bearing remanufacturing offers an economical way to utilize bearings to their maximum potential. SKF bearing remanufacturing services include a compre-

hensive bearing analysis and a report that can provide useful information for machine improvements.



Train
Stand and No.
Type
Bearing designation





Appendix 2  
Bearing checklist

Bearing type	Bearing designation	Consecutive number of bearing	Delivery date	Delivery number	from
--------------	---------------------	-------------------------------	---------------	-----------------	------

Bearing dimensions: Bore diameter	Outside diameter	Width
-----------------------------------	------------------	-------

Bearing Mounted Date	Dis-mounted Date	Position Dept./Train Stand No.	Roll No.	Roll side/ Outboard	Upper roll/ Lower roll	Chock		Drive side (A) Operator side (B)	Hours of operation	Production in tonnes	Lubricant	Remarks	Signed
						No.	No.						

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