SKF Explorer four-row tapered roller bearings

Contents

The SKF brand now stands for more than ever before, and means more to you as a valued customer.

While SKF maintains its leadership as a high-quality bearing manufacturer throughout the world, new dimensions in technical advances, product support and services have evolved SKF into a truly solutions-oriented supplier, creating greater value for customers.

These solutions enable customers to improve productivity, not only with breakthrough application-specific products, but also through leading-edge design simulation tools and consultancy services, plant asset efficiency maintenance programmes, and the industry's most advanced supply management techniques.

The SKF brand still stands for the very best in rolling bearings, but it now stands for much more.

SKF – the knowledge engineering company

SKF

User-friendly and reliable

The SKF Explorer design of four-row tapered roller bearings without spacer rings provides the following customer benefits:

• Higher load-carrying capacity
• Longer service life
• Unique maintenance and inspection features
• Improved sealing

Spacer-less bearings have the same envelope dimensions as conventional designs with spacers, but offer the following advantages:

• Fewer bearing components which simplifies mounting and dismounting
• Reduced inner ring width tolerance which facilitates the axial location of the bearing on the roll neck
• A more favourable load distribution in the bearing which extends bearing service life

These SKF Explorer tapered roller bearings are quality products representing a considerable investment and as such should be handled carefully.

The trouble-free operation of such bearings is not just a question of bearing quality. Several other factors influence their service life:

Environment

Cleanliness during mounting is a prerequisite for the correct performance of the bearings and to help ensure that they do not fail prematurely.

Mounting

Four-row tapered roller bearings are precision mechanical components and should therefore be handled with appropriate care when mounting and dismounting. It is important to use the appropriate tools and to follow the instructions supplied to avoid bearing damage.

Proper maintenance

Under the operating conditions that most four-row tapered roller bearings must endure, maintenance and periodic inspection are essential. However, with the newly-developed SKF cage and seal, which enable the bearing to be disassembled, inspected and re-installed, maintenance is faster and easier than ever before. The seals, as well as the cage and roller assemblies, can be removed for a more complete inspection. If wear or damage is detected, the bearings can also be refurbished by an SKF Industrial Service Centre saving you the expense of buying a new bearing.

Efficient remanufacturing

SKF Explorer four-row tapered roller bearings have decisive advantages when it comes to remanufacturing:

• The cage and roller assemblies can be readily dismantled from, and reassembled to, the inner rings enabling full inspection and eventual remanufacturing
• When needed, cage and roller assemblies and inner and outer rings of various bearings can be combined to form "new" bearings. To do this, the ring side faces need regrinding, which is also possible for inner rings. This work is best carried out in an SKF Industrial Service Centre. The new seal design enables quick removal and installation

Experience

Skill and experience with mounting multi-row tapered roller bearings are also important for long bearing service life. It is therefore recommended that the instructions provided in this publication are studied and that all appropriate tools and mounting aids be used. If adequate skill and experience is lacking, contact the nearest SKF Industrial Service Centre.

Packaging

SKF Explorer four-row tapered roller bearings are, depending on their size, supplied in one or more packages. Each bearing has a unique serial number. Component parts of that bearing are marked with the same number to avoid confusion if several bearings of the same size are to be mounted. The components of bearings of the same type and size are not interchangeable.

Note: To avoid contaminating the bearings, they should only be removed from their packaging immediately prior to mounting.

Matching bearing components

When mounting four-row tapered roller bearings, the individual components of the bearing must be mounted in the correct order. Parts belonging together are identified by letter markings. All the components of one bearing are also marked with the same serial number, so that the parts of one bearing are not mixed with those of another when several bearings are mounted at the same time (→ **fig. 1**).

Note: To make sure that the bearing components are mounted in the correct order, a sheet containing mounting instructions is included with each bearing (→ **fig. 2**) and should be followed.

Load zone markings

The side faces of the outer rings are divided into four zones marked I to IV (→ **fig. 3**). The markings indicating load zone I are also indicated by lines extending across the whole width on each outer ring. 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.
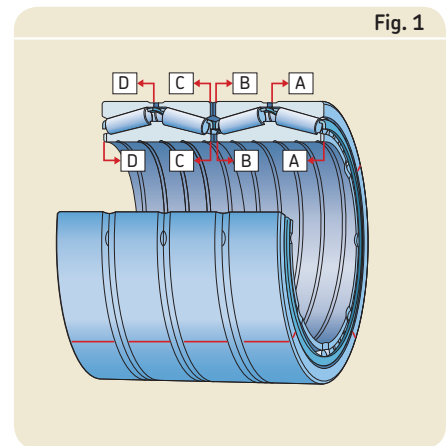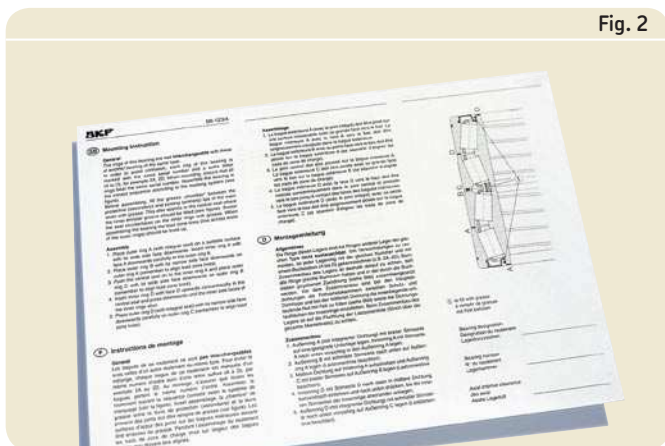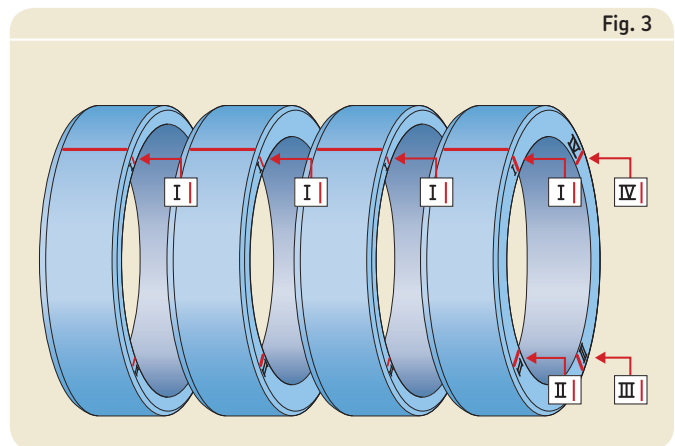

Fig. 1

Fig. 2

Fig. 3

Mounting bearings without seals

Preparing the chock

- Clean the work area
- Position the chock in the same orientation as it will be after mounting on the roll stand
- Clean the lubrication and ventilation ducts with compressed air and solvent (→ **fig. 4**)
- Use a magnetic rod to remove any remaining metallic shavings from all holes
- Check that the transitions to the lubrication ducts in the chock are properly round
- Lightly coat the chock bore with SKF mounting paste LGAF 3
- If required, lay the O-ring used to seal the roll-side cover in position
- Screw the roll-side cover onto the chock (→ **fig. 5**)
- Stand the chock on the roll-side cover

Assembling the bearing

- For grease lubricated bearings, fill the free space between the rollers and the roller rows with grease
- Place wooden blocks under the inner ring C–D so that they do not come into contact with the cage (→ **fig. 6**) as otherwise the cage may be damaged
- Position the other bearing rings (except outer ring D) on the inner ring C–D (→ **fig. 7**)
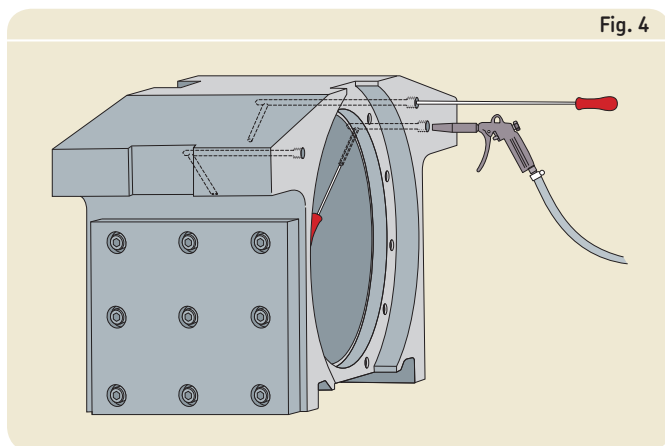- Check that the lines indicating load zone I are in alignment
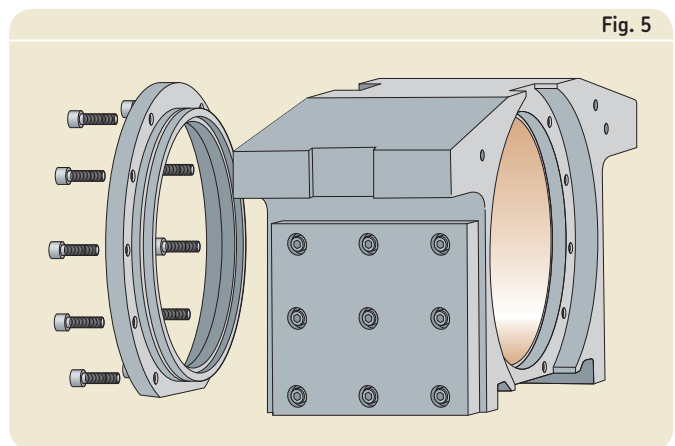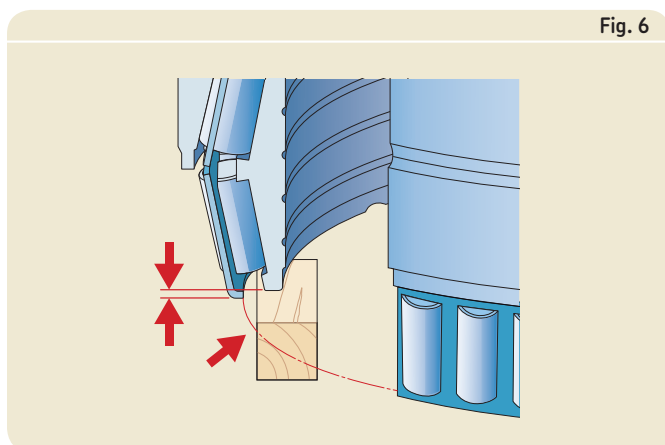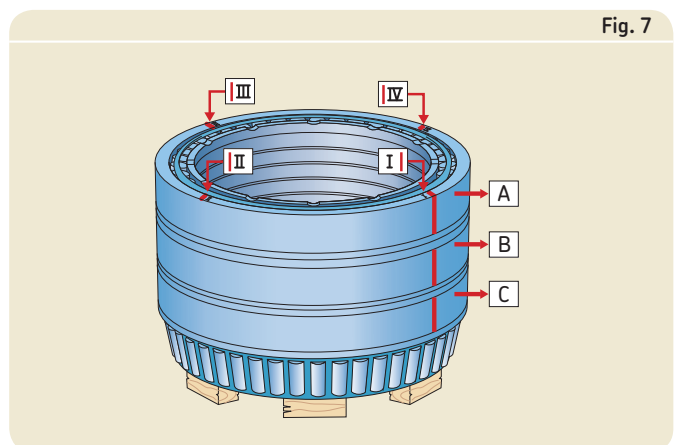

Fig. 4

Fig. 5

Fig. 6

Fig. 7

Lifting the bearing

- Apply the lifting tool under outer ring D (→ **fig. 8**) and lift into the chock bore. When mounting for the first time, the load zone I line should be positioned as shown (→ **fig. 9**). If appropriate, mark the position of zone I on the top of the chock
- Lift the other bearing components into the chock bore taking care that the load zone I markings on all four outer rings line up (→ **fig. 10**)
- Note the bearing number, the chock number and the roll number as well as the actual loaded zone on the report sheet "Bearing position" (→ Appendix 1, **page 19**)

Turning the bearing

- Place the second chock cover in position and secure it in place using four screws (→ **fig. 11**)
- Position the chock as shown in **fig. 12**
- Position a clamping tool in the bearing bore as shown in **fig. 12**
- Turn the inner rings with roller and cage assemblies and alternately tighten nuts and cover screws
- Use a feeler gauge to check that the inner rings abut each other (→ **fig. 12**)
- Measure the gap between the chock face and cover (→ **fig. 13**)
- Remove the cover

- Insert the seal (→ **fig. 14**)
  a) The elastic cork seal should be 1,2 times as thick as the measured gap
  b) If axial loads are high, it may be necessary to use spacing washers between the chock and the end cover. These should be 0,05 mm thinner than the measured gap and be positioned under the screws. The cork seal should be 1,2 times as thick as the measured gap
  c) If sheet metal shims are used together with an O-ring, the sheet thickness should be 0,05 mm thinner than the measured gap
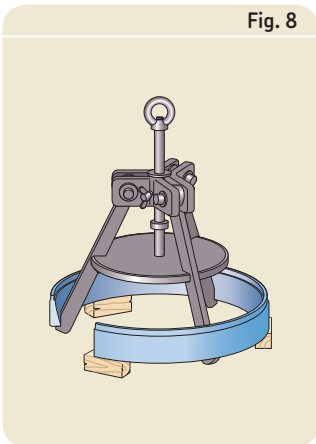- Replace the cover and alternately tighten the screws
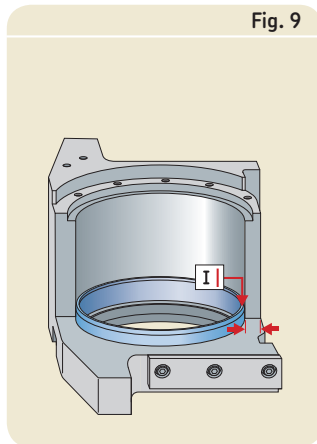- Remove the clamping tool from bearing bore
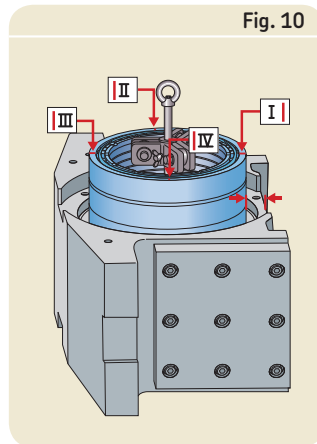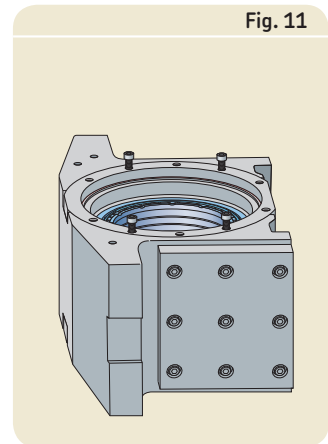

Fig. 8

Fig. 9

Fig. 10

Fig. 11

Fig. 12

Fig. 13

Fig. 14

SKF
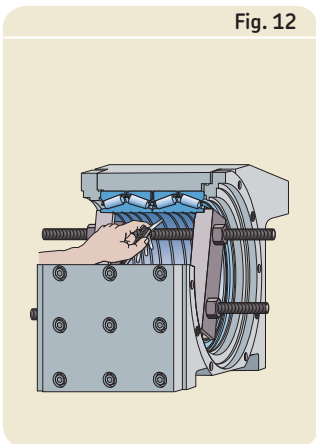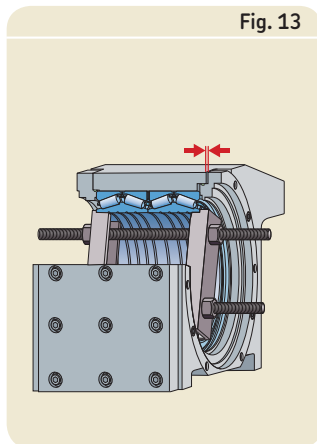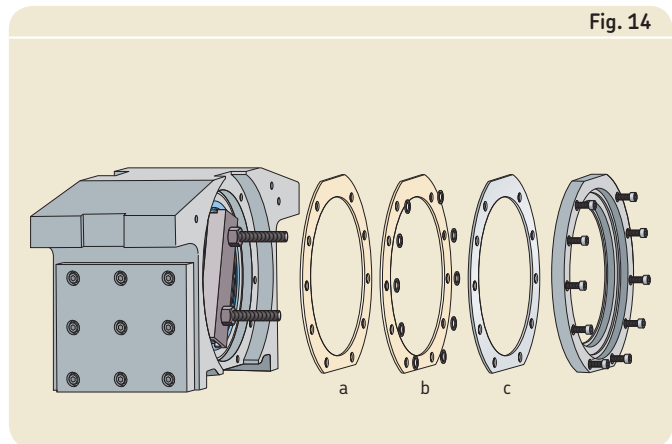
Mounting the chock

Pushing the chock on to the roll neck
(→ fig. 15):
- Coat the bearing bore and seating surfaces with SKF mounting paste LGAF 3
- Align the chock with the assembled bearing and push the chock onto the roll neck until it abuts the roll

Axial location of inner rings on the roll neck
Alternative 1:
Simple axial location (→ **fig. 16**)
- Push distance ring A on to the roll neck and fix the split clamping ring B in position. The requisite axial gap of 0,4 to 1,3 mm between the inner rings and the abutments will be obtained provided the distance ring, clamping ring and clamping ring groove are correctly dimensioned

Alternative 2:
Conventional axial location (→ **fig. 17**)
- Push distance ring A and nut B into position and fix clamping ring C in position
- Tighten nut B until it abuts the clamping ring C
- Loosen nut B until the requisite axial gap of 0,4 to 1,3 mm has been obtained

Fig. 15

Fig. 16

Fig. 17

Mounting sealed bearings

(→ *WARNING!: For fluoro rubber seals,* *follow safety precautions below*)

- Fill the free space between the rollers and roller rows with grease
- Coat the counter faces (inner ring extensions) for the seals with grease (→ **fig. 18**)
- Fill the annular groove for the seal, that is in the middle of the bearing, with grease (→ **fig. 19**)
- Assemble the bearing components in the correct order starting with outer ring D, supporting the bearing on wooden blocks (→ **fig. 20**)
- Use lifting tool to insert bearing into the chock bore. Be sure that the load zone I markings line up
- Tip the chock and remove the lifting tool. Insert the clamping tool, making sure that the holding shoe (H) engages the inner ring face. Then tighten the clamping tool (→ **fig. 21**)
- Turn the bearing (→ **page 6**)

Fig. 18

Fig. 19

Fig. 20

Fig. 21

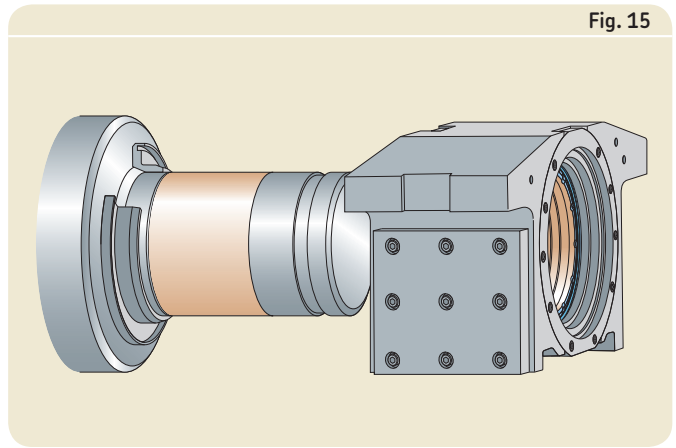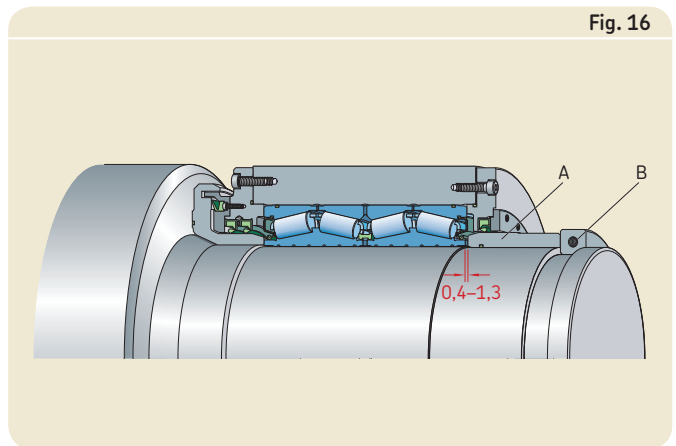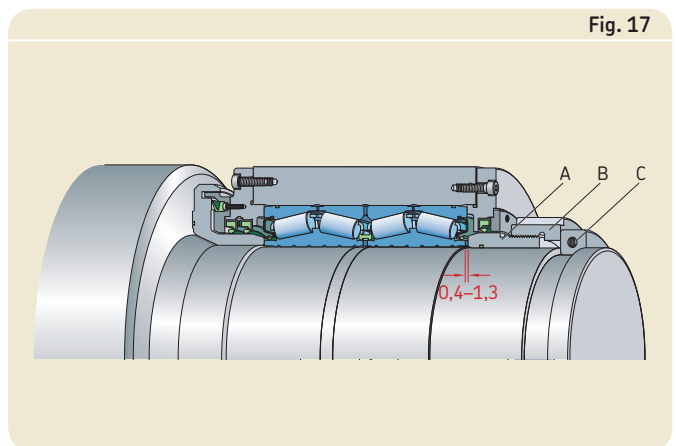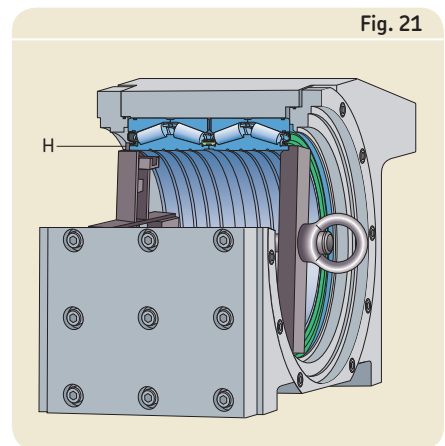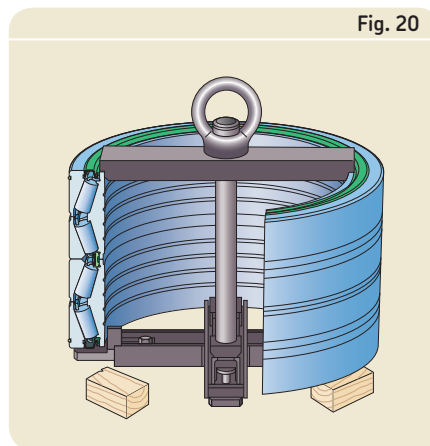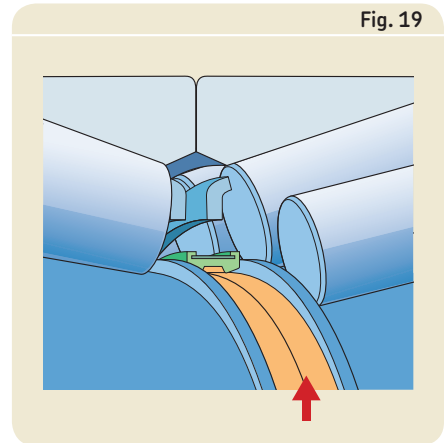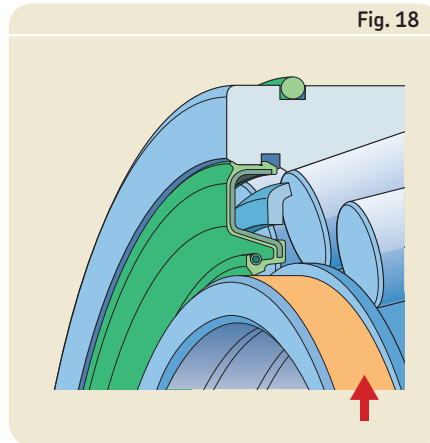## WARNING!

Safety precautions for fluoro rubber
Fluoro rubber is very stable and harmless under normal operating conditions, up to +200 °C. However, if exposed to extreme temperatures above 300 °C, e.g. fire or the flame of a cutting torch, fluoro rubber seals give off hazardous fumes. These fumes can be harmful to the eyes or if inhaled. In addition, once the seals have been heated to such temperatures, they are dangerous to handle even after they have cooled and should not touch the skin.

If it is necessary to handle bearings with seals that have been subjected to high temperatures, such as when dismounting the bearing, the following safety precautions should be observed:

- Always wear protective goggles, gloves and appropriate breathing apparatus
- Place the remains of the seals in an airtight plastic container marked with a symbol for "material will etch"
- Follow the safety precautions in the appropriate material safety data sheet (MSDS)

If there is unintentional contact with the seals, wash hands with soap and plenty of water and flush eyes with plenty of water and consult a doctor immediately. If the fumes have been inhaled, consult a doctor immediately.

The user is responsible for the correct use of the product during its service life and its proper disposal. SKF takes no responsibility for the improper handling of fluoro rubber seals or for any injury resulting from their use.

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Maintenance

- Use "Bearing check list" (→ *Appendix 2*, **page 20**)
- Dismount the bearing in the reverse order of mounting (→ **fig. 22** and **pages 8** to **5**)
- Clean all the bearing components carefully and oil them
- Check the raceways and rollers for damage
- If damage is observed, contact the nearest SKF Industrial Service Centre
- Clean the chock and roll neck and check the dimensional and form accuracy; rework if necessary (→ **page 7**)
- If using sealed bearings, clean any water drainage ducts (→ **figs. 23** and **24**)
- If using sealed bearings, replace O-rings and damaged seals (→ **fig. 25**)

Fig. 22

Fig. 23

Fig. 24

Fig. 25
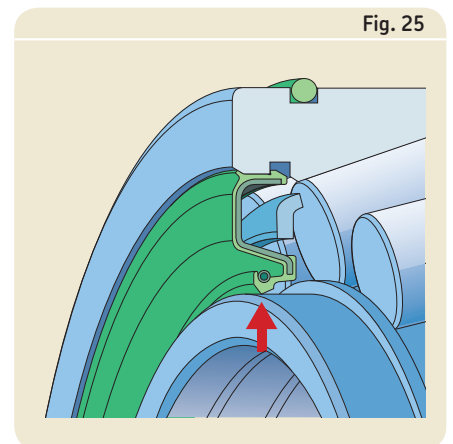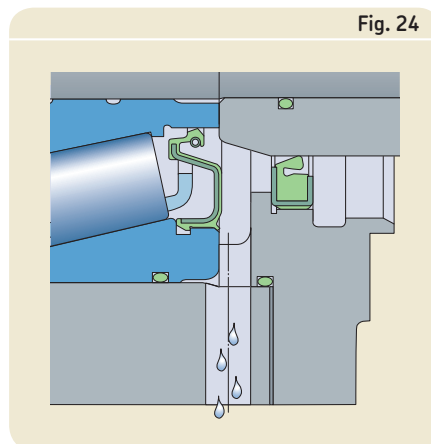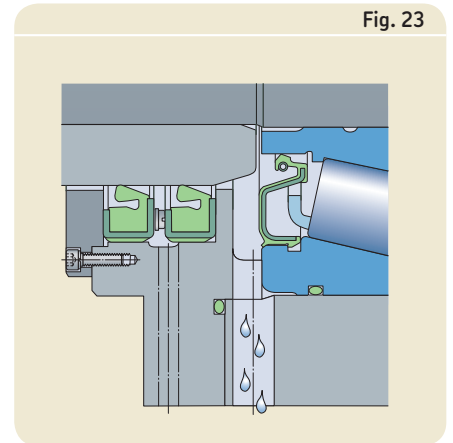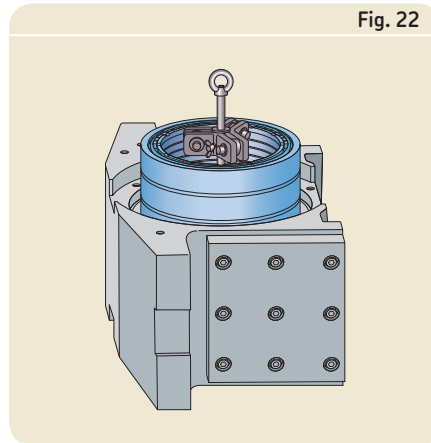
Measuring and correcting axial clearance

After the bearings have been in operation for 2 000 to 3 000 hours, check their internal axial clearance. This can be performed by an SKF Industrial Service Centre.

If the bearings are to be reworked on site, the actual bearing clearance should be accurately determined. If the clearance exceeds three times the original axial clearance of the bearing when new, the bearing should be reworked.

Measuring equipment

To measure the bearing clearance, suitable measuring equipment must be used. Such equipment is, for example, the well-proven measuring tool shown in **fig. 26**. It is adjustable and can be used for a range of diameters. The three-point support can also be adjusted. A gauge is mounted on each of the three arms which are at 120° to each other.
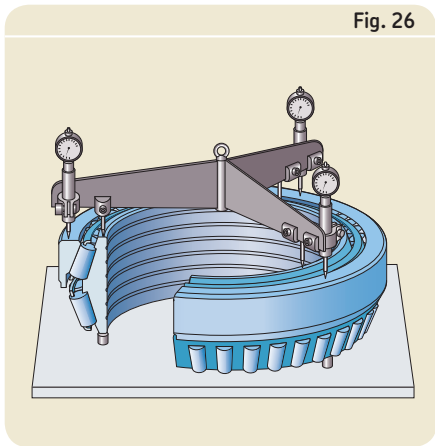
Fig. 26

Measuring procedure

Before taking measurements, the equipment should be placed on a flat surface and the gauges should be adjusted to show zero.

To measure the stand-out or stand-in of the outer ring in relation to the inner ring, the equipment should be positioned on the face of the inner ring. The gauges placed on the face of the outer ring will then indicate the standout or stand-in of the outer ring. The results should be entered in a "Test report: Determining axial internal clearance" (→ *Appendix 3*, **page 21**). The mean value should be determined. The various steps required to determine the bearing axial internal clearance are described on **pages 11** through **12**. An example of the measured results and the determination of the requisite new outer ring width are shown on **page 14**.

The flow chart on **page 13** provides an overview of the procedure.

Symbols

The symbols used in the evaluation of the bearing clearance are listed below.

A_{AB} Axial clearance between roller rows A and B

A_{BC} Axial clearance between roller rows B and C

A_{CD} Axial clearance between roller rows C and D

A_0 Original axial internal clearance of the bearing as delivered (given on bearing drawing)

B_{AB} Width of inner ring A–B

B_{AB1} Width of the inner ring A–B after regrinding of the side face B

B_{CD} Width of inner ring C–D

B_{CD1} Width of the inner ring C–D after regrinding of the side face C

C_A Width of outer ring A

C_B Width of outer ring B

C_{B1} Width of outer ring B after regrinding the narrow face

C_C Width of outer ring C

C_{C1} Width of outer ring C after regrinding the narrow face

C_D Width of outer ring D

S_A Mean stand-out/stand-in of outer ring A with respect to inner ring A–B

S_B Mean stand-out/stand-in of outer ring B with respect to inner ring A–B

S_C Mean stand-out/stand-in of outer ring C with respect to inner ring C–D

S_D Mean stand-out/stand-in of outer ring D with respect to inner ring C–D

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Determining the axial internal clearance between roller rows A and B

- Check that the bearing components are clean and if necessary wash and oil them
- Measure outer ring widths C_A and C_B and inner ring width B_{AB}
- Lay inner ring A–B on a suitable support with the B side downwards and place outer ring A over the cage and roller assembly (→ **fig. 27**)
- Turn outer ring A so that all of the rollers of the upper roller row are in contact with the inner ring guide flange
- Position measuring equipment on inner ring side face and read off the three values of S_A on the gauges; enter in test report
- Remove measuring equipment
- Turn inner ring A–B over so that the A side is downwards and place outer ring B over the cage and roller assembly (→ **fig. 28**)
- Turn outer ring B so that all of the rollers of the upper roller row are in contact with the inner ring guide flange
- Position measuring equipment on inner ring side face and read off the three values S_B on the gauges; enter in test report

- Determine the axial clearance between roller rows A and B from

$$A_{AB} = C_A + C_B - S_A - S_B - B_{AB}$$

If the outer ring stands out (→ **fig. 29**), the measured values for S_A and S_B should be considered positive, i.e. entered with a + sign. If the inner ring stands out (→ **fig. 30**), then the values should have a – sign both in the test report and in the equation above. This is referred to as outer ring stand-in

- If the value of the axial clearance A_{AB} determined as above is much greater than the original clearance A_0 ($A_{AB} \geq 3 A_0$), the narrow face of outer ring B should be ground down (→ **fig. 31**). The final width of the outer ring B after grinding is obtained from
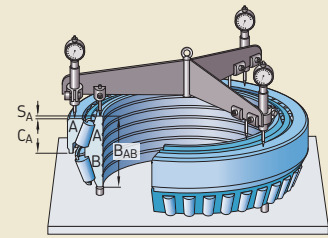
$$C_{B1} = C_B - A_{AB} + A_0$$
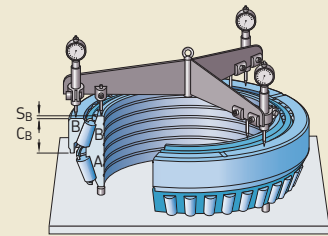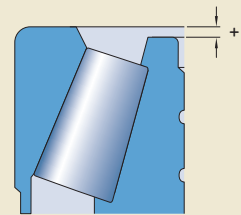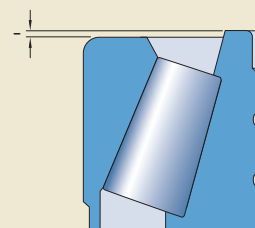

Fig. 27

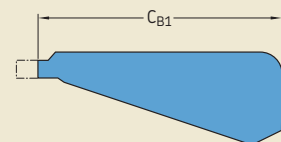Fig. 28

Fig. 29

Fig. 30

Fig. 31

Determining the axial internal clearance between roller rows C and D

- Check that the bearing components are clean and if necessary wash and oil them
- Measure outer ring widths C_C and C_D and inner ring width B_{CD}
- Lay inner ring C–D on a suitable support with the C side downwards and place outer ring D over the cage and roller assembly (→ **fig. 32**)
- Turn outer ring D so that all of the rollers of the upper roller row are in contact with the inner ring guide flange
- Position measuring equipment on inner ring side face and read off the three values of S_D on the gauges; enter in test report
- Remove measuring equipment
- Turn inner ring C–D over so that the D side is downwards and place outer ring C over the cage and roller assembly (→ **fig. 33**)
- Turn outer ring C so that all of the rollers of the upper roller row are in contact with the inner ring guide flange
- Position measuring equipment on inner ring side face and read off the three values S_C on the gauges; enter in test report

- Determine the axial clearance between roller rows C and D from

$$A_{CD} = C_C + C_D - S_C - S_D - B_{CD}$$

If the outer ring stands out (→ **fig. 34**), the measured values for S_C and S_D should be considered positive, i.e. entered with a + sign. If the inner ring stands out (→ **fig. 35**), then the values should have a – sign both in the test report and in the equation above. This is referred to as outer ring stand-in

- If the value of the axial clearance A_{CD} determined as above is much greater than the original clearance ($A_{CD} \geq 3 A_0$), the narrow face of outer ring C should be ground down (→ **fig. 36**). The final width of the outer ring C after grinding is obtained from

$$C_{C1} = C_C - A_{CD} + A_0$$

Fig. 32

Fig. 33

Fig. 34

Fig. 35

Determining the axial internal clearance between roller rows B and C

- Determine the axial clearance between the roller rows B and C using

$$A_{BC} = -S_B - S_C$$

If the outer ring stands out (→ **fig. 34**), the measured values for S_C and S_B should be considered positive, i.e. entered with a + sign. If the inner ring stands out (→ **fig. 35**), then the values should have a – sign both in the test report and in the equation above. This is referred to as outer ring stand-in

  If the value obtained is much greater than the original axial clearance ($A_{BC} > 3 A_0$), then the side face B of the inner ring A–B and side face C of the inner ring C–D need to be ground

- The final width of the inner ring A–B after grinding of the side face B can be calculated from

$$B_{AB1} = B_{AB} + S_B + A_0/2$$

- The final width of the inner ring C–D after grinding of the side face C can be calculated from

$$B_{CD1} = B_{AB} + S_C + A_0/2$$

- Grind the side face B of the inner ring A–B to the final width B_{AB1} and the side face C of the inner ring C–D to the final width B_{CD1} (→ **fig. 37**)

Fig. 36

Fig. 37

SKF
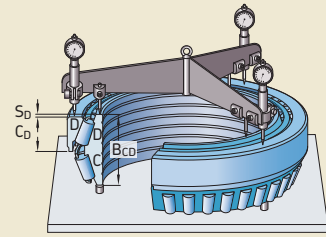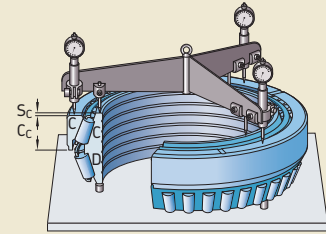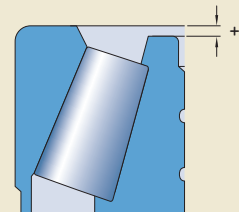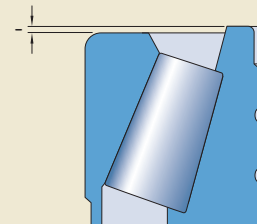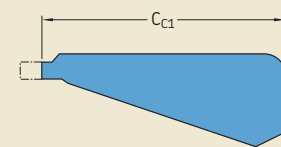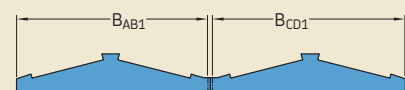
Flow chart for measuring and correcting the axial internal clearance

Start

Sealed bearing — No →

Dismount seal

Clean and oil bearing components

Measure
- outer ring width
- inner ring width
- stand-out/stand-in

Determine axial clearance between
- **roller rows A and B**
- **roller rows C and D**
- **roller rows B and C**

Compare with original axial internal clearance A_0

Axial clearance A_0 known — No →

Read off from bearing drawing or ask SKF

Measured axial clearance $\geq 3A_0$ — No →

Calculate new widths for outer rings B and C

Grind narrow side faces of outer rings B and C

Grind side faces B and C of inner rings

Clean bearing rings and oil

Sealed bearing — No →

Insert new seal

Pack bearing components keeping those of each individual bearing separate

End

Example of a test report for bearing BT4B 328817 E1/C475

Original axial internal clearance = 0,440 mm

SKF

Test report: Determining axial internal clearance

Bearing designation	Consecutive number of bearing
BT4B 328817 E1/C475	**437**

Part 1: Calculation of axial clearance

Dimensions	Measuring position a	Measuring position b	Measuring position c	Mean $\frac{a+b+c}{3}$	Calculated axial clearance
–	mm	mm	mm	mm	mm
Axial clearance between roller rows A and B					Axial clearance A_{AB}
Outer ring width C_A	68,554	68,555	68,555	68,555	$A_{AB} = C_A + C_B - S_A - S_B - B_{AB} =$
Outer ring width C_B	58,285	58,285	58,285	58,285	**68,555+58,285−(−0,720)**
Inner ring width B_{AB}	126,980	126,980	126,980	126,980	**−(−0,920)−126,980 =**
Stand-out/in S_A	−0,835	−0,710	−0,615	−0,720	**1,500**
Stand-out/in S_B	−0,932	−0,925	−0,903	−0,920	
Axial clearance between roller rows C and D					Axial clearance A_{CD}
Outer ring width C_C	58,959	58,960	58,960	58,960	$A_{CD} = C_C + C_D - S_C - S_D - B_{CD} =$
Outer ring width C_D	68,641	68,640	68,640	68,640	**58,960+68,640−(−0,507)**
Inner ring width B_{CD}	126,980	126,980	126,981	126,980	**−(−0,558)−126,980 =**
Stand-out/in S_C	−0,500	−0,506	−0,515	−0,507	**1,685**
Stand-out/in S_D	−0,578	−0,570	−0,526	−0,558	
Axial clearance between roller rows B and C					Axial clearance A_{BC}
					$A_{BC} = S_B + S_C =$
					(−0,920)+(−0,507) =
					−1,427

Part 2: Calculation of new widths for outer and inner rings

Outer and inner ring/surface to be ground	Width	Calculated axial clearance	New width
–	mm	mm	mm
Outer ring B/narrow face	$C_B =$ **58,285**	$A_{AB} =$ **1,500**	$C_{B1} = C_B - |A_{AB}| + A_0 =$ **58,285−1,500+0,475 = 57,260**
Outer ring C/narrow face	$C_C =$ **58,960**	$A_{CD} =$ **1,685**	$C_{C1} = C_C - |A_{CD}| + A_0 =$ **58,960−1,685+0,475 = 57,750**
Inner ring AB/side face B	$B_{AB} =$ **126,980**	$A_{BC} =$ **−1,427**	$B_{AB1} = B_{AB} + S_B + A_0/2 =$ **126,980+(−0,920)+0,475/2 = 126,298**
Inner ring C–D/side face C	$B_{CD} =$ **126,980**		$B_{CD1} = B_{CD} + S_C + A_0/2 =$ **126,980+(−0,507)+0,475/2 = 126,711**

NB. The absolute values (i.e. the numerical value without + or − sign) of the axial clearances A_{AB}, A_{CD} and A_{BC} should be used to calculate the new outer ring widths C_{B1} and C_{C1}. This is signified by the two vertical lines, e.g. $|A_{BC}|$.

Date	Reported by	Approved by
2010-02-23	*Helmut Gläser*	*Thilo Nicklas*

Seal replacement

Seal disassembly (→ **fig. 38**)
- Lay outer ring on wooden blocks, leaving the seal unsupported
- Remove the seal by tapping it out of the ring

Seal assembly (→ **fig. 39**)
- Lay outer ring on the table
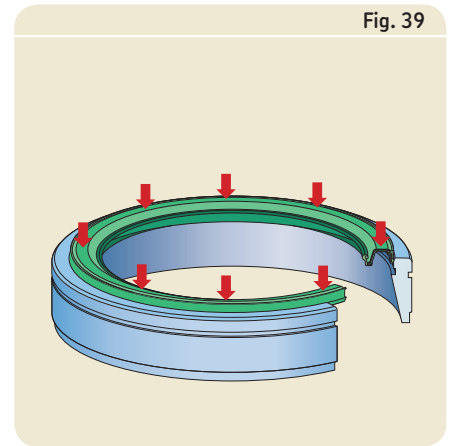- Put the seal into the ring and press it until the snap flange will snap into the groove in the bearing ring

Fig. 38

Fig. 39
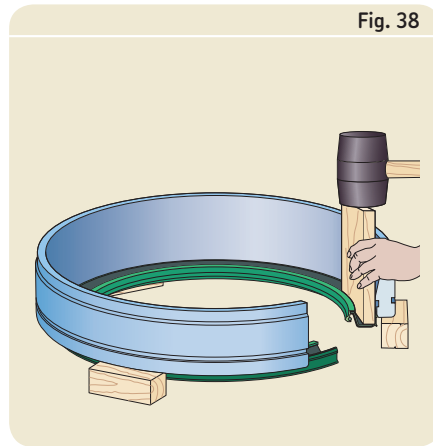
Disassembling SKF Explorer inner rings and cage and roller assemblies

The inner rings with cage and roller assemblies of SKF Explorer four-row tapered roller bearings can be separated. This allows for easy and full inspection of the inner ring raceways and refurbishment.

For the separation, a strip of spring steel and two screwdrivers are required.

Note: The screwdrivers should have a maximum hardness of 45 HRC to avoid damage to the bearing. SKF recommends following the below procedures to avoid damage:

1 Displace the cage radially in one direction to obtain the maximum roller clearance between inner ring and cage at this side (→ **fig. 40**)
2 Insert the spring steel strip between the inner ring and roller at this side, supporting it on the outer retaining flange (→ **fig. 41**)

3 Place one screwdriver against the inner guide flange close to the strip and lift the cage and roller assembly on to the retaining flange. Use the second screwdriver to lift each individual roller, one at a time, over the retaining flange until the cage and roller assembly can be removed from the inner ring (→ **fig. 42**)
4 As the cage is removed, the rollers will fall out (→ **fig. 43**).
Note: A suitable surface should be provided so that the rollers are not damaged or contaminated
5 The rollers of a cage and roller assembly must remain together and not be mixed with rollers of another assembly

Fig. 40

Fig. 41

Fig. 42

Fig. 43
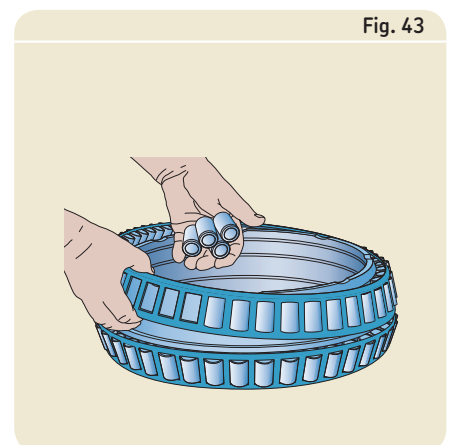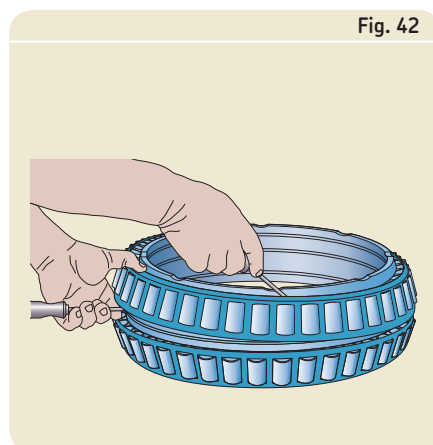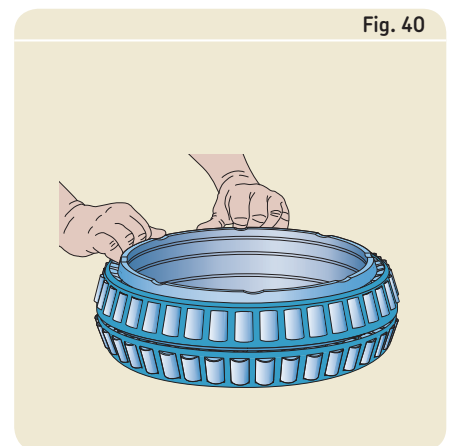
Reassembling SKF Explorer inner rings and cage and roller assemblies

SKF recommends following the below procedures to reassemble the bearing. **Figures 44** to **47** illustrate the reassembling of a second roller and cage assembly.

1 Insert the rollers into the cage with the small roller diameter downwards. A support ring may be used to prevent the rollers from falling out again (→ **fig. 44**)
2 Put the inner ring into the cage and roller assembly (→ **fig. 45**) and turn all the components together (→ **fig. 46**)
3 Snap the cage and roller assembly over the outer retaining flange by hand (→ **fig. 47**). For larger bearings, the force required might be so large that a screwdriver needs to be used

Fig. 44

Fig. 45

Fig. 46

Fig. 47

SKF
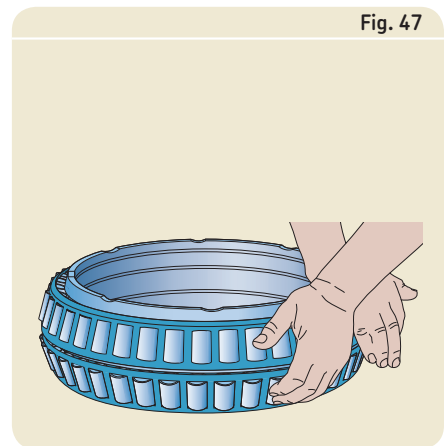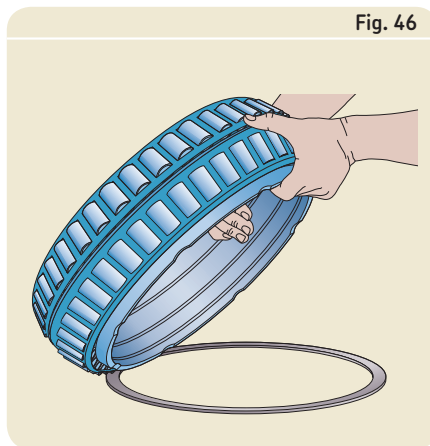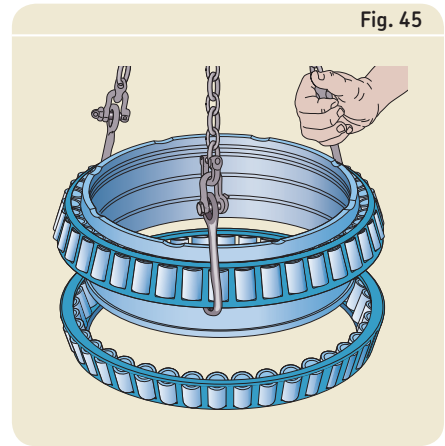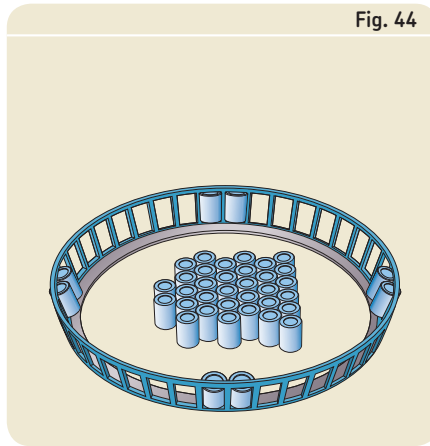
Checking that the chock bore is within tolerances

The arduous operating conditions to which a roll neck bearing is subjected cause wear and deformation of the chock. This leads in turn to unfavourable load distribution in the bearing and can shorten the bearing service life. Therefore, SKF recommends reworking the chocks within the limits provided in **table 1**.

Table 1

Permissible chock bore diameter limits
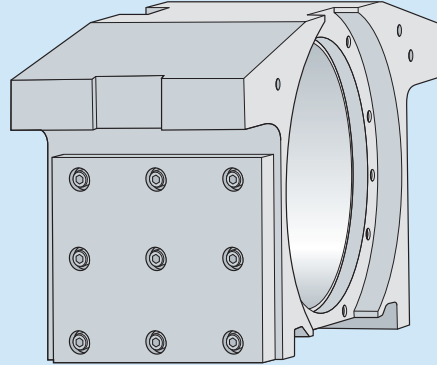
Bore diameter Nominal		Tolerances		Permissible deviation from nominal diameter	cylindricity
over	incl.	high	low	max	max
mm		mm		mm	mm
Bearings with inch dimensions					
–	304,8	+0,076	+0,050	+0,15	0,11
304,8	609,6	+0,152	+0,102	+0,25	0,15
609,6	914,4	+0,229	+0,152	+0,35	0,20
914,4	1 219,2	+0,305	+0,204	+0,47	0,23
1 219,2	1 524	+0,381	+0,254	+0,57	0,27
1 524	1 960	+0,420	+0,300	+0,64	0,32
Bearings with metric dimensions					
150	180	+0,041	+0,025	+0,12	0,11
180	250	+0,046	+0,025	+0,12	0,11
250	315	+0,051	+0,025	+0,12	0,11
315	400	+0,102	+0,051	+0,20	0,15
400	500	+0,107	+0,051	+0,20	0,15
500	630	+0,112	+0,051	+0,20	0,15
630	800	+0,129	+0,076	+0,25	0,20
800	1 000	+0,154	+0,076	+0,25	0,20
1 000	1 250	+0,180	+0,102	+0,35	0,23
1 250	1 600	+0,221	+0,127	+0,41	0,27
1 600	2 000	+0,250	+0,163	+0,47	0,32

Checking that the roll neck is within tolerances

Four-row tapered roller bearings are generally mounted with a loose fit on the roll neck. The resultant relative movements between bearing and roll neck lead to wear. To limit the misalignment of the roll and the eccentricity of the bearing to the roll, SKF recommends grinding the roll neck. The limits are listed in **table 2**.

Table 2

Permissible roll neck diameter limits
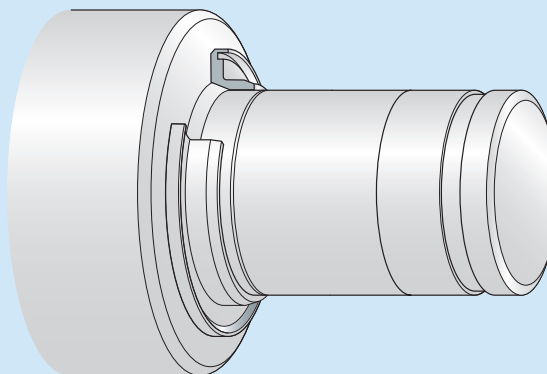
Roll neck diameter Nominal		Tolerances (e7)		Permissible deviation from nominal diameter
over	incl.	high	low	max
mm		mm		mm
Bearings with inch dimensions				
120	152,4	−0,085	−0,125	−0,35
152,4	180	−0,085	−0,125	−0,45
180	250	−0,100	−0,146	−0,45
250	304,8	−0,110	−0,162	−0,45
304,8	315	−0,110	−0,162	−0,60
315	400	−0,125	−0,182	−0,60
400	500	−0,135	−0,198	−0,60
500	609,6	−0,145	−0,215	−0,60
609,6	630	−0,145	−0,215	−0,80
630	800	−0,160	−0,240	−0,80
800	914,4	−0,170	−0,260	−0,80
914,4	1 000	−0,170	−0,260	−1,00
1 000	1 219,2	−0,195	−0,300	−1,00
1 219,2	1 250	−0,195	−0,300	−1,20
1 250	1 524	−0,220	−0,345	−1,20
Bearings with metric dimensions				
120	180	−0,110	−0,150	−0,37
180	250	−0,130	−0,171	−0,48
250	315	−0,145	−0,187	−0,48
315	400	−0,165	−0,233	−0,64
400	500	−0,180	−0,249	−0,64
500	630	−0,195	−0,266	−0,64
630	800	−0,235	−0,316	−0,87
800	1 000	−0,270	−0,336	−0,87
1 000	1 250	−0,320	−0,402	−1,10
1 250	1 600	−0,380	−0,472	−1,30

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Bearing position

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Train

Stand and No.

Type

Bearing designation

Chock No.

Bearing No.

Upper roll No./Company

Load zone No.

Chock No.

Bearing No.

Load zone No.

Lower roll No./Company

Load zone No.

Bearing No.

Chock No.

Load zone No.

Bearing No.

Chock No.

Bearing check list

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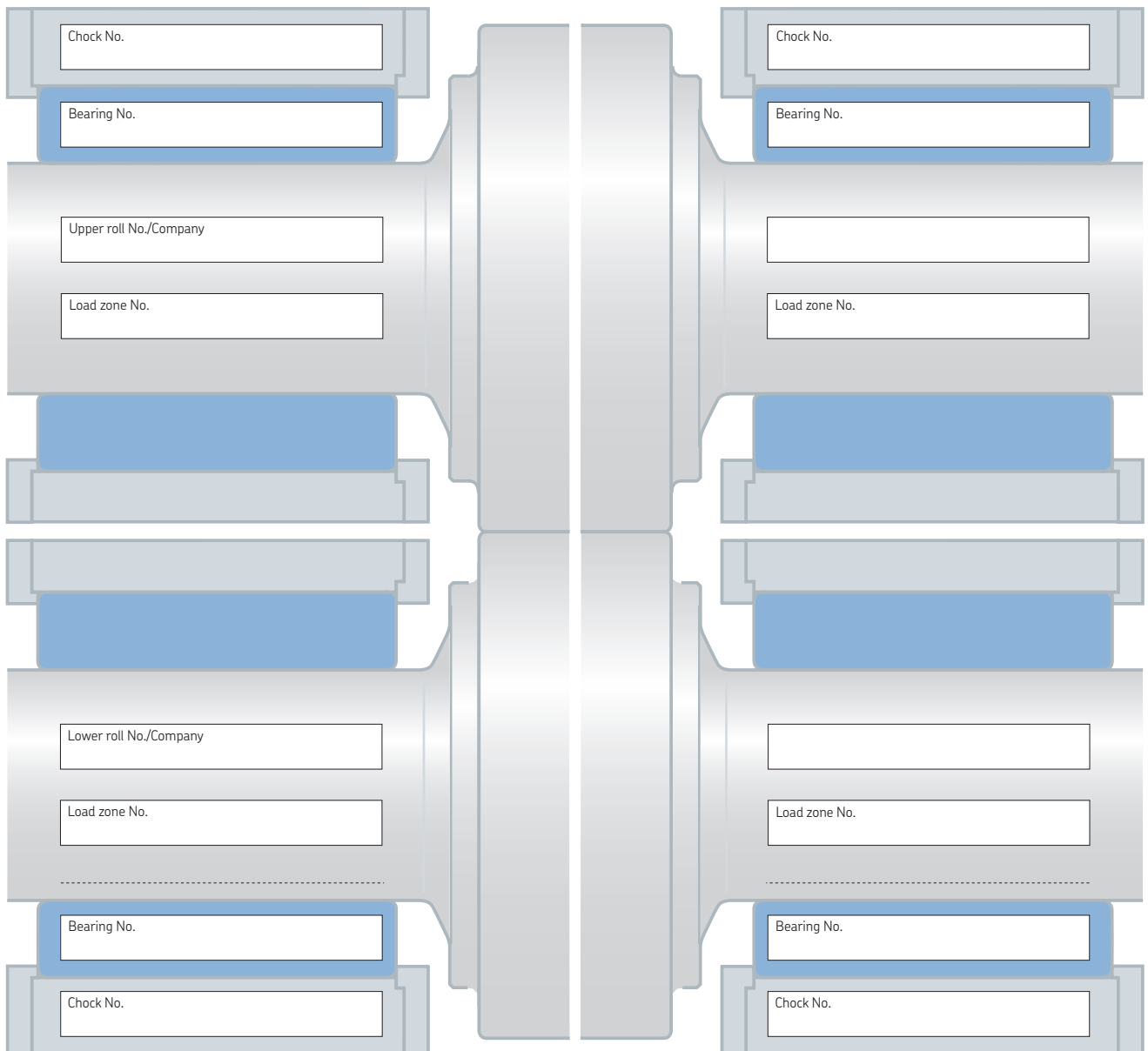
Bearing type	Bearing designation	Consecutive number of bearing	Delivery date	Delivery number	from

Bearing dimensions: Bore diameter	Outside diameter	Width

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

SKF

Test report: Determining axial internal clearance

Bearing designation	Consecutive number of bearing

Part 1: Calculation of axial clearance

Dimensions	Measuring position a	Measuring position b	Measuring position c	Mean $\dfrac{a + b + c}{3}$	Calculated axial clearance
–	mm	mm	mm	mm	mm

Axial clearance between roller rows A and B					Axial clearance A_{AB}
Outer ring width C_A					$A_{AB} = C_A + C_B - S_A - S_B - B_{AB} =$
Outer ring width C_B					
Inner ring width B_{AB}					
Stand-out/in S_A					
Stand-out/in S_B					

Axial clearance between roller rows C and D					Axial clearance A_{CD}
Outer ring width C_C					$A_{CD} = C_C + C_D - S_C - S_D - B_{CD} =$
Outer ring width C_D					
Inner ring width B_{CD}					
Stand-out/in S_C					
Stand-out/in S_D					

Axial clearance between roller rows B and C					Axial clearance A_{BC}
					$A_{BC} = S_B + S_C =$

Part 2: Calculation of new widths for outer and inner rings

Outer and inner ring/surface to be ground	Width	Calculated axial clearance	New width
–	mm	mm	mm
Outer ring B/narrow face	$C_B =$	$A_{AB} =$	$C_{B1} = C_B - |A_{AB}| + A_0 =$
Outer ring C/narrow face	$C_C =$	$A_{CD} =$	$C_{C1} = C_C - |A_{CD}| + A_0 =$
Inner ring AB/side face B	$B_{AB} =$	$A_{BC} =$	$B_{AB1} = B_{AB} + S_B + A_0/2 =$
Inner ring C–D/side face C	$B_{CD} =$		$B_{CD1} = B_{CD} + S_C + A_0/2 =$

NB. The absolute values (i.e. the numerical value without + or – sign) of the axial clearances A_{AB}, A_{CD} and A_{BC} should be used to calculate the new outer ring widths C_{B1} and C_{C1}. This is signified by the two vertical lines, e.g. $|A_{BC}|$.

Date	Reported by	Approved by

SKF – the knowledge engineering company

From the company that invented the self-aligning ball bearing more than 100 years ago, SKF has evolved into a knowledge engineering company that is able to draw on five technology platforms to create unique solutions for its customers. These platforms include bearings, bearing units and seals, of course, but extend to other areas including: lubricants and lubrication systems, critical for long bearing life in many applications; mechatronics that combine mechanical and electronics knowledge into systems for more effective linear motion and sensorized solutions; and a full range of services, from design and logistics support to condition monitoring and reliability systems.

Though the scope has broadened, SKF continues to maintain the world's leadership in the design, manufacture and marketing of rolling bearings, as well as complementary products such as radial seals. SKF also holds an increasingly important position in the market for linear motion products, high-precision aerospace bearings, machine tool spindles and plant maintenance services.

The SKF Group is globally certified to ISO 14001, the international standard for environmental management, as well as OHSAS 18001, the health and safety management standard. Individual divisions have been approved for quality certification in accordance with ISO 9001 and other customer specific requirements.

With over 120 manufacturing sites worldwide and sales companies in 70 countries, SKF is a truly international corporation. In addition, our distributors and dealers in some 15 000 locations around the world, an e-business marketplace and a global distribution system put SKF close to customers for the supply of both products and services. In essence, SKF solutions are available wherever and whenever customers need them. Overall, the SKF brand and the corporation are stronger than ever. As the knowledge engineering company, we stand ready to serve you with world-class product competencies, intellectual resources, and the vision to help you succeed.


© Airbus – photo: eXm company, H. Goussé

Evolving by-wire technology
SKF has a unique expertise in the fast-growing by-wire technology, from fly-by-wire, to drive-by-wire, to work-by-wire. SKF pioneered practical fly-by-wire technology and is a close working partner with all aerospace industry leaders. As an example, virtually all aircraft of the Airbus design use SKF by-wire systems for cockpit flight control.

SKF is also a leader in automotive by-wire technology, and has partnered with automotive engineers to develop two concept cars, which employ SKF mechatronics for steering and braking. Further by-wire development has led SKF to produce an all-electric forklift truck, which uses mechatronics rather than hydraulics for all controls.
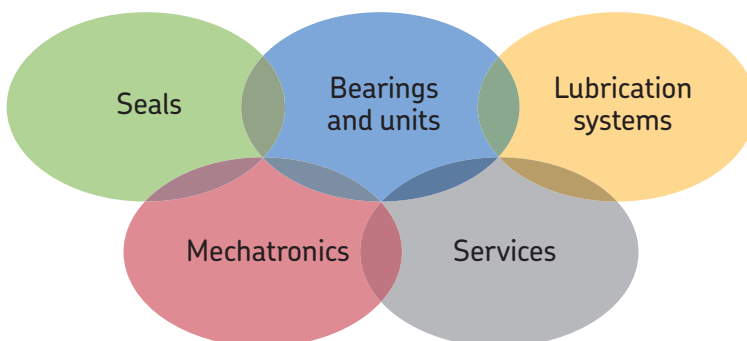
Harnessing wind power

The growing industry of wind-generated electric power provides a source of clean, green electricity. SKF is working closely with global industry leaders to develop efficient and trouble-free turbines, providing a wide range of large, highly specialized bearings and condition monitoring systems to extend equipment life of wind farms located in even the most remote and inhospitable environments.

Working in extreme environments

In frigid winters, especially in northern countries, extreme sub-zero temperatures can cause bearings in railway axleboxes to seize due to lubrication starvation. SKF created a new family of synthetic lubricants formulated to retain their lubrication viscosity even at these extreme temperatures. SKF knowledge enables manufacturers and end user customers to overcome the performance issues resulting from extreme temperatures, whether hot or cold. For example, SKF products are at work in diverse environments such as baking ovens and instant freezing in food processing plants.

Developing a cleaner cleaner

The electric motor and its bearings are the heart of many household appliances. SKF works closely with appliance manufacturers to improve their products' performance, cut costs, reduce weight, and reduce energy consumption. A recent example of this cooperation is a new generation of vacuum cleaners with substantially more suction. SKF knowledge in the area of small bearing technology is also applied to manufacturers of power tools and office equipment.

Maintaining a 350 km/h R&D lab

In addition to SKF's renowned research and development facilities in Europe and the United States, Formula One car racing provides a unique environment for SKF to push the limits of bearing technology. For over 60 years, SKF products, engineering and knowledge have helped make Scuderia Ferrari a formidable force in F1 racing. (The average racing Ferrari utilizes around 150 SKF components.) Lessons learned here are applied to the products we provide to automakers and the aftermarket worldwide.


Delivering Asset Efficiency Optimization

Through SKF Reliability Systems, SKF provides a comprehensive range of asset efficiency products and services, from condition monitoring hardware and software to maintenance strategies, engineering assistance and machine reliability programmes. To optimize efficiency and boost productivity, some industrial facilities opt for an Integrated Maintenance Solution, in which SKF delivers all services under one fixed-fee, performance-based contract.

Planning for sustainable growth

By their very nature, bearings make a positive contribution to the natural environment, enabling machinery to operate more efficiently, consume less power, and require less lubrication. By raising the performance bar for our own products, SKF is enabling a new generation of high-efficiency products and equipment. With an eye to the future and the world we will leave to our children, the SKF Group policy on environment, health and safety, as well as the manufacturing techniques, are planned and implemented to help protect and preserve the earth's limited natural resources. We remain committed to sustainable, environmentally responsible growth.
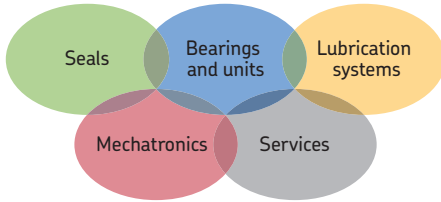
The Power of Knowledge Engineering

Drawing on five areas of competence and application-specific expertise amassed over more than 100 years, SKF brings innovative solutions to OEMs and production facilities in every major industry worldwide. These five competence areas include bearings and units, seals, lubrication systems, mechatronics (combining mechanics and electronics into intelligent systems), and a wide range of services, from 3-D computer modelling to advanced condition monitoring and reliability and asset management systems. A global presence provides SKF customers uniform quality standards and worldwide product availability.

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