Mounting rolling bearings

2

Preparations prior to mounting

Rolling bearings are reliable machine elements that can provide long service life, provided they are properly mounted and maintained. Proper mounting calls for experience as well as care, cleanliness, accuracy, the correct mounting method and the use of appropriate tools for the job.

Planning

Prior to mounting, study any drawings or instructions to determine:

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

The tools and methods used to mount rolling bearings often depend on the size of the bearing. Generally, bearings can be categorized as:

- small bearings: bore diameter d ≤ 80 mm
- medium-size bearings: bore diameter 80 mm < d < 200 mm
- large bearings: bore diameter d ≥ 200 mm

For additional information about SKF mounting tools, including mechanical tools, hydraulic tools, heating equipment and gloves, visit www.mapro.skf.com.

For detailed mounting instructions for specific bearings (per bearing designation), visit www.skf.com/mount.

The SKF Reliability Maintenance Institute (RMI) offers a comprehensive range of training courses in mounting (→ *Training*, starting on **page 326**). Contact your local SKF representative for additional information, or visit www. skf.com/services.

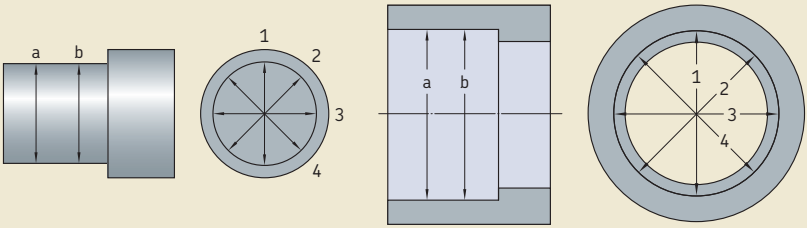
Cleanliness

Cleanliness is essential to long bearing service life. Cleanliness begins in the storage room. Store bearings in a cool, dry area, on shelves that are not subjected to vibrations from adjacent machinery (→ *Storage of bearings, seals and lubricants*, starting on **page 41**). Do not open the bearing package until it is time to install the bearing.

Whenever possible, install bearings in a dry, dust-free area, away from metalworking or other machines producing swarf and dust. Make sure that the bearings and all mating parts, including the lubricant, are clean and free from damaging contaminants.

When bearings have to be mounted in an unprotected area, which is often the case with

Fig. 1



large bearings, steps need to be taken to protect the bearing and mounting position from contaminants such as dust, dirt and moisture, until installation has been completed. This can be done by covering or wrapping bearings, machine components etc. with plastic or foil.

NOTE: It is better to prevent bearings from becoming dirty than to clean them. Many bearing types cannot be separated and are therefore difficult to clean.

Removing the preservative from new bearings

Bearings should be left in their original packages until immediately before mounting so that they will not be exposed to any contaminants, especially dirt. Normally, the preservative applied to new bearings does not need to be completely removed. It is only necessary to wipe off the outside diameter and bore surfaces.

CAUTION: SKF recommends carefully washing and drying the bearings if the bearings are to be grease lubricated and used at very high or very low temperatures. The bearings should also be washed if the lubricant to be used is not compatible with the preservative (→ *Compatibility between greases and SKF bearing preservatives*, **page 202**).

Checking associated components

A bearing will only perform satisfactorily if the associated components have the requisite accuracy and if the prescribed tolerances are adhered to. Therefore:

- Remove any burrs or rust.
- Check the dimensional and form accuracy of all associated components of the bearing arrangement.
- Check cylindrical shaft seats. Using a micrometer, measure in two places on the shaft seat. Be sure to measure in four directions (→ **fig. 1**). For large seats, measuring in three or four places might be needed (→ **Measurement report form**, **page 48**).
- Check tapered shaft seats using a ring gauge (→ **fig. 2**), a taper gauge (→ **fig. 3**) or a sine bar (→ **fig. 4**).

Fig. 2

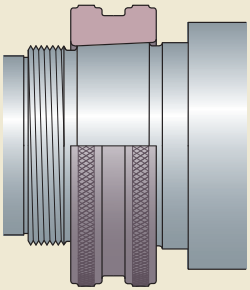


Fig. 3

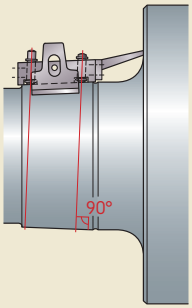
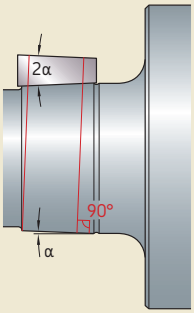
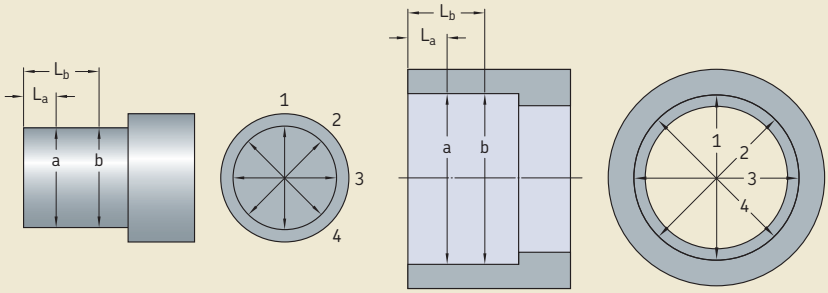


Fig. 4



Measurement report form

Bearing:
Bearing position:
Application:



Measuring directions	**Shaft** Measurement values [mm] at place				**Housing** Measurement values [mm] at place			
	a	b	(c)	(d)	a	b	(c)	(d)
	Distance L				Distance L			
	Diameter d				Diameter D			
1								
2								
3								
4								
	Calculated mean: (1+2+3+4)/4				Calculated mean: (1+2+3+4)/4			

Remarks:	
Date:	Checked by:

- Housing seats are usually checked in two places with an internal micrometer or other comparable measuring gauge. Be sure to measure in four directions (→ **fig. 1, page 46**). For large seats, measuring in three or four places might be needed.
- Record the measurement values of the shaft and bore diameters for future reference. Use the measurement report form.

When measuring, it is important that the components and the measuring instruments are at the same approximate temperature. This is particularly important where large bearings and their associated components are concerned.

Safety

To minimize the chance of injury, when handling or mounting bearings:

- Always wear gloves, especially when handling heated bearings or working with lubricants.
- Always use appropriate lifting or carrying tools.
- Never strike the bearing directly with any hard object such as a steel hammer or a chisel.

Preparing components

Before mounting a bearing, prepare the associated components and do the following:

- Mount any components that are on the shaft in front of the bearing.
- For a tight shaft and/or housing fit, coat the bearing seat(s) with a thin layer of light oil.
- For a loose shaft and/or housing fit, coat the bearing seat(s) with SKF Anti-fretting agent.
- If the shaft or sleeve is equipped for oil injection, make sure that the ducts and grooves are clean.

Bearing handling

SKF recommends using gloves as well as carrying and lifting tools that have been specially designed for mounting bearings. In addition to being a safety issue, using the proper tools will save time and effort.

When handling hot or oily bearings, SKF recommends wearing the appropriate heat or oil resistant gloves (→ *Gloves*, **page 73**).

Heated bearings and larger, heavier bearings can be difficult for one or two persons to handle safely. In these instances, satisfactory equipment for lifting and transporting the bearing should be used (→ **figs. 5** and **6**).

Fig. 5

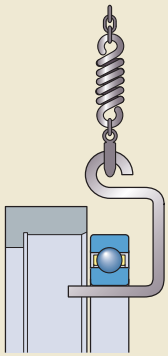
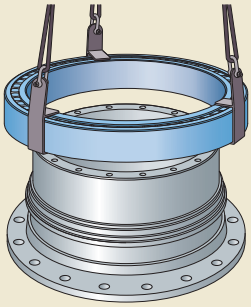


Fig. 6



Bearing handling tools are available from SKF (→ **fig. 7**). For large, heavy bearings, use lifting tackle that supports the bearing from the bottom (→ **fig. 8**). Never suspend the bearing from a single point, as it could permanently deform the rings. A spring between the hook and tackle (→ **fig. 5**, **page 49**) can facilitate positioning the bearing onto the shaft.

Large bearings provided with threaded holes in one of the ring side faces can accommodate eye bolts. Because the size and depth of the hole is limited by the ring thickness, these holes are designed to accommodate only the weight of the bearing.

Make sure that the eye bolts are only subjected to load in the direction of the shank axis (→ **fig. 9**).

CAUTION: Never place any additional components on the bearing prior to lifting.

When mounting a solid, large housing over a bearing that is already in position on a shaft, it is advisable to provide three-point suspension for the housing, with one of the slings adjustable. This facilitates the process of aligning the housing bore with the bearing outside diameter.

Fig. 7

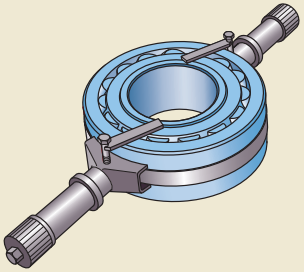


Fig. 8

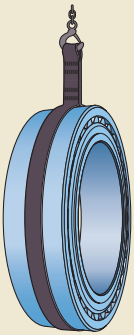
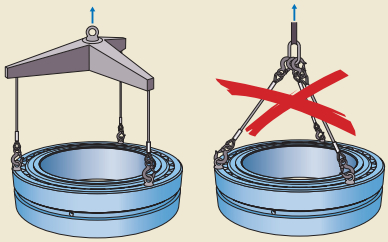


Fig. 9



Bearing internal clearance

The internal clearance of a bearing is the total distance through which one bearing ring can be moved relative to the other.

Movement in the radial direction is called “radial internal clearance”; axial movement is called “axial internal clearance” (→ **fig. 10**).

Clearance before and after mounting

It is important to distinguish between the internal clearance of a bearing before mounting and the internal clearance of a mounted bearing under actual operating conditions.

Clearance before mounting is usually greater than the operational clearance because the rings expand or compress due to the interference fit, and because of thermal expansion of the bearing rings and associated components.

As a general rule, operational radial internal clearance should be slightly greater than zero, while a slight preload for ball bearings usually has no detrimental effect. Preload is usually not recommended for replacement bearings because the seats might not be optimal anymore.

Values for clearance before mounting can be found in **Appendix E**, starting on **page 388**.

Fig. 10

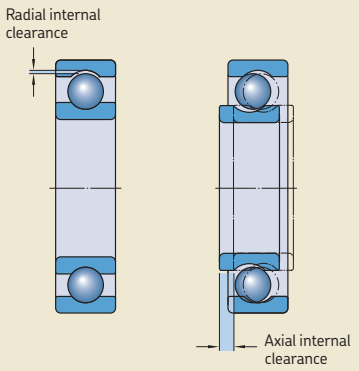


Fig. 11

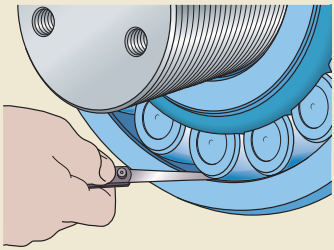
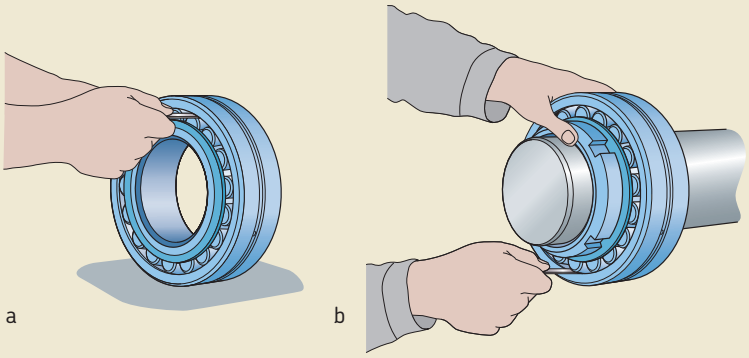


Fig. 12



Measuring clearance with a feeler gauge

A feeler gauge is most often used to measure the radial internal clearance in medium-size and large spherical roller bearings and CARB toroidal roller bearings, before, during and after mounting (→ **fig. 11**, **page 51**).

Before measuring, rotate the inner or outer ring a few times. Make sure that both bearing rings and the roller complement are centrically arranged relative to each other.

To start, select a feeler gauge blade that is slightly thinner than the minimum value for initial bearing clearance (→ **Appendix E**, starting on **page 388**). When measuring, move the blade back and forth between the middle of the roller and raceway. Repeat this procedure using a thicker blade each time until you can feel a slight resistance between the blade and roller. Take measurements between:

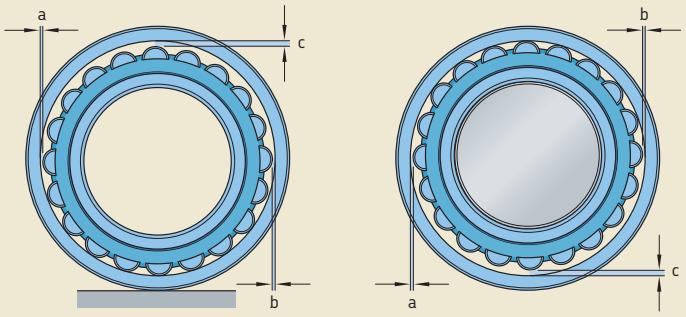
- the outer ring and uppermost roller, before mounting (→ **fig. 12a**, **page 51**)
- the outer ring and lowest roller, after mounting (→ **fig. 12b**, **page 51**)

For large bearings, especially those having a rather thin-walled outer ring, the measurements are affected by the elastic deformation of the rings, caused by the weight of the bearing or the force to draw the feeler gauge blade through the gap between the raceway and an unloaded roller. To establish the "true" clearance before and after mounting, use the following procedure (→ **fig. 13**):

- Measure the clearance "c" at the 12 o'clock position for a standing bearing or at the 6 o'clock position for an unmounted bearing hanging from the shaft.
- Measure the clearances "a" at the 9 o'clock position and "b" at the 3 o'clock position without the bearing being moved.
- Obtain the "true" radial internal clearance with relatively good accuracy using the following equation:

radial internal clearance = 0,5 (a + b + c).

Fig. 13



Cold mounting

For cold mounting, there is a choice of methods:

- mechanical methods
- the SKF Drive-up method
- the oil injection method
- the SENSORMOUNT method

Mechanical methods are usually used to drive small bearings with a cylindrical or tapered bore onto a shaft or into a housing. The other three methods are only used to drive up bearings with a tapered bore onto a tapered seat.

CAUTION: When mounting a bearing, never strike it directly with any hard object such as a steel hammer or a chisel, and never apply the mounting force through the rolling elements.

Mechanical methods

Bearings with a cylindrical bore

Small bearings should be mounted with an appropriate bearing fitting tool, e.g. the SKF Bearing fitting tool kit (→ **fig. 14a**).

If the shaft has an external (→ **fig. 14b** and **c**) or an internal thread (→ **fig. 14d**), the threads can be used to mount the bearing onto a shaft.

If a bearing has to be pressed onto the shaft and into the housing bore at the same time, the mounting force must be applied equally to both rings (→ **fig. 15**).

To mount a larger number of bearings, a mechanical or hydraulic press can be used. When using a press, place an appropriate sleeve between the ram and the ring to be mounted (→ **fig. 16**, **page 54**).

Fig. 14

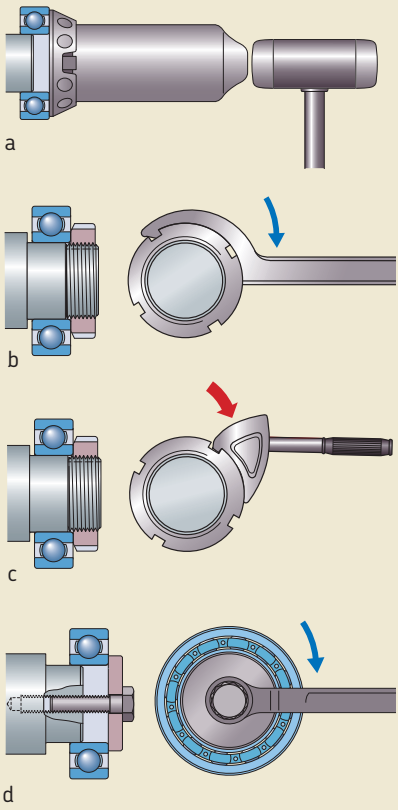
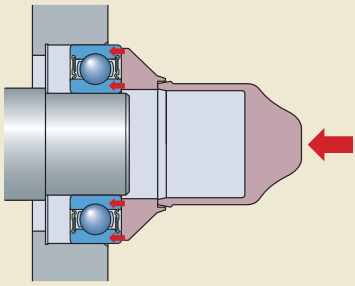


Fig. 15



Bearings with a tapered bore

Small and medium-size bearings can be driven up onto a tapered seat using either a bearing fitting tool or preferably a lock nut. In the case of adapter sleeves, the sleeve nut is used.

A hook or impact spanner can be used to tighten the nut (→ **fig. 17**) and to drive up the bearing on its tapered seat. Small withdrawal sleeves may be driven into the bearing bore using a bearing fitting tool or an end plate.

Bearings with a bore diameter d ≥ 50 mm can be simply and reliably mounted, applying the SKF Drive-up method (→ *The SKF Drive-up method*, starting on **page 57**).

Combining the SKF Drive-up method and the oil injection method facilitates mounting medium-size and large bearings (→ *The oil injection method*, starting on **page 62**).

Combining the oil injection method and the SENSORMOUNT method further simplifies the mounting of large bearings (→ *The SENSORMOUNT method*, **page 67**).

Bearings with a tapered bore are mounted with an interference fit. The degree of interference is normally determined by one of the following methods:

- feeling the clearance reduction by swivelling the outer ring
- measuring the clearance reduction with a feeler gauge
- measuring the lock nut tightening angle
- measuring the axial drive-up
- measuring the inner ring expansion

Fig. 16

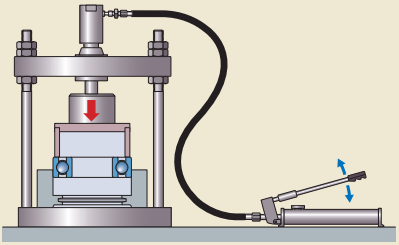


Fig. 17

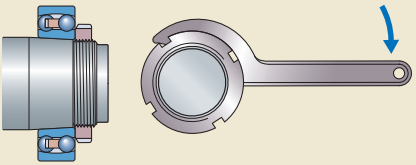


Fig. 18

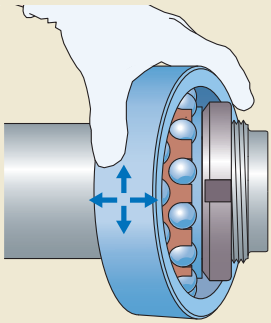
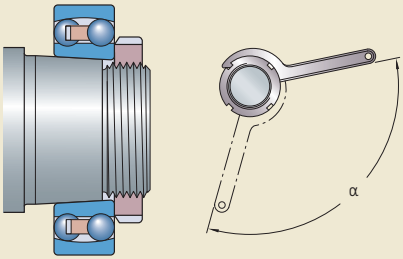


Fig. 19



Feeling the clearance reduction by swivelling the outer ring

When mounting self-aligning ball bearings with Normal radial clearance, it is generally sufficient to check clearance during axial drive-up by turning and swivelling the outer ring (→ **fig. 18**). The bearings are properly mounted when the outer ring can be easily turned, but a slight resistance is felt when it is swivelled out. The bearing then has the requisite interference fit.

Measuring the clearance reduction with a feeler gauge

Using a feeler gauge (→ **fig. 12**, **page 51**) is one way to measure the radial internal clearance in medium-size and large bearings, before, during, and after mounting (→ *Measuring clearance with a feeler gauge*, **page 52**).

Recommended values for reduction of radial internal clearance are provided for:

- spherical roller bearings in **Appendix F-2** (→ **page 403**)
- CARB toroidal roller bearings in **Appendix F-3** (→ **page 404**)

Measuring the lock nut tightening angle (α)

SKF recommends this method (→ **fig. 19**) for mounting small to medium-size bearings with a tapered bore and up to approximately 120 mm bore diameter. Guideline values for the lock nut tightening angle (α) are provided for:

- self-aligning ball bearings in **Appendix F-1** (→ **page 402**)
- spherical roller bearings in **Appendix F-2** (→ **page 403**)
- CARB toroidal roller bearings in **Appendix F-3** (→ **page 404**)

Before starting the final tightening procedure, place the bearing onto the tapered seat until it is firmly in position. By tightening the nut through the recommended angle (α), the bearing is driven up over the proper distance on the tapered seat. The bearing inner ring then has the requisite interference fit.

Measuring the axial drive-up

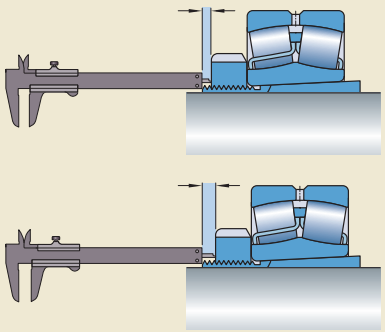
Controlling the axial displacement of a bearing on its tapered seat provides an easy way to achieve the fit. One way is to simply measure the axial displacement (→ **fig. 20**). This method is not very accurate since it is not easy to determine the start position.

Guideline values for axial drive-up are provided for:

- self-aligning ball bearings in **Appendix F-1** (→ **page 402**)
- spherical roller bearings in **Appendix F-2** (→ **page 403**)
- CARB toroidal roller bearings in **Appendix F-3** (→ **page 404**)

The most suitable method is the SKF Drive-up method, which is an easy, fast and very reliable method to achieve the correct drive-up and thereby the appropriate interference fit (→ *The SKF Drive-up method*, starting on **page 57**).

Fig. 20



Measuring the inner ring expansion

Measuring the inner ring expansion when the bearing is driven up on its tapered seat simplifies the mounting process of large bearings. To do this, the SENSORMOUNT method is available using a sensor integrated with the bearing inner ring and a dedicated hand-held indicator (→ *The SENSORMOUNT method*, **page 67**).

Table 1

Suitable tools for the SKF Drive-up method

Designation	Description
Hydraulic nuts	
HMV ..E, e.g. HMV 40E	Hydraulic nut with a metric thread, e.g. M 200 × 3
HMVC ..E, e.g. HMVC 40E	Hydraulic nut with an inch thread, e.g. ANF 7.847 × 8 Class 3
Pumps	
729124 SRB	Hand operated hydraulic pump for – working pressure up to 100 MPa and – hydraulic nuts up to 270 mm thread diameter
TMJL 100 SRB	Hand operated hydraulic pump for – pressure up to 100 MPa and – hydraulic nuts up to 460 mm thread diameter
TMJL 50 SRB	Hand operated hydraulic pump for – working pressure up to 50 MPa and – hydraulic nuts up to 1 000 mm thread diameter
Pressure gauge	
TMJG 100 D	Pressure range: 0 – 100 MPa
Dial indicators	
TMCD 10R	Horizontal dial indicator for measuring displacement up to 10 mm
TMCD 1/2R	Horizontal dial indicator for measuring displacement in inches, up to 0.5 in.
TMCD 5	Vertical dial indicator for measuring displacement up to 5 mm

The SKF Drive-up method

The SKF Drive-up method is recommended for medium-size and large bearings. The method is based on a two-stage mounting procedure using a hydraulic nut fitted with a dial indicator.

Stage one: by applying a predetermined pressure in the hydraulic nut, a reliable start position is reached.

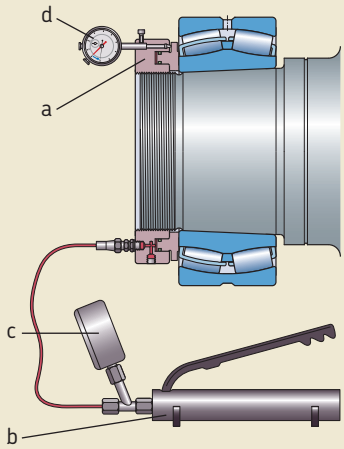
Stage two: by increasing the pressure in the hydraulic nut, the bearing inner ring is pushed further on its tapered seat. The displacement is measured by the dial indicator, until a predetermined axial displacement is obtained. Guideline values for the requisite oil pressure to reach the start position and the axial displacement to reach the final position are provided for:

- self-aligning ball bearings in **Appendix H-1** (→ **page 406**)
- spherical roller bearings in **Appendix H-2** (→ **page 407**)
- CARB toroidal roller bearings in **Appendix H-3** (→ **page 411**)

The SKF Drive-up method requires the following tools (→ **table 1** and **fig. 21**):

- an SKF HMV ..E or HMVC ..E hydraulic nut (**a**)
- a suitably sized hydraulic pump (**b**)
- a pressure gauge, appropriate to the mounting conditions (**c**)
- an appropriate dial indicator (**d**)

Fig. 21



The SKF Drive-up method: Step-by-step

1 Before starting, carefully follow the guidelines provided under *Preparations prior to mounting*, starting on **page 46**, and apply where appropriate.

2 Determine whether one or two surfaces slide during mounting (→ **fig. 22**):

- one surface: **cases 1, 2** and **3**
- two surfaces: **cases 4** and **5**

3 Check whether the bore diameter of the bearing and the thread diameter of the hydraulic nut are equal (→ **fig. 22**: **cases 1**, **3** and **4**). If so, the requisite oil pressure to reach the start position is provided for:

- self-aligning ball bearings in **Appendix H-1** (→ **page 406**)
- spherical roller bearings in **Appendix H-2** (→ **page 407**)
- CARB toroidal roller bearings in **Appendix H-3** (→ **page 411**)

If the bore diameter of the bearing and the thread diameter of the hydraulic nut are not equal (→ **fig. 22: cases 2** and **5**), the requisite oil pressure to reach the start position must be adjusted, as a smaller hydraulic nut is used than that shown for the appropriate bearing. In these cases, the requisite oil pressure can be calculated from

$$P_{req} = \frac{A_{ref}}{A_{req}} P_{ref}$$

where

P_{req} = requisite oil pressure for the actual hydraulic nut [MPa]
P_{ref} = oil pressure specified for the reference hydraulic nut [MPa]
A_{req} = piston area of the actual hydraulic nut [mm^2]
A_{ref} = piston area of the specified reference hydraulic nut [mm^2]

The appropriate values for P_{ref}, A_{req} and A_{ref} are listed in the above-mentioned appendices.

4 Coat the sliding surfaces with a thin layer of light oil and place the bearing on the tapered shaft or sleeve.

5 Screw the hydraulic nut onto the thread of the shaft or sleeve so that it abuts the bearing or the withdrawal sleeve (→ **fig. 23**).

NOTE: Detailed mounting instructions, specific to the bearing designation can be found at www.skf.com/mount.

Fig. 22

Steps 2 and 3: Determine the number of sliding surfaces and appropriate starting pressure.

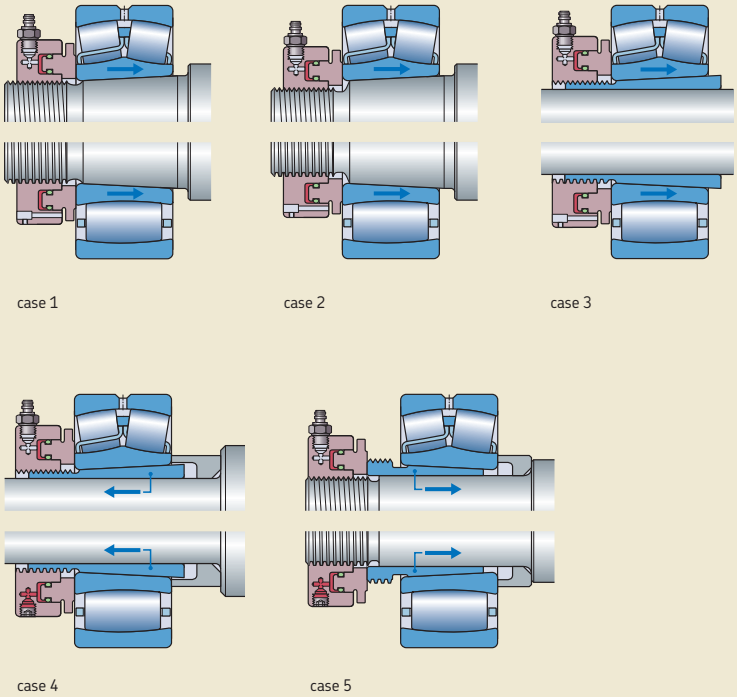


Fig. 23

Step 5: Put the hydraulic nut in place.

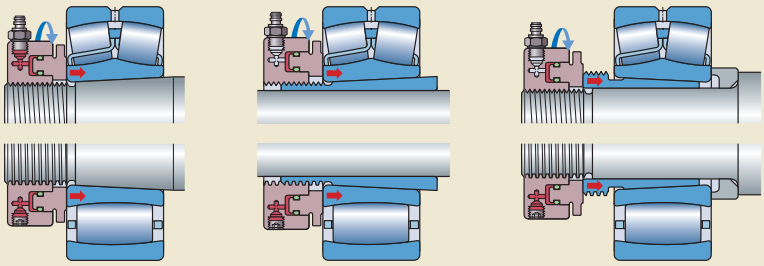


Fig. 24

Step 6: Apply the requisite pressure to reach the start position.

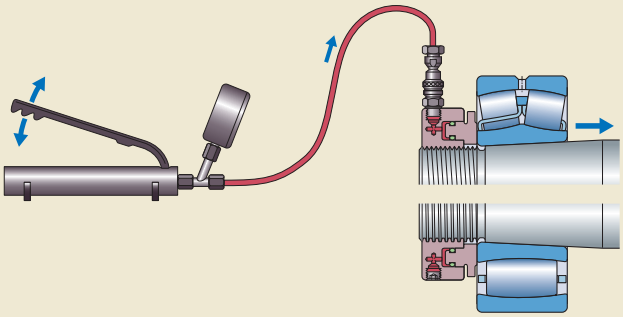


Fig. 25

Step 7: Read the axial displacement from the dial indicator.

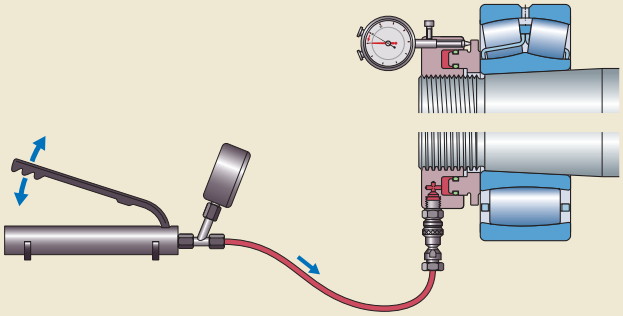
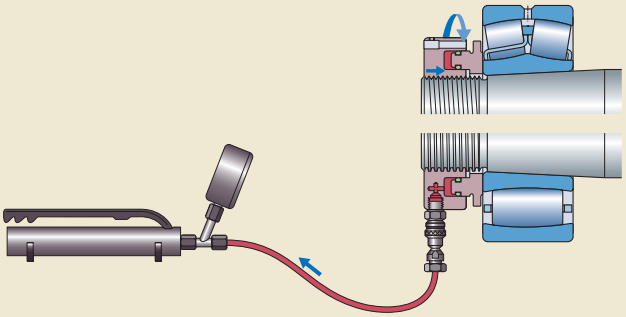


Fig. 26

Step 9: Drain the oil from the hydraulic nut.



6 Connect the oil pump with the hydraulic nut. Drive the bearing to its start position by applying oil to the hydraulic nut until the requisite pressure is reached. Do not release the pressure (→ **fig. 24**).

NOTE: When mounting the bearing in combination with the oil injection method, do not inject oil between the contact surfaces before having reached the start position.

7 Attach the dial indicator to the hydraulic nut. Set the dial indicator to the required drive-up distance. Pump additional oil to the hydraulic nut until the bearing has been driven up the required distance and the dial indicator reads zero (→ **fig. 25**).

NOTE: If the oil injection method is used, open the oil release valve of the oil pump(s) used for the oil injection (to the shaft or sleeve) and allow the oil to drain for at least 20 minutes.

8 When mounting is complete, open the oil release valve of the oil pump to depressurize the oil.

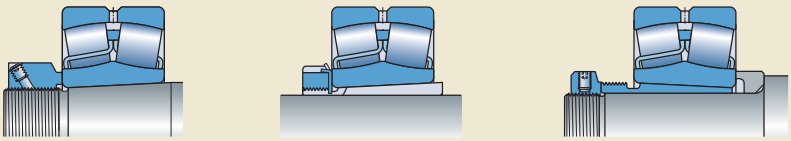
9 To drain the oil, bring the piston of the hydraulic nut to its original position. To do this, screw the nut up the threaded portion of the shaft or sleeve (→ **fig. 26**).

10 Disconnect the oil pump and remove the nut from the shaft or sleeve. The bearing will not come loose.

11 Secure the bearing on its shaft seat or on the sleeve, e.g. using the appropriate locking device (→ **fig. 27**).

Fig. 27

Step 11: Secure the bearing on its shaft seat or on the sleeve.



Tapered shaft | Adapter sleeve | Withdrawal sleeve

The oil injection method

Using the oil injection method (→ **fig. 28**) can save considerable effort when mounting a bearing with a tapered bore. With this method, oil under high pressure is injected between the bearing bore and its seat to form an oil film. This oil film separates the mating surfaces and appreciably reduces the friction between them.

Provided the application has been prepared for oil injection (→ **Appendix G**, **page 405**), this method can be used to mount a bearing:

- on a tapered shaft
- on an adapter sleeve
- on a withdrawal sleeve

The equipment required for the oil injection method is also available from SKF. Products are shown and described in the section *Hydraulic tools*, on **page 73**.

If the oil injection method is applied when mounting medium-size and large bearings, SKF recommends the following step-by-step mounting procedure.

The oil injection method: Step-by-step

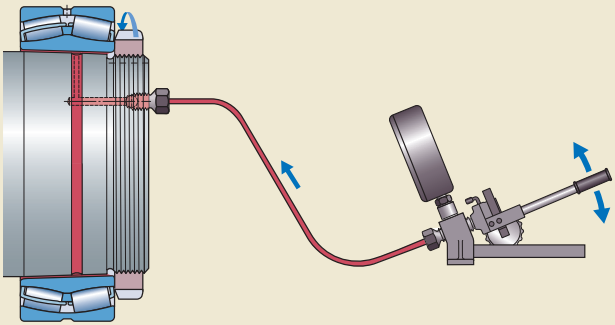
1 Before starting, carefully follow the guidelines provided under *Preparations prior to mounting*, starting on **page 46**, and apply where appropriate.

2 Measure the bearing radial internal clearance. Also, determine the required clearance reduction and the axial drive-up distance (→ *The SKF Drive-up method*, starting on **page 57**) of the bearing. Guideline values are provided for:

- self-aligning ball bearings in **Appendix F-1** (→ **page 402**)
- spherical roller bearings in **Appendix F-2** (→ **page 403**)
- CARB toroidal roller bearings in **Appendix F-3** (→ **page 404**)

NOTE: When measuring the radial internal clearance, follow the instructions provided under *Measuring clearance with a feeler gauge* on **page 52**.

Fig. 28



3 Sleeve mounting:
- If applicable, remove the nut and locking device. When using a lock nut to drive the bearing into position, coat the sleeve thread and the side of the nut facing the bearing with a molybdenum disulphide paste.

4 Coat all the mating surfaces with a thin layer of light oil.

5 Start to mount the bearing (→ **fig. 29**).
Tapered shaft:
- Push the bearing onto its seat.

Adapter sleeve:
- Slide the sleeve into position. Place the bearing onto the sleeve.

Withdrawal sleeve:
- Place the bearing centrically on the shaft and against the abutment. Push the sleeve along the shaft into the bearing bore.

NOTE: For excessive sliding resistance, slightly expand the sleeve by inserting a small plastic wedge in the slot of the sleeve.

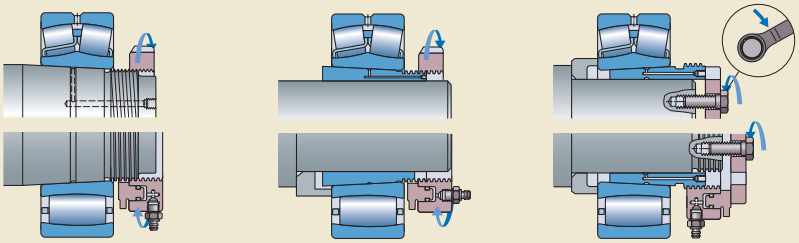
6 Put the accessories in place.
Tapered shaft:
- Screw the lock nut or hydraulic nut onto the shaft until the bearing is firmly in position.

Adapter sleeve:
- Screw the lock nut or hydraulic nut onto the sleeve until the bearing is firmly in position.

Withdrawal sleeve:
- When using a hydraulic nut or applying the SKF Drive-up method to drive the sleeve into the bearing bore, screw the nut onto the sleeve with the piston facing outward, leaving at least a gap corresponding to the axial mounting distance. Provide a stop on the shaft, e.g. an end plate for the piston to work against.

Fig. 29

Steps 5 and 6: Put the bearing and accessories in place.



Tapered shaft | Adapter sleeve | Withdrawal sleeve

7 Install the appropriate fittings and pipes (→ **fig. 30**).
Tapered shaft:
– Install the fitting into the threaded hole for the oil supply at the shaft end.
Adapter sleeve:
– Screw the oil supply extension pipe with a quick-connector into the threaded side of the sleeve.
Withdrawal sleeve:
– Screw the oil supply extension pipe with a quick-connector into the threaded side of the sleeve.

8 Connect the appropriate oil pump(s).

NOTE: When applying the SKF Drive-up method, follow the procedure provided under *The SKF Drive-up method*, starting on **page 57**.

9 Inject oil with a viscosity of approximately 300 mm²/s at 20 °C (*70 °F*), e.g. SKF Mounting fluid, between the mating surface(s) until the contact surfaces are separated by a layer of oil (→ **fig. 31**).

10 Drive up the bearing (→ **fig. 32**).
Tapered shaft:
– Drive up the bearing the determined distance to its final position on the shaft by tightening the lock nut or operating the hydraulic nut.
Adapter sleeve:
– Drive up the bearing the determined distance to its final position on the sleeve by tightening the lock nut or operating the hydraulic nut.
Withdrawal sleeve:
– Drive the sleeve into the bearing bore to the determined axial distance by tightening the screws in turn or operating the oil pump of the hydraulic nut.

NOTE: When using the SKF Drive-up method, apply the appropriate oil pressure to the hydraulic nut until the bearing is in the start position. Then position the dial indicator and set it to the required drive-up value. Continue to pump oil until the indicator reaches the drive-up distance. The indicator will then read zero.

Fig. 30

Steps 7 and 8: Install fittings and pipes, and connect the oil injection equipment.

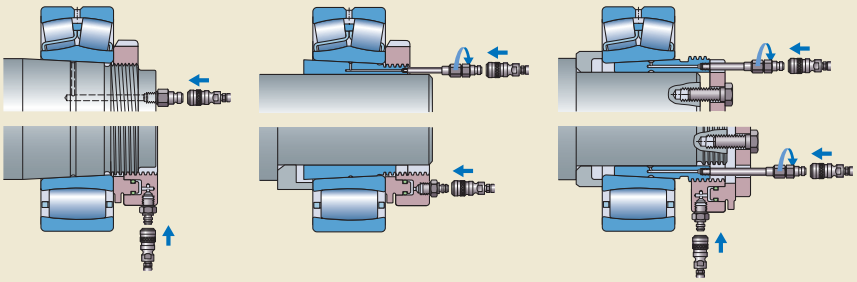
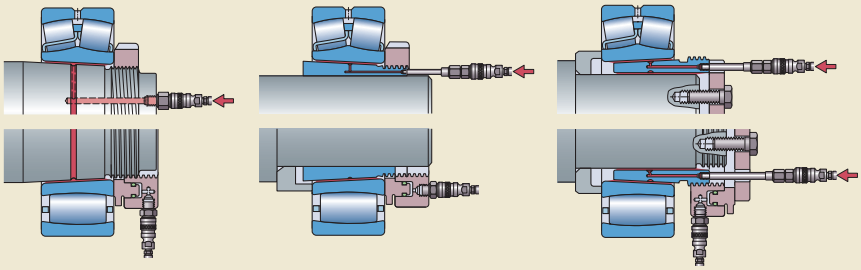


Fig. 31

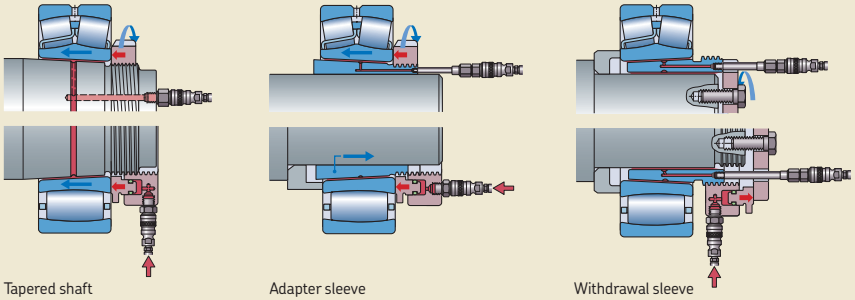
Step 9: Inject oil under high pressure to separate the mating surfaces.



Tapered shaft | Adapter sleeve | Withdrawal sleeve

Fig. 32

Step 10: Drive up the bearing.



Tapered shaft | Adapter sleeve | Withdrawal sleeve

11 When mounting is complete, open the oil release valve to the pump(s) used for oil injection. Allow the oil to drain for at least 20 minutes.

CAUTION: When using the SKF Drive-up method, do not release the pressure to the hydraulic nut at this stage.

12 Check the residual radial internal clearance using a feeler gauge.

NOTE: When using the SKF Drive-up method, it is not necessary to check radial internal clearance after mounting.

13 If the residual clearance is in accordance with the recommended values, disconnect the oil supply to the shaft or sleeve (including the extension pipe), remove the fitting and replace the oil duct.

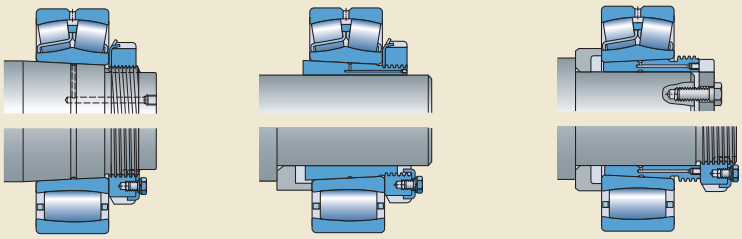
NOTE: When using the SKF Drive-up method, open the oil release valve on the pump that operates the hydraulic nut. To empty the nut, return the piston to the start position by screwing the nut up the thread.

14 Where applicable, remove the lock nut, hydraulic nut or the screws on the end plate. The assembly will not come free.

15 Secure the bearing with the appropriate locking device (→ **fig. 33**):
- For KM or KML lock nuts, use the appropriate MB or MBL lock washer.
- For HM 30 and HM 31 series lock nuts, use the supplied locking clip and bolt.
- For applications with an end plate, use bolts and appropriate spring washers.

Fig. 33

Step 15: Secure the bearing.



Tapered shaft | Adapter sleeve | Withdrawal sleeve

The SENSORMOUNT method

The SENSORMOUNT method enables SKF spherical roller bearings and CARB toroidal roller bearings with a tapered bore and a diameter of 340 mm and above to be mounted accurately without measuring neither the radial internal clearance nor the drive-up distance before or after mounting. Mounting is quick and accurate.

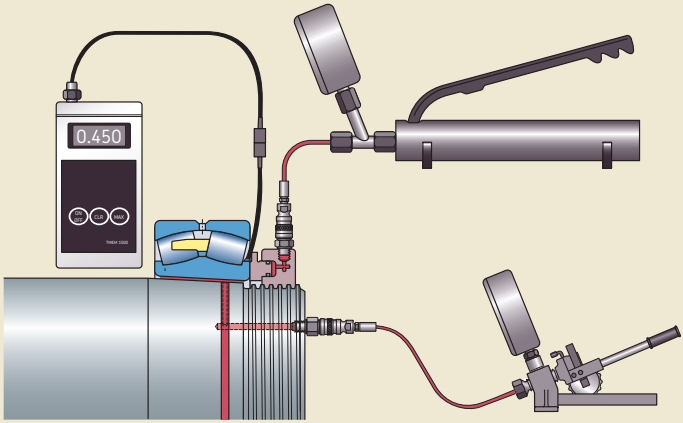
This method uses a sensor, imbedded in the bearing inner ring, and a dedicated hand-held indicator (→ **fig. 34**).The indicator processes the information from the sensor. Inner-ring expansion is displayed as the relationship between the clearance reduction (µm) and the bearing bore diameter (mm). The value 0,450 shown on the indicator display is a common limit for bearings operating under normal conditions.

Aspects like bearing size, shaft material, design (solid or hollow) and surface finish does not need any special consideration.

Bearings that will be mounted onto a tapered shaft or adapter sleeve have the sensor on the small bore diameter side of the inner ring – designation prefix ZE, e.g. ZE 23084 CAK/W33. Bearings that will be mounted on a withdrawal sleeve have the sensor on the large bore diameter side – designation prefix ZEB, e.g. ZEB C 23084 KM.

NOTE: Detailed mounting instructions are supplied with the bearing. Alternatively, instructions can be found at www.skf.com/mount.

Fig. 34



Hot mounting

The requisite difference in temperature between the bearing ring and shaft or housing depends on the degree of interference and the diameter of the bearing seat.

When heating bearings, temperature control is essential:

- Do not heat open bearings to more than 120 °C *(250 °F)*.
- Do not heat sealed bearings above 80 °C *(175 °F)* because of their grease fill and/or seal material.

For housings, a moderate increase in temperature, from 20 up to 50 °C *(35 up to 90 °F)*, is normally sufficient, since the degree of interference is seldom large.

Once a bearing has been heated, the objective is to get that bearing in place, up against its shoulder as quickly as possible and keep it there until the bearing has cooled. To do this, SKF recommends using the SKF Bearing handling tool and lifting tackle, especially when mounting medium-size and large bearings (→ **figs. 7** to **9** on **page 50**).

CAUTION: When mounting a bearing, never strike it directly with any hard object such as a steel hammer or a chisel, and never apply the mounting force through the rolling elements.

To heat a bearing or housing to the proper temperature quickly and safely, SKF offers a wide assortment of heaters. The following is a listing of available heating techniques and their typical uses.

CAUTION: Never heat a bearing using an open flame (→ **fig. 35**)!

Fig. 35

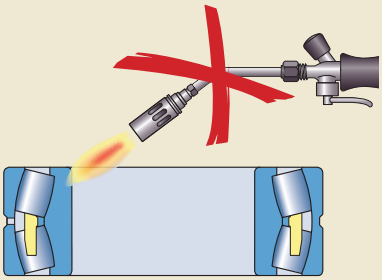
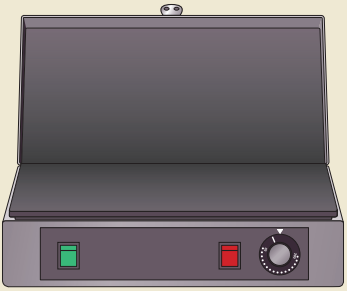


Fig. 36



Electric hot plates

An electric hot plate (→ **fig. 36**) can be used to heat small bearings or small housings. To provide uniform heating, the bearings must be turned over a number of times.

The SKF Electric hot plate is a thermostatically controlled heating device with an adjustable temperature range of 50 to 200 °C *(120 to 390 °F)*.

CAUTION: Sealed bearings should never contact the heating plate directly. Place a ring between the plate and bearing.

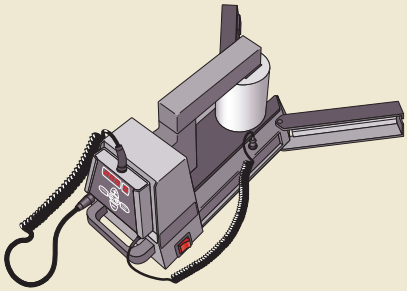
Induction heaters

SKF recommends using an electric induction heater (→ **fig. 37**) to heat rolling bearings. Induction heaters heat bearings evenly within a relatively short time and are particularly safe because the heater and yoke never get hot.

Induction heaters will magnetize a bearing. Therefore, it is important to demagnetize the bearing prior to installation. All SKF induction heaters have an automatic demagnetizing device. They are available in several sizes for heating bearings with a bore diameter from 20 mm and upwards.

Operating instructions are supplied with the induction heaters.

Fig. 37



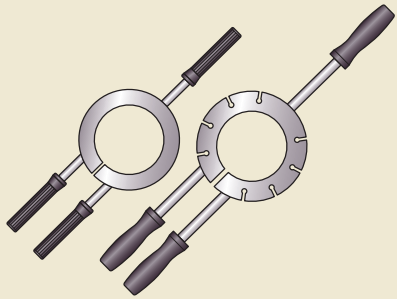
Aluminium heating rings

Aluminium heating rings (→ **fig. 38**), originally developed for dismounting the inner rings of NU, NJ and NUP cylindrical roller bearings, can also be used for mounting.

SKF aluminium heating rings are available for bearing sizes 204 to 252, 304 to 340 and 406 to 430.

Operating instructions are supplied with the rings.

Fig. 38

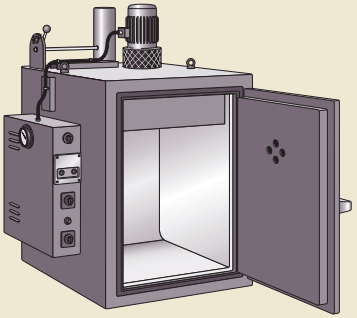


Heating cabinets

Heating cabinets are typically used when a larger number of small bearings or a number of bearings of different sizes as well as small housings have to be heated.

Suitable heating cabinets are equipped with an adjustable thermostat and fan (→ **fig. 39**). The fan circulates the heated air to maintain an even temperature throughout the cabinet.

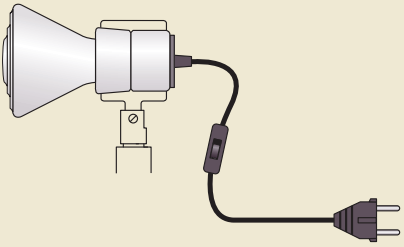
Fig. 39



Infrared radiators

Infrared radiators provide a clean, safe and very simple way to heat small, thin-walled housings. The infrared radiator, encased in a screw cap is placed in the housing bore and switched on. It normally takes only a few minutes to sufficiently heat the housing, because the interference fit between the housing bore and bearing is rarely tight (→ **fig. 40**). After heating, switch off the radiator, remove it from the housing bore and quickly push the cold bearing into position.

Fig. 40



Heating panels

Flexible heating panels are an excellent and safe solution for heating housings without complicated installations. They are made from several flexible materials and available in a number of types and sizes (→ **fig. 41**).

Heating panels suit individual heating needs, e.g. they can be used to cover the housing or placed in the housing bore or as a flat bottom heater.

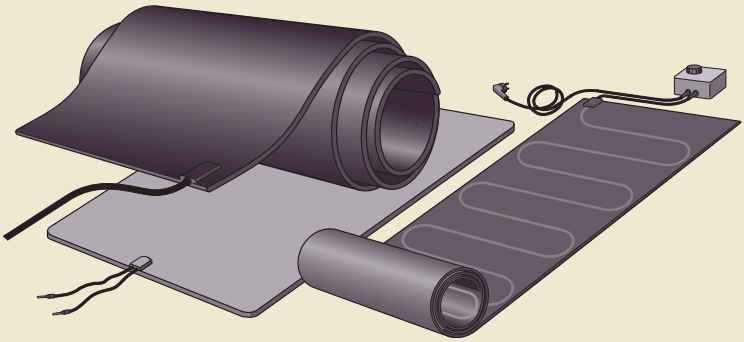
Oil baths

Years ago, oil baths were a popular way to heat bearings and small housings. Today, this method is no longer recommended due to economic, environmental and safety reasons. However, sometimes there is no alternative.

When heating a bearing in an oil bath, some basic rules must be followed. Only use clean oil with a flashpoint above 250 °C *(480 °F)* and a clean receptacle with an adjustable thermostat. Furthermore, the bearings or bearing rings should never make direct contact with the receptacle. After heating the bearing and before pushing the bearing into position on the shaft, allow the oil adhering to the bearing to drip off and then wipe clean the outside of the bearing.

WARNING
Do not place large heavy bearings on the heating panels as this could create an electrical hazard and may damage the heating elements.

Fig. 41



SKF mounting tools

Using the appropriate mounting tools, applying the right mounting method and following the correct procedures will help prevent premature bearing failures and provide proper bearing performance. For that very reason, the SKF product range of mounting tools includes:

- mechanical tools
- hydraulic tools
- heating equipment
- gloves

An overview of the SKF mounting tools and products is provided in **Appendix J**, starting on **page 416**. For additional information, visit www.mapro.skf.com.

Mechanical tools

SKF supplies a full assortment of mechanical tools, such as bearing fitting and handling tools, and spanners, for all common mounting needs.

The SKF Bearing fitting tool kit consists of 36 impact rings in different sizes to facilitate the mounting of more than 400 different bearings (as well as various seals).

The assortment of SKF spanners comprises hook spanners (including adjustable and special hook spanners), impact spanners and axial lock nut sockets.

Table 2

SKF hydraulic pumps and oil injectors selection guide

Max. working pressure	**Pump** Designation	Description	Oil container capacity	Connection fitting	Mounting applications
MPa	–	–	cm^3	–	–
50	**TMJL 50**	Hand operated pump	2 700	G 1/4	All HMV ..E nuts
100	**729124**	Hand operated pump	250	G 1/4	Hydraulic nuts ≤ HMV 54E
	TMJL 100	Hand operated pump	800	G 1/4	Hydraulic nuts ≤ HMV 92E
150	**THAP 150**	Air-driven pump	Separate container	G 3/4	All HMV ..E nuts, oil injection method
	728619 E	Hand operated pump	2 550	G 1/4	Hydraulic nuts of all sizes, oil injection method
300	**THAP 300E**	Air-driven pump	Separate container	G 3/4	Large pressure joints, oil injection method
	226400	Hand operated oil injector	200	G 3/4	Oil injection method, adapter and withdrawal sleeves
	729101 B	Hand operated oil injection kit	200	Several	Oil injection method, adapter and withdrawal sleeves
	TMJE 300	Hand operated oil injection set	200	Several	Oil injection method, adapter and withdrawal sleeves
400	**729101 E**	Hand operated oil injection kit	200	G 1/4	Oil injection method, high pressure joints

Hydraulic tools

SKF has developed a comprehensive assortment of hydraulic tools, including hydraulic nuts, hydraulic pumps and oil injectors, to facilitate bearing installation.

SKF hydraulic nuts have the following characteristics:

- In the HMV ..E series, from a thread diameter size 50 up to and including 200 mm, they have a metric thread in accordance with ISO 965-3:1998, tolerance class 6H.
- In the HMV ..E series, from a thread diameter size 205 up to and including 1 000 mm, they have a metric trapezoidal thread in accordance with ISO 2901:1977, tolerance class 7H.
- In the HMVC ..E series, from a thread diameter size 1.967 up to and including 12.5625 in., they have an American National, Form NS, thread in accordance with ANSI B1.1-1974, class 3.
- In the HMVC ..E series, from thread diameter size 13.339 up to and including 37.410 in., they have a General Purpose ACME Thread in accordance with ANSI B 1.5-1957, class 3G.

SKF hydraulic pumps and oil injectors are available in several designs and sizes (→ **table 2**). SKF also offers an assortment of accessories, such as high-pressure pipes, connectors, hoses and gauges.

Heating equipment

The assortment of SKF heating tools includes induction heaters, electric hot plates and aluminium heating rings, for all common mounting needs.

Gloves

SKF supplies various types of gloves for the safe handling of bearings and components. Four types are available, each suited to specific working conditions:

- special working gloves
- heat resistant gloves
- extreme temperature gloves
- heat and oil resistant gloves

Mounting instructions by bearing type

The mounting methods and tools mentioned in the section *Preparations prior to mounting*, starting on **page 46**, can generally be used for all types of rolling bearings. However, due to design, size or weight, some bearing types require extra care or specific mounting methods, including:

- single row angular contact ball bearings and tapered roller bearings
- angular contact ball bearings with a two-piece inner ring
- self-aligning ball bearings with protruding balls
- sealed self-aligning ball bearings
- self-aligning ball bearings with an extended inner ring
- single row cylindrical and needle roller bearings with a cage
- multi-row cylindrical and tapered roller bearings
- spherical roller and CARB toroidal roller bearings

Mounting angular contact ball bearings

Single row angular contact ball bearings are typically adjusted against a second bearing in a solid housing, either in a face-to-face or back-to-back bearing arrangement, to balance the counterforces.

Stand-alone bearings

Stand-alone angular contact ball bearings are intended for arrangements where only one bearing is used in each bearing position. Although the widths of the bearing rings are made to very tight tolerances, these bearings are not suitable for mounting immediately adjacent to each other.

Adjusted bearing arrangements with one bearing used in each bearing position are referred to as cross-located arrangements and are generally used for short shafts. The required clearance or preload in these arrangements is achieved during mounting by moving one bearing ring axially.

Adjusting face-to-face bearing arrangements

Whenever possible, SKF recommends adjusting face-to-face bearing arrangements while the shaft is in the vertical position so it will be supported by the lower bearing.

Measure the distance from the side face of the outer ring to side face of the housing (→ **fig. 42**). Determine the requisite shoulder width of the end cover based on the required axial clearance or preload required during operation. If necessary, determine the requisite thickness of the shims to be inserted either between the housing and end cover, or between the outer ring and end cover.

Attach the final machined end cover (and shims) and turn the bearing arrangement back to the horizontal position.

For bearing arrangements with clearance, verify the outcome of the adjustment by measuring the residual axial clearance using a dial indicator (→ **fig. 43**).

NOTE: Direct measurements with a dial indicator are not suitable for preloaded bearing arrangements. In practice, indirect methods are used to adjust the preload, e.g. by fits, displacement measurements or frictional moment control. For assistance in calculating the preload, contact the SKF application engineering service.

NOTE: During operation, clearance is typically reduced (preload increases) as a result of increased temperatures and temperature differences between the inner and outer rings and other factors such as speeds and loads.

Fig. 42

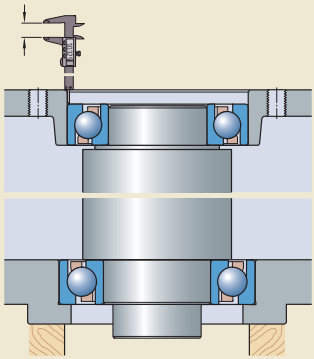
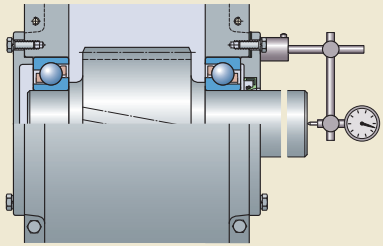


Fig. 43



Adjusting back-to-back bearing arrangements

When adjusting back-to-back bearing arrangements, tighten the lock nut or the bolts in the end plate, while occasionally rotating the shaft (→ **fig. 44**).

For bearing arrangements with clearance, measure the residual axial clearance using a dial indicator (→ **fig. 45**). If the residual clearance is too big, tighten the lock nut or end plate bolts. If the residual clearance is too small, dismount the bearings and start again.

NOTE: Direct measurements with a dial indicator are not suitable for preloaded bearing arrangements. In practice, indirect methods are used to adjust the preload, e.g. by fits, displacement measurements or frictional moment control. For assistance with preload calculations, contact the SKF application engineering service.

If a spacer sleeve is used between two bearing inner rings (→ **fig. 46**), the requisite clearance or preload can be set by grinding the width of the spacer sleeve accordingly.

NOTE: During operation, clearance is typically reduced (preload increases) as a result of increased temperatures and temperature differences between the inner and outer rings, and other factors such as speeds, and loads.

Universally matchable bearings and matched bearing sets

When two or more angular contact ball bearings are mounted adjacent to each other, either universally matchable bearings or a matched bearing set should be used. These bearings are specifically manufactured so that when mounted immediately adjacent to each other, a given internal clearance or preload and/or even load distribution will be obtained without the use of shims or similar devices.

Fig. 44

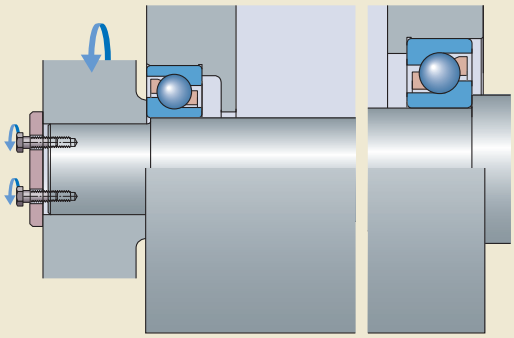


Fig. 45

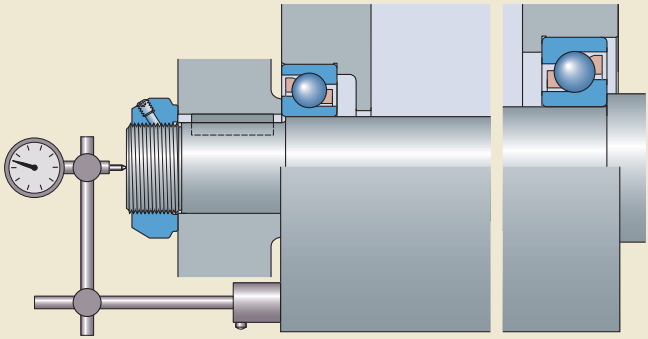
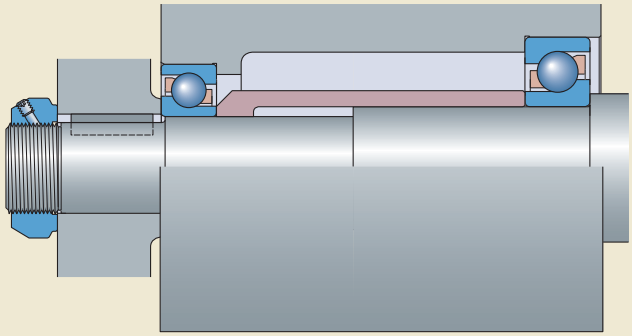


Fig. 46



Angular contact ball bearings with a two-piece inner ring

For double row angular contact ball bearings with a two-piece inner ring and four-point contact ball bearings, a specific mounting sequence should be followed (→ **fig. 47**).

First, drive the inboard inner ring half into position (**1**). Then, place the outer ring with ball and cage assembly(ies) onto the mounted inner ring half (**2**). Finally, drive the outboard inner ring half against the mounted inner ring half (**3**).

Small inner rings can be mounted with a bearing fitting tool and a dead blow hammer; larger bearings should be heated prior to mounting.

NOTE: SKF Explorer four-point contact ball bearings are marked with a serial number on the side face of the outer ring and both inner ring halves (→ **fig. 48**). An asterisk on one of the outer ring side faces and one of the inner ring halves enables the bearing to be mounted in the same position as originally manufactured.

Fig. 48

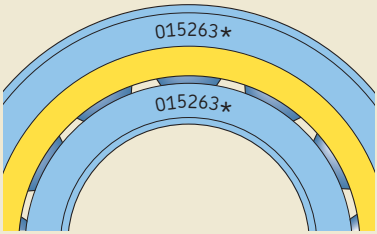
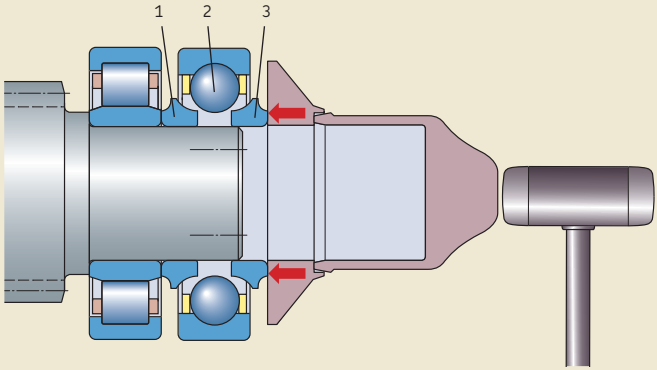


Fig. 47



Mounting self-aligning ball bearings

Basic design bearings with protruding balls

The balls of some self-aligning ball bearings in the 12 series (d ≥ 120 mm) and 13 series (d ≥ 90 mm) protrude from the sides of the bearing. This design feature needs to be considered when mounting these bearings.

For bearings with a cylindrical bore, SKF recommends mounting with heat. If the bearing is to be cold mounted, the intermediate mounting ring of the fitting tool must be recessed by at least 3 mm to avoid damaging the balls (→ **fig. 49**).

If the bearing has a tapered bore, SKF recommends the SKF Drive-up method (→ **page 57**), together with a distance ring or an intermediate spacer (→ **fig. 50**).

Sealed bearings with a tapered bore

When a sealed self-aligning ball bearing is mounted on an adapter sleeve, use an adapter sleeve in the H 3 .. C series. These adapter sleeves are equipped with a special lock washer, which has a protrusion on the side face to prevent the seal from being damaged (→ **fig. 51**).

Fig. 49

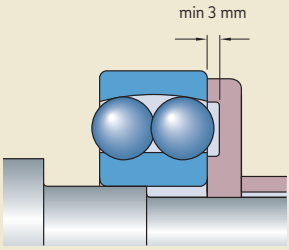


Fig. 50

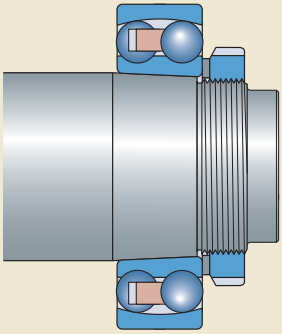


Fig. 51

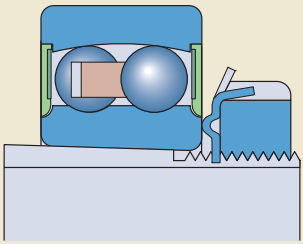
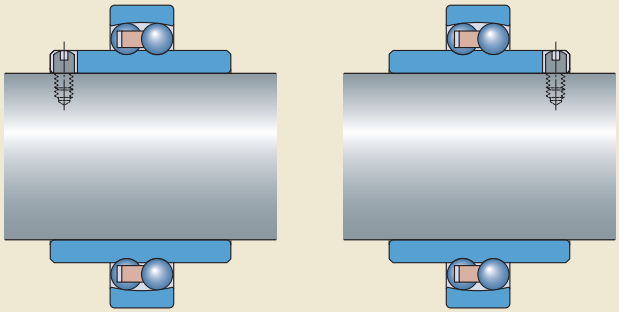


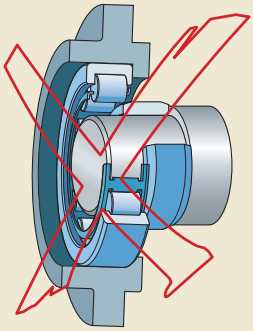
Fig. 52



Bearings with an extended inner ring

Self-aligning ball bearings with an extended inner ring are located axially on the shaft by means of a pin or shouldered screw. When two of these bearings are used to support a shaft, they should be positioned so that the inner ring slots either face each other, or are opposed to each other (→ **fig. 52**). If this is not the case, the shaft will be axially located in one direction only.

Fig. 53



Mounting cylindrical and needle roller bearings

Single row cylindrical and needle roller bearings with a cage

Many cylindrical and needle roller bearings are separable. For NU design cylindrical roller bearings, for example, the outer ring with the roller and cage assembly can be mounted independently of the inner ring, which simplifies assembly.

When mounting an inner ring with or without a roller and cage assembly, SKF recommends mounting with heat. The method used to apply heat depends on the size of the ring (→ *Hot mounting*, starting on **page 68**).

CAUTION: Apply oil or grease to the rollers and raceways prior to mounting. Rotate the shaft or housing during assembly. Be sure that the roller and cage assembly is not skewed during assembly (→ **fig. 53**) or damage to the rollers and raceways could result.

To prevent skewing during mounting, SKF recommends the following:

- use a mounting sleeve for bearings mounted on horizontal shafts (→ **fig. 54**)
- use a mounting sleeve and guide rods attached to the housing for bearings mounted on long shafts and where mounting is done in the vertical position (→ **fig. 55**)

When using a mounting sleeve, the outside diameter of the sleeve should be the same as the raceway diameter of the inner ring and should be machined to tolerance class d10 for cylindrical roller bearings and to tolerance 0/-0,025 mm for needle roller bearings.

CAUTION: When using an induction heater, be sure that the ring is demagnetized before removing it from the heater. All SKF induction heaters have an automatic demagnetization function.

When using an aluminium heating ring (→ **fig. 56**), coat the inner ring raceway with oxidation-resistant oil, e.g. lubricating oil CLP68, before heating the ring, and remove the oil after installation.

Fig. 54

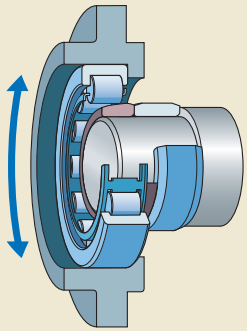


Fig. 55

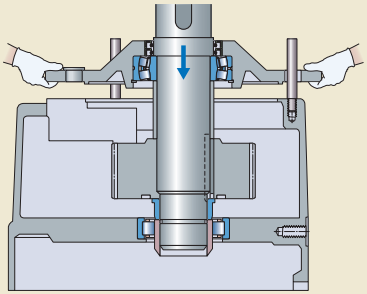
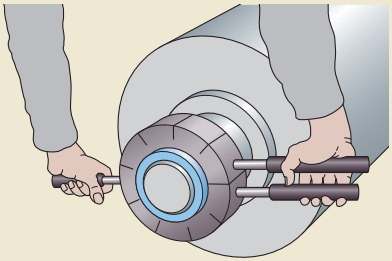


Fig. 56



Four-row cylindrical roller bearings

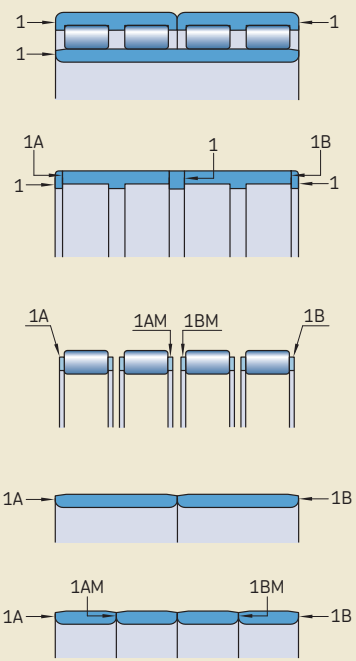
Four-row cylindrical roller bearings are typically used in rolling mills or other heavy applications. They are of separable design with a movable inner ring and are produced in many designs, which differ basically in the number of inner and outer rings as well as in the number of loose or integral flanges on the outer ring.

SKF recommends mounting (and dismounting) the inner ring(s) using a special SKF Fixed induction heater and a specially made mounting sleeve (→ *Mounting a four-row cylindrical roller bearing using a special mounting sleeve*).

During mounting, the individual bearing components must be mounted in the correct order (→ **fig. 57**). In addition, all components of the bearing are marked with the same serial number so that there is no risk of mixing components if several bearings are to be mounted at the same time. The inner rings and inner ring pairs are fully interchangeable and do not necessarily have the same serial number as the other parts.

The side faces of the outer rings are divided into four zones marked I to IV. On each bearing, the position of zone I is also identified by a line across the external surface of the outer ring. When the bearing is mounted for the first time, zone I should typically be positioned in the load zone. Depending on the operating conditions, the outer rings are normally turned 90° after a determined period of service so that a different part of the bearing's outer rings is positioned in the load zone, which extends the service life of the bearing.

Fig. 57



Mounting a four-row cylindrical roller bearing using a special mounting sleeve

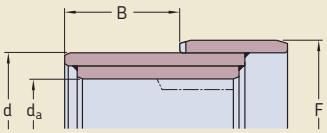
Fig. 58 shows the use of a special mounting sleeve, typically used for a four-row cylindrical roller bearing with a two-piece inner ring and outer ring.

The outside diameter of the sleeve is stepped. The smaller outside diameter corresponds to the bore diameter of the inner ring. The larger diameter corresponds to the diameter of the inner ring raceway. The width of both seats is the same as the width of the inner ring(s). The smaller outside diameter is for mounting the inner ring(s), the larger outside diameter when mounting the outer ring(s) with cage and roller assemblies.

The mounting procedure for the inner rings is as follows (→ **fig. 59**):

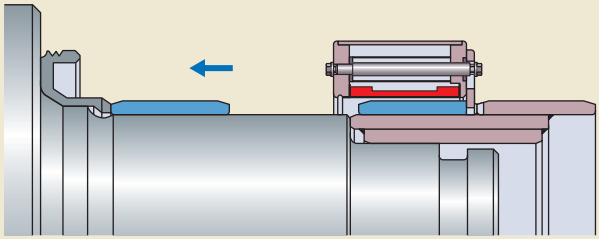
1 Mount any parts between the inner ring and shaft shoulder.
2 Put the first ring on the sleeve.
3 Position the sleeve (with the inner ring) on the roll neck support diameter.
4 Put the heater in place and heat the inner ring to the required temperature.
5 Push the inner ring into position against its abutment.
6 Keep pressing until the ring has cooled.
7 Remove the sleeve.
8 Mount the second inner ring, repeating **steps 2** to **7**.

Fig. 58



B = width of inner ring(s)
F = raceway diameter
d = inner ring bore
d_a = sleeve support diameter

Fig. 59



The mounting procedure for the outer rings is as follows (→ **fig. 60**):

1. Lubricate the cage and roller assemblies, and the outer ring raceways with the lubricant to be used.
2. Put the first roller assembly, which should be mounted in the housing together with the second assembly, on the large raceway diameter of the mounting sleeve.
3. Mount the seals, if any, in the inner cover before it is pushed up against the sealing collar.
4. Lubricate the seal lips and take care not to damage the seals.
5. Place the sleeve on the shaft and push gently until the complete assembly is in position. Use lifting equipment with a spring suspension to facilitate the positioning of the bearing assembly to the shaft.
6. For grease lubricated applications, completely fill the bearing arrangement with grease.
7. Mount the outer seals and lock the bearing arrangement onto the shaft.

Mounting tapered roller bearings

Single row tapered roller bearings

A single row tapered roller bearing is typically adjusted against a second bearing, either in a face-to-face or back-to-back bearing arrangement, to balance the counterforces. The clearance or preload in the bearing arrangement is achieved during mounting by moving one bearing ring axially.

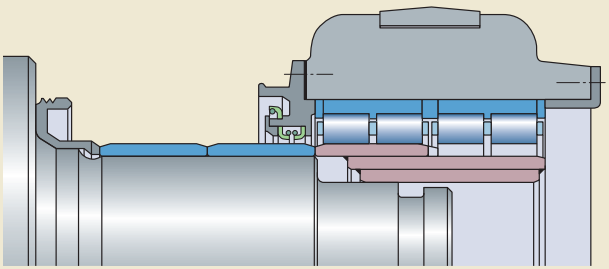
NOTE: During operation, clearance is typically reduced (preload increases) as a result of increased temperatures, temperature differences between the inner and outer rings and other factors such as speeds and loads.

CAUTION: During adjustment, it is important to turn the shaft through several revolutions in both directions to make sure there is proper contact between the roller ends and guide flanges. If there is no proper contact, the resulting clearance/preload will be incorrect, leading to early bearing damage and finally failure.

Adjusting a face-to-face bearing arrangement (inner ring rotation)

Fig. 61 shows a typical bearing arrangement for an intermediate shaft in a split gearbox, using tapered roller bearings mounted face-to-face. The clearance or preload in this arrangement is achieved by moving the outer ring of the bearing on the left side via the centring flange of the cover. The following procedure is simple, reliable and well proven.

Fig. 60



Preparation:

1 Use appropriate mounting methods to mount the inner rings (cones) with roller and cage assembly on the shaft. Push the outer rings (cups) over the roller and cage assemblies and place the shaft assembly in the gearbox. Bolt down the cover on the non-adjustment side of the case and turn the case on its side. A proper holding device is required that enables the shaft to rotate.

Determine the required length of the centring flange:

2 Rotate the shaft by hand, while pressing down the outer ring of the upper bearing. All rollers in the bearings have to make contact with the guide flange on the inner ring. This is achieved with a few revolutions of the shaft.

3 Place the cover. The centring flange of the cover must be too long (→ **fig. 62**, left) for the final outer ring position, or a spacer has to be used (→ **fig. 62**, right). There must be a gap between the cover and case (→ **fig. 62**, dimension x).

4 Bolt the cover while turning the shaft until there is a sudden increase in the frictional moment.

5 Measure the gap between the cover and case (dimension x).

6 Determine the requisite length of the centring flange (or spacer) or the shim thickness:

Length of centring flange or spacer

$a_f = a_i - x + s$ for clearance

$a_f = a_i - x - t$ for preload

Shim thickness

$b_f = x + s$ for clearance

$b_f = x - t$ for preload

where

a_i = initial length of the centring flange or spacer

a_f = final length of the centring flange or spacer

b_f = final thickness of the shims

x = measured clearance between the cover and gearbox case

s = clearance value (absolute value)

t = preload value (absolute value)

Final assembly:

7 Machine the centring flange or spacer to the required length. Alternatively, insert shims between the cover and case.

8 Bolt down the cover.

NOTE: For preload, the housing resilience is not taken into account. If required, refer to the SKF publication *Rolling bearings in industrial gearboxes*.

Fig. 61

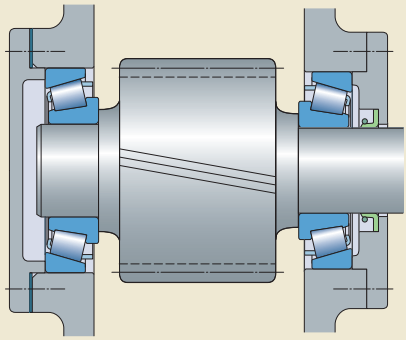
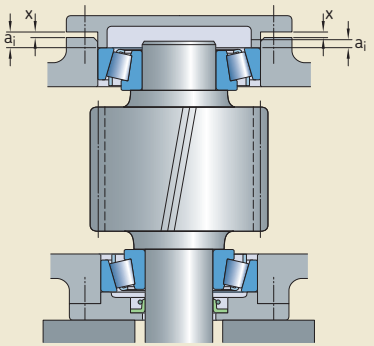


Fig. 62



Adjusting a back-to-back bearing arrangement with an adjusting nut (inner ring rotation)

Fig. 63 shows a typical bearing arrangement, using back-to-back mounted tapered roller bearings. The clearance or preload in this arrangement is achieved by moving the inner ring of the bearing on the left side by tightening the adjusting nut. For arrangements requiring axial preload, a value for the tightening angle or a tightening torque value must be provided on the assembly drawing.

Preparation:

1. Use appropriate mounting methods to mount the outer rings (cups) into their housing seats and the inboard inner ring (cone) with roller and cage assembly on the shaft. A proper holding device is required, which allows the shaft to rotate.
2. Fit together the preassembled shaft and housing. A device may be required to hold the shaft in place.
3. Mount the outboard inner ring (cone).
4. Mount any components between the outboard cone and the adjusting nut.

Adjustment for clearance:

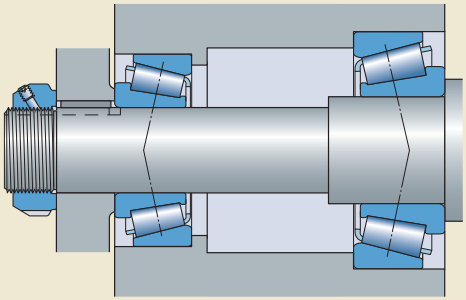
5. Measure axial clearance with a dial indicator. To do this, place the tip of the dial indicator against the shaft end, and push the shaft firmly in one direction while turning it several times. Set the reading to zero. Then push the shaft in the opposite direction and read the measured axial displacement.
6. Tighten the adjusting nut slowly. Bearings with a tight fit on the shaft are gradually adjusted until the set value is achieved. To do this, measure the clearance several times.

CAUTION: Do the adjustment in small steps. If too much clearance is taken out of the bearing arrangement, the inner ring has to be withdrawn and adjusted again, which may prove difficult and time-consuming.

Adjustment for preload:

7. Tighten the adjusting nut slowly while turning the shaft until there is a sudden increase in the frictional moment.
8. Continue to tighten the nut slowly to the set torque value or tightening angle.

Fig. 63



Adjusting back-to-back bearing arrangements (vehicle wheel application – two tapered roller bearings without a spacer)

Wheel hub designs differ from one manufacturer to another. However, the correct procedures for installing bearings and seals and assembling the wheel hub remain basically the same. **Fig. 64** shows a typical bearing arrangement. As this is an outer ring rotation application, in most cases the outer rings (cups) have a tight fit, while the inner rings (cones) can have a loose fit on the axle spindle. The clearance or preload in this arrangement is achieved by moving the inner ring of the outboard bearing by tightening the adjusting nut.

CAUTION: Replace the seal each time the hub is removed from the spindle.

1. Press both outer rings (cups) into the hub using a suitable tool, such as a sleeve or vertical press (→ **fig. 65**), taking care not to damage the raceways. Make sure that the side face of each outer ring abuts the hub shoulder completely.
2. Install the relevant seal or seal components into the hub using a suitable seal installation tool (→ **fig. 66**). Make sure that the seal is straight and that it has bottomed out completely.
3. Fit any seal components or spacers on the inboard side of the spindle.
4. Prepare the inner ring of the inboard bearing:
   - For grease lubricated applications, apply grease to the roller set and make sure to fill the space between the inner ring raceway and the cage.
   - For oil lubricated bearings, coat the inner ring completely with a thin layer of oil.
5. Press the inboard inner ring (cone) onto the spindle, using a suitable tool, such as a sleeve, taking care not to apply any force to the cage and rollers. Make sure that the side face of the inner ring abuts the spindle shoulder or abutment ring completely.
6. Install the hub assembly over the spindle, making sure that the hub bore and the centre of the spindle are aligned. Use a mechanical support to facilitate this and avoid damaging the spindle, threads and in particular the seal.
7. Prepare the inner ring of the outboard bearing in the same way as the inner ring of the inboard bearing.

Fig. 64

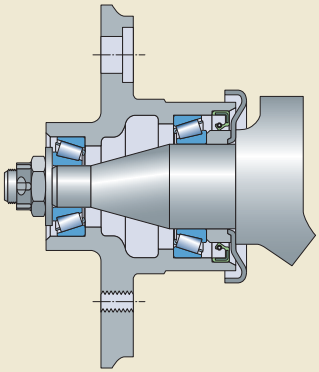


Fig. 65

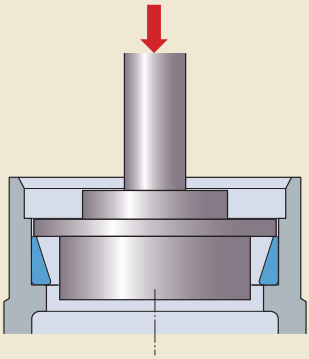
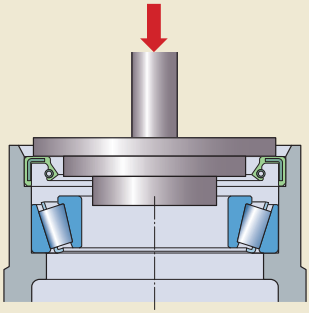


Fig. 66

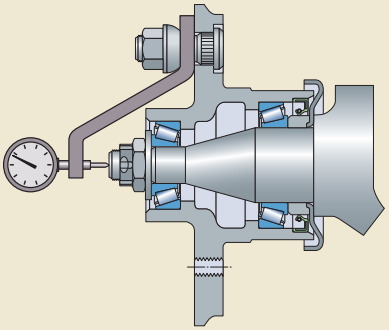


8 Press the outboard inner ring with the cage and roller assembly onto the spindle using a suitable tool, such as a sleeve, taking care not to apply any force to the cage and rollers.

CAUTION: Turn the shaft through several revolutions in both directions to make sure there is proper contact between the roller ends and guide flanges. If there is no proper contact, the resulting clearance will be incorrect, leading to early bearing damage and finally failure.

9 Fit the washer(s) and the adjusting (castle) nut. Tighten the adjusting nut with a torque wrench to the appropriate torque as described in the vehicle service or maintenance manual. Alternatively, for arrangements requiring axial clearance, tighten the adjusting nut slowly until the bearing frictional moment rapidly increases. Loosen the nut by turning it approximately 1/12 of a turn (30°) until the bearing arrangement feels "free".
10 Remove the hub support.
11 Check that the bearing rotates freely. If desired, verify the axial clearance (end play) in the bearing arrangement using a dial indicator as follows:
12 Attach the dial indicator (→ **fig. 67**), or use a dial indicator with a magnetic base attached at the bottom of the hub or brake drum.
13 Adjust the dial indicator so that its plunger or pointer is against the end of the spindle with its line of action approximately parallel to the axis of the spindle. (For aluminium hubs, attach the magnetic base of the indicator to the end of the spindle with the plunger against the hub or brake drum.)
14 Set the dial indicator to zero.
15 Grasp the wheel assembly at the 3 o'clock and 9 o'clock positions and push it back and forth. Read the axial clearance as the total indicator movement.
16 Mount the cover and perform a test run.

Fig. 67



Double row and multi-row tapered roller bearings

Double row and four-row tapered roller bearings are produced in many designs, which differ basically in the number of outer rings as well as in the number of spacer rings between the inner and outer rings.

When mounting these bearings, the individual bearing components must be mounted in the correct order. Parts that belong together are marked with letters (→ **fig. 68**). In addition, all components of the bearing are marked with the same serial number to avoid the risk of mixing components if several bearings are to be mounted at the same time.

The side faces of the outer rings are divided into four zones, marked I to IV (→ **fig. 69**). On each bearing, the position of zone I is also identified by a line across the external surface of the outer ring. When the bearing is mounted for the first time, zone I should typically be positioned in the load zone. Depending on the operating conditions, the outer rings are normally turned 90° after a determined period of service so that a different part of the bearing outer rings is positioned in the load zone, to extend the service life of the bearing.

For detailed mounting instructions, refer to the publication *SKF Explorer four-row tapered roller bearings, Mounting and maintenance instructions*.

Fig. 68

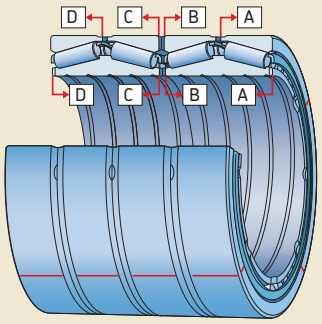
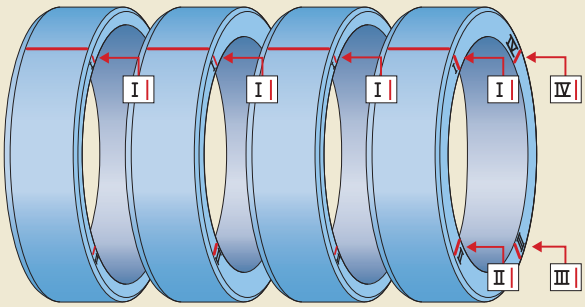


Fig. 69



Mounting spherical roller and CARB toroidal roller bearings

Due to the design of spherical roller and CARB toroidal roller bearings, the rings and roller complement may be displaced axially from the normal position during handling. For this reason, SKF recommends mounting spherical roller and CARB toroidal roller bearings when the shaft or housing is in the horizontal position and to rotate the inner ring before mounting, where possible.

When mounting spherical roller and CARB toroidal roller bearings (especially large and heavy ones) when the shaft or housing is in the vertical position, the roller complement together with the inner ring or outer ring will move downward until all clearance has disappeared. Unless proper clearance is maintained during and after installation, the expansion or compression forces resulting from an interference fit on either the inner or outer ring can create a preload.

CAUTION: This preload can cause indentations in the raceways and/or prevent the bearing from turning altogether.

To prevent this preload condition from occurring during vertical mounting, use a bearing-handling tool or a special device that keeps the bearing components centrally arranged (→ **fig. 70**).

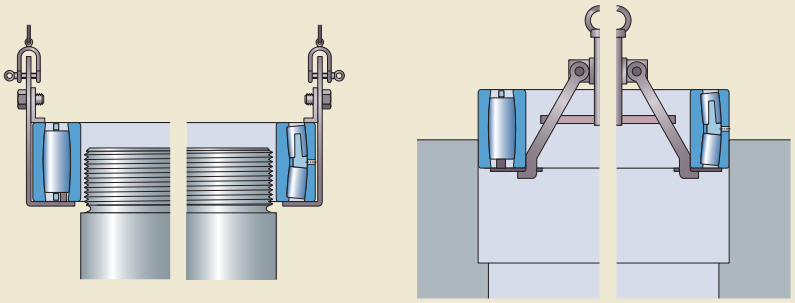
Sealed spherical roller bearings

Sealed spherical roller bearings typically do not require relubrication. However, when operating conditions are arduous, relubrication might be necessary. Bearings in the lower size range (d < 100 mm) have a protective polymer band that covers the lubrication groove and holes in the outer ring. If relubrication is expected, the polymer band must be removed from these bearings before mounting (→ **fig. 71**).

NOTE: For additional information about relubrication, refer to the section *Relubrication*, starting on **page 192**.

Sealed spherical roller bearings with a tapered bore are preferably mounted using the SKF Drive-up method (→ *The SKF Drive-up method*, starting on **page 57**).

Fig. 70



CARB toroidal roller bearings

Taking axial displacement into consideration

CARB toroidal roller bearings can accommodate axial expansion of the shaft within the bearing. To be sure that these axial displacements of the shaft with respect to the housing can take place, it is necessary to provide adequate space on both sides of the bearing (→ **fig. 72** and see *Abutment and fillet dimensions*, **page 38**).

Normally, the bearing rings are mounted so that they are not displaced relative to each other. However, if considerable thermal changes in shaft length can be expected, the inner ring should be mounted offset relative to the outer ring, in the direction opposite to the expected thermal expansion.

Bearings with a tapered bore can be mounted with modified adapter sleeves and/or lock nuts to prevent the locking device from chafing the adjacent cage. If standard lock nuts are used, a spacer ring may be needed between the bearing inner ring and the lock washer.

The SKF Drive-up method is especially suitable to mount CARB toroidal roller bearings on a tapered bore (→ *The SKF Drive-up method*, starting on **page 57**).

If information about the required free space, permissible offset position and spacer dimensions (where applicable) are not provided on the arrangement drawing, refer to the *SKF Interactive Engineering Catalogue*, available online at www.skf.com.

Bearings with a retaining ring

For full complement CARB toroidal roller bearings that have a retaining ring in the outer ring and need to accommodate relatively large axial displacements, make sure that the inner ring can be displaced away from the retaining ring (→ **fig. 73**).

Fig. 71

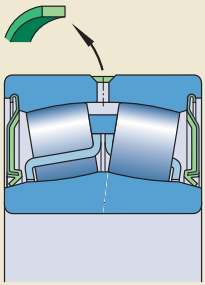


Fig. 72

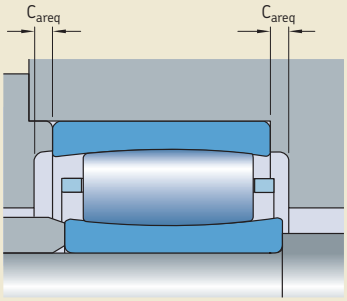


Fig. 73