Fitting-removal and maintenance

Fitting of bearings 136

- General rules 136
- Fitting principles 136
- Hot fitting 137
- Press fitting (or with anti-rebound hammer) 138
- Adapter sleeves 139

Removal of bearings 140

- Removal with extractors or press 140
- Removal of tapered bore bearings 141

Maintenance 141

- Monitoring and preventive maintenance 141
- Causes of premature bearing failure 142
  - *Examination of failed bearings* 142
  - *Appearance of failures* 142
  - *Causes of bearing failure* 145
- Storage 146
  - *Packaging* 146
  - *Storage conditions* 146

Fitting of bearings

General rules

Cleanliness

Cleanliness must be the constant concern of the installer. Any contamination from foreign matter will result in rapid deterioration of the bearing.

Protect the bearing against contamination if it has to be stored in the workshop before fitting.

Fitting precautions for sealing components

Lubricate the seal seats while fitting. A bead of grease applied at the seal lip and on the shaft passage helps to increase the efficiency of the seal and limit risks of damage.

Fitting principles

- Check the bearing reference and review the drawings, specifications and procedures
- Check that the dimensions and the precision of the shapes and positions of the bearing seats are in accordance with the SNR drawings and specifications
- Prepare all equipment, parts and the necessary tools before starting the fitting procedure. Ensure that all these elements are clean
- Carefully clean and check all parts and components that are adjacent to the bearing
- Remove the bearing from its packing at the last moment, working on a perfectly clean work-bench
- Never wash the new bearing, unless it is exceptionally specified

The bearing is protected against oxidation by a thin film of oil compatible with all lubricants

- Fit the bearing using the selected method
- Lubricate with a special bearing grease in accordance with the instructions
- After fitting and before start of operation, check operating conditions to avoid possible defects (noise, vibration, temperature, abnormal clearance, etc.)

Pressurized casings

In certain applications there is a pressure difference between the casing and the outside environment that demands certain fitting precautions. Bearings with standard integrated sealing do not allow a pressure difference between the two sides of the bearing due to the risk of eliminating the lubricant and turning back the seal lips.

Only seals independent from the bearing seals can support a pressure difference. These are essentially metalloplastic seals and mechanical seals. When the pressure difference is significant, special seals adapted to the environment shall be used.

Certain mechanisms are placed under slight positive pressure to prevent contamination of the internal components. In this case the protection system shall be of the non-friction type in order to ease venting.

Hot fitting

Important: Heating with a flame is absolutely prohibited

■ Hot fitting involves expanding the bearing to allow an effort-free installation on its shaft.

The temperature must not be too high to prevent alteration of the characteristics of the steel (maximum 130°C or 266°F) or internal components of the bearing.

It must however be sufficiently high to give an adequate expansion allowing easy installation of the bearing by temporary cancellation of the interference fit.

■ The heating temperature depends primarily on the bearing dimension and secondly on the fit category and the seat material.

	Bore diameter	Heating temperature
As a general rule, the following temperature values can be applied:	up to 100 mm	+ 90°C *(194°F)*
	from 100 to 150 mm	+120°C *(248°F)*
	over 150 mm	+130°C *(266°F)*

■ The various heating methods used to fit a bearing onto its shaft are:

Induction heating with SNR appliances

Heating by induction is the most clever and safe method of raising the bearing temperature:

- Installer safety

Only the part to be heated undergoes a rise in temperature, which eases handling and reduces the risk of burns.

- Temperature control

The temperature is controlled by an integrated probe. The initial qualities of the bearing are thus totally protected.

- Demagnetization

The electronics of the appliance undergoes automatically a demagnetization step at the end of the cycle.

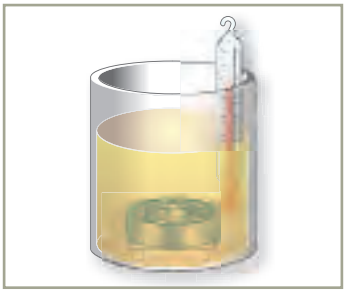
Fitting of bearings *(continued)*

Oil bath

The oil and the container must be clean.

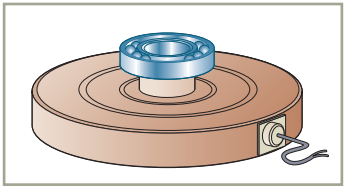
The oil must be fluid (e.g. F oil).

Locally higher temperatures occurring in the bath may damage the bearing; place an insulating spacer between the bearing and the bottom of the container.



Hot plate

Avoid direct contact of the bearing with the plate by means of a supporting block. It is compulsory to use a supporting block with sealed bearings.



Freezing

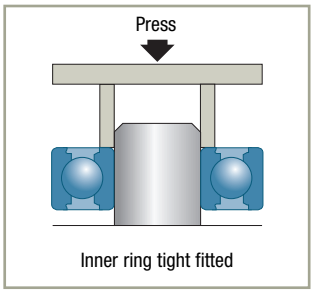
Cooling of the shaft

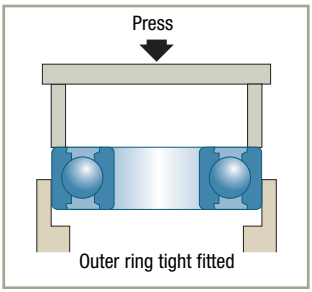
Cold fitting may sometimes be possible by shrinking the shaft in a bath of liquid nitrogen at -170°C (-274°F).

Press fitting (or with anti-rebound hammer)

Apply the force on the ring to be installed. This force must not under any circumstances be transmitted through the rolling elements, as this would make dents in the raceways.

Use a tube or socket to apply the pressure on the ring that has to be tight fitted.

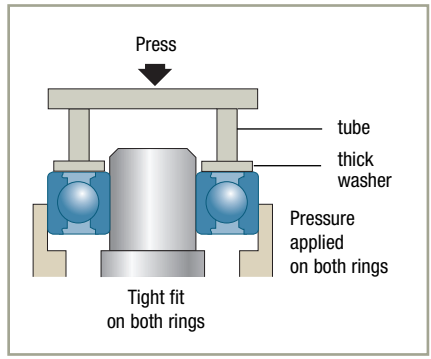




If there is a tight fit on the shaft and on the housing, use a socket that applies pressure on the two rings simultaneously.

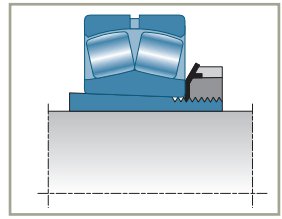
The two contact surfaces are in the same plane to ensure correct installation of the bearing.

This method is particularly recommended for fitting self-aligning ball bearings or spherical roller bearings.

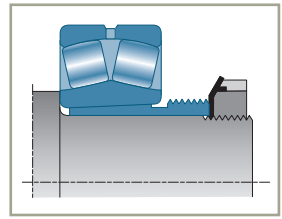


Adapter sleeves

Two main types of sleeves



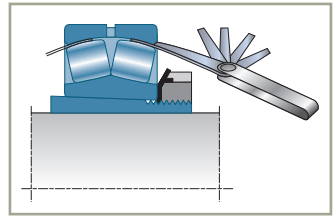
Adapter sleeve, the most common



Withdrawal sleeve which makes the removal of large bearings easier

Fitting self-aligning ball bearings or spherical roller bearings

Ball bearings



While tightening the nut, check for:

- smoothness of rotation
- easy swivelling of the outer ring over the balls

Tightening is continued very gradually until one starts to feel resistance to swivelling the bearing, at this point rotation must still be easy.

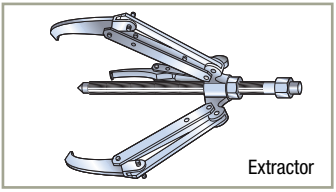
Roller bearings

The SNR clearance card gives the required clearance and the procedure for checking using feeler gauges.

Removal of bearings

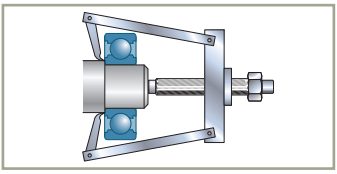
Removal with extractors or press

■ Apply the force on the ring to be removed. The force must not under any circumstances be transmitted through the rolling elements.

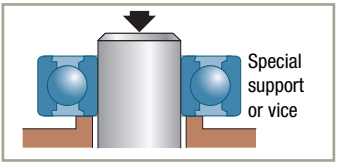


■ **Bearings tight fitted on the shaft**

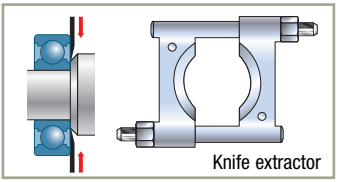
If you expect to reuse the bearing grip it by its inner ring to avoid transmitting the extraction force through the rolling elements.



If no extractor is available, use a vice, resting the inner ring on a stand above the jaws and with the shaft hanging freely between them. The extraction force is applied either with a mallet or with a press.

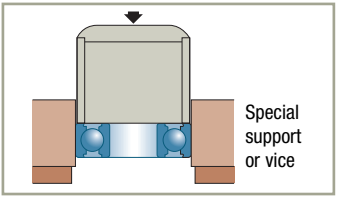


If the bearing abuts against a shoulder that is higher than the thickness of the ring, it can be dislodged using the knife extractor tool shown in the opposite figure. This tool may be used as a support for the extractor.



■ **Bearings tight fitted in the housing**

Apply the removal force on one of the faces of the outer ring through a tube as is shown in the opposite figure.

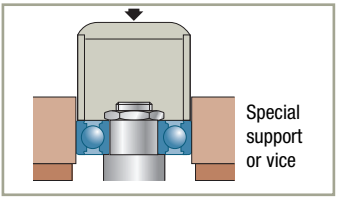


■ **Bearings interference-fitted on the shaft and in the housing**

The principle consists in letting the shaft follow the bearing when it is extracted from the housing.

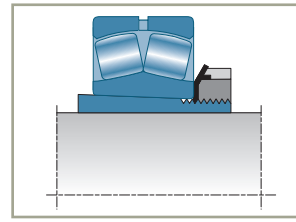
The force must be exerted on the outer ring and not on the shaft.

The opposite figure illustrates this process which assumes that the housing is accessible from both sides. The bearing is then separated from the shaft.



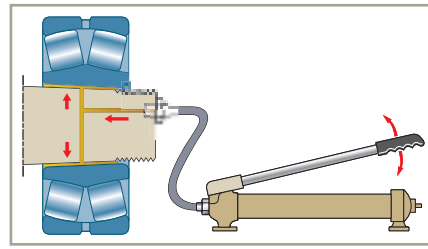
Removal of tapered bore bearings

With bearings fitted on an adapter sleeve, unscrew the nut and then extract the bearing by its inner ring.



Bearings fitted on a withdrawal sleeve are removed by means of a withdrawal nut.

Large bearings are sometimes fitted directly on a tapered-seat shaft (e.g. rolling mill pillow block). In such cases, they are removed using oil pressure.



Holes made for this purpose permit connection of a high pressure pump which forces oil between the shaft seat and the inner ring. The elastic expansion of the inner ring enables the bearing to be removed.

Maintenance

Monitoring and preventive maintenance

Broadly speaking the bearing does not require any monitoring or maintenance in operation other than the addition of lubricant if applicable. In certain applications it is very important to avoid bearing failures for either safety reasons (aeronautics, mine ventilation, etc.) or economic reasons (damage to machines, production shut down). In such cases monitoring and preventive maintenance are necessary.

The beginning of bearing deterioration can be diagnosed by witnessing an increase in the level of vibration, noise, temperature, rotation torque. The most common means of checking is the vibration level. Detection can be in a summary way by listening (transmission through stethoscope or metal rod) or by electronic devices (frequency and amplitude analysers) which give the alert or stop the machine.

The efficiency of these checks depends on the qualification and experience of the operator and the quality of the equipment used. In the case of grease lubricated bearings, monitoring the thermal level is also a good indicator of the working conditions.

The inspection frequency depends on the reliability goals, the equipment usage ratio and the company internal organisation. The frequency must be based on the likely service life of the bearing.

Maintenance *(continued)*

Causes of premature bearing failure

Examination of failed bearings

The examination of a failed bearing is a valuable source of information to identify its installation and operating conditions, therefore it must be carried out methodically and with precision:

Before removal
- note noises
- vibrations
- rise in temperature
- loss of lubricant
- contamination

During removal
- remove the end caps, seals (do not wash them), and grease, then place them in a clean place for later examination
- record the torque of the tightening nut that clamps the ring faces
- note the axial and radial positions of the bearing (identification marks on rings with respect to the shaft and the housing) and the direction of installation
- check the fits in at least 2 planes(shaft and housing)
- note the condition of the seats and the surrounding parts

After removal
- perform visual examination
- dismantle the bearing
- examine the components
- analyse the grease, check for foreign particles by washing and filtering

Appearance of failures

Fatigue spalling

Cracking and removal of material fragments.

Surface spalling

Stains resulting from flaking of surface material.

Seizing

Matte areas with removal of material, brown marks from heating, deformation of rolling elements, local melting and scoring of the metal.

Indentations caused by deformation

Ball or roller indentations corresponding to the space between the elements. The bottom of each indentation is shiny, but the original grinding marks are still visible. The material has been displaced without wear.

Raceway indentations due to abrasive wear

Indentations which may or may not correspond to the spacing of the rolling elements. Removal of material due to the vibration to which the bearing is subjected when stationary.

Wear

General wear of the rolling elements, raceways and cage. Grey tint (due to the effect of abrasive contamination).

Pitting and fluting

Pits with sharp edges or sequence of narrow parallel grooves resulting from the leakage of an electric current.

Maintenance *(continued)*

Nicks, cracks, fractures

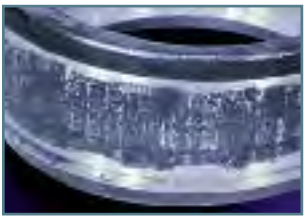
Impact load dents, removal of surface material, cracks, fracture of rings

Fretting corrosion

Red or black discoloration of the bearing contact surfaces, on the face, in the bore or on the outside diameter.

Corrosion

Local or total oxidation of the bearing surfaces, both inside and outside.



Discoloration

Discoloration of the raceways and rolling elements: over heating of protection oil.

Cage failure

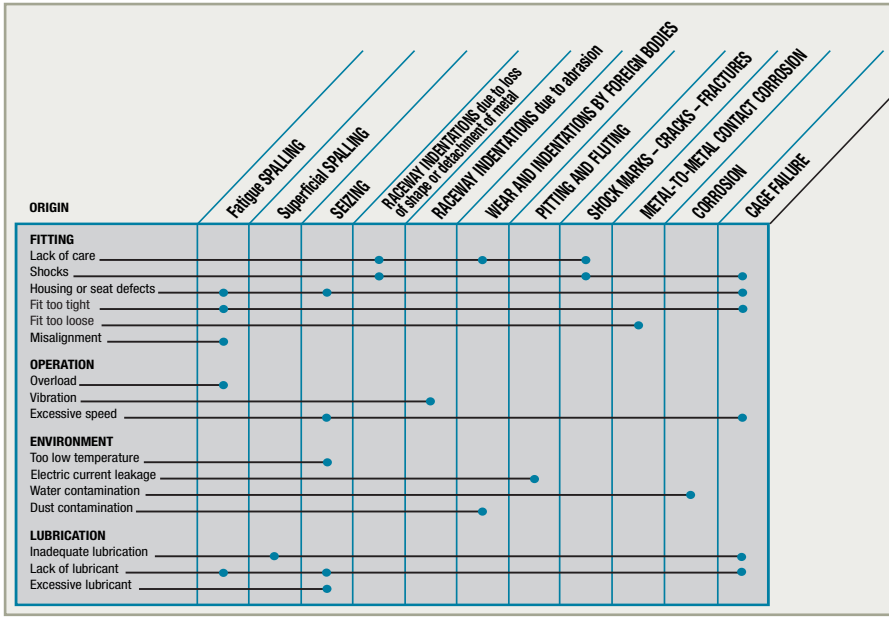
Bending, wear, fractures.

Causes of bearing failure

The causes of failure can be related to four main sources:

- **Poor fitting procedure**
  - Inadequate or improper fitting equipment and method
  - Contamination during fitting
  - Excessive force
  - Poor construction of bearing seats: shafts and housings out of tolerances, poor lubricant access, misalignment
- **Operating conditions**
  - Overloads, accidental or otherwise
  - Vibration in service or when stationary
  - Excessive speed
  - Shaft bending
- **Environmental conditions**
  - Ambient temperature too low or too high
  - Conduction current across the bearing
  - Contamination by water, dust, chemical products, textile debris, etc…
- **Lubrication** (deterioration can result from one or more causes. The following table summarizes the types of deterioration and enables the user to identify the probable origin)
  - Incorrect choice of lubricant
  - Unsuitable quality
  - Inadequate relubrication frequency

The SNR technical file "Causes of premature bearing failure" describes and illustrates in detail the identification, diagnostics and prevention of the various types of failure. For a more detailed examination, consult SNR.



Maintenance *(continued)*

Storage

Bearings must be stored in a clean and dry place. Certain rules must be observed to maintain the original quality of the bearing.

Packaging

The bearing is protected and packed by SNR under carefully controlled conditions:

- Assembly in an air-conditioned dust-free environment.
- A rust-inhibiting protective grease with high covering power is applied in a controlled environment. It is compatible with all standard lubricants.
- A greaseproof wrapping further improve the rust protection.
- The cardboard box completes the protection.

Bearings must be stored in their original packaging, which should not be opened until just before installation.

Storage conditions

Premises

The following are the normal storage conditions: general cleanliness, a dust-free and non-corrosive atmosphere, recommended temperature: 18 to 20°C (64,4 to 68°F), maximum relative humidity: 65%. In exceptional climatic conditions special packaging will be required (tropical packaging).

Avoid using wooden shelves. Store at a distance of at least 30 cm (1 foot) from the floor, walls and heating pipes. Avoid exposure to direct sunlight. Store the boxes flat. Do not stack them too high. Arrange boxes so that the bearing. Part number can be read without having to move the boxes.

Storage life

The standard SNR packaging guarantees long-term storage under normal indoor storage conditions. For it is a must not to open, not to change and not to damage the packaging.

The shelf life counts from the date indicated on the packaging.

Special-purpose packaging intended for products shipped to OEMs is only suitable for a rapid usage of the products. Such packaging will not provide the same long storage life.