

NKE AUSTRIA GmbH

GENERAL BEARING MANUAL

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1. General instructions

- Keep the working environment and bearings clean.
- Handle with caution.
If handled roughly, bearings may get broken and brindled by hard impact.
- Use proper tools to handle.
- Keep bearings thoroughly rust-protected.
If the humidity is excessive, avoid handling bearings.
- To prevent sweat from hands to contaminate bearings, operators should wear gloves
- Operators should have the necessary experience or training to handle bearings.
- Establish and obey guidelines following for bearing operation:
 - Storage of bearings
 - Cleaning of the bearings and the components nearby.
 - Inspect the dimensions of adjoining parts
 - Mounting
 - Inspecting/Test after mounting
 - Dismounting
 - Inspection and upkeep (periodical inspection)
 - Resupply of lubricants

1.1 Storage of bearings

The quality of the bearings is assured during delivery as long as the packaging is undamaged since the bearings are properly protected against corrosion and wrapped in corrosion inhibiting film. It is advised to keep bearings in a clean environment, higher than 30 cm from the ground, at a humidity level under 65%, and at a temperature of about 20°C. Avoid keeping bearing boxes next to cold walls or storing them in areas where they will be immediately exposed to the sun.

2. General mounting instructions

2.1 Mounting preparations

- Mount the bearing in a clean environment. Take steps to protect all the components from dust, dirt and moisture.
- Leave the components in their original packaging until mounting
- Preservatives from bore and outside diameter should be wiped off
- Make sure to mount bearings according to the intended use and approved operating conditions.
- Check the dimensional and geometrical tolerances of all components that will be in contact with the bearing.
- Use proper tools for mounting and dismounting.

2.2 Mounting Methods

- **Never apply mounting forces via the bearing rolling elements!**
It can easily lead to localized overloading in the contact area between the rolling elements and raceways; this overload

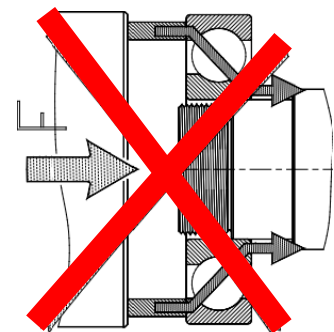


Fig. 1

damage is not visible and will cause premature bearing failures

- **Never hit the bearing a surface directly with any hardened tools such as hammers, cotter pin drives etc.**

This can cause a breakage or fragmenting of parts of the hardened bearing rings. For correct fitting recoil free hammers should be preferably used. Hammers with lead or plastic heads that may split, however, are not appreciated due to the risk of particles coming off and getting into the bearing

2.2.1 Mounting bearings in cold condition

Small and medium sized bearings are usually mounted in a cold condition as they do not normally have tight fits. The bearings are mounted using either presses or by hammer strikes. In principle the bearing that has the tighter fit must always be mounted first. For mounting small and medium-sized bearings impact sleeves and impact bushes have been proven to be satisfactory tools. These are sets of discs and rings made from a special impact-proof plastic and lengths of aluminum tubes that fit to them.

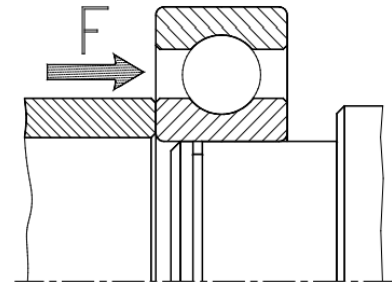


Fig. 2

2.2.2 Press mounting of bearings

The mounting of small and medium sized rolling bearings may be completed quickly and simply by using either mechanical or hydraulic presses. For such cases the bearing seats of shaft and housing should be prepared by lightly oiling. Also when applying this method the general rules that the introduction of forces via the rolling elements must be avoided. For these reason

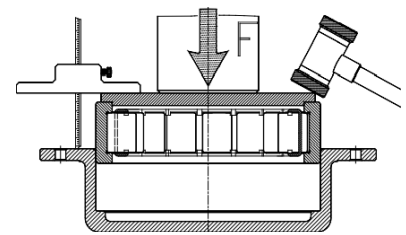


Fig. 3

satisfactory auxiliary sleeves, washers or mounting bushes have to be used. When using presses misalignment of parts particularly must be avoided.

Because misalignment is possible even in the case of loose bearing fits, the bearings have to be centered and aligned very carefully, for reference.

2.2.3 Simplification of bearing mounting by constructive measures

The mounting of bearings may be completed effectively and efficiently using good design practice. Such measures are justified in the case of applications that only require minor maintenance. Examples of such aids are screw threads on shafts and housings, which may also be used for mounting purposes.

For example pilot holes or even tapped holes may be used to support the mounting of the bearings onto shaft seats.

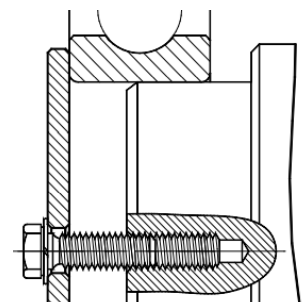


Fig. 4

2.2.4 Mounting bearings by heating

In cases where mounting of bearings in the cold condition is not possible, heating of the bearing or even individual bearing rings may be of advantage.

This method is widely used for ease of mounting the bearings or even other machine components on interference fits, particularly on tight shaft seats (i.e. heavy interference).

When heated, the bearing rings expand, due to the thermal coefficients, and thus the diameters increase, which enables easier bearing mounting.

Immediately after the ring sits on its comparatively cold shaft seat it will shrink to its correct diameter by cooling down to the ambient temperature.

The following recommended methods and procedures for mounting rolling bearings are also satisfactory for other machine parts, such as cog wheels, bushes or disks which may also be mounted on interference fits.

The amount of heat required for a certain application depends on the actual ring sizes and shaft fit. **Usually the heating of bearing rings to temperatures between 90°C to 110°C (197°F to 230°F) is sufficient for a totally problem-free mounting.**

Some Basic Rules for heating rolling bearings:

- **Never heat standard rolling bearings above 120°C (248°F).** Higher temperatures may cause some structural changes in the ring material causing undesired dimensional and geometrical changes with no advantages for mounting the bearing.
- Sealed or shielded bearings (e.g. bearings with suffix RS, -2RS, -2Z, -2LS, LFS, -2LFS...) should never be heated by using the oil bath method.
- When heating bearings always ensure there is effective temperature controls to protect the bearing rings from excessive heat.

Important: Never heat rolling bearings or even separate bearing rings directly by means of open flames, blow and welding torches or soldering irons.

Even with extra special care it is not possible to control the bearing or ring temperature uniformly and consequently localized overheating can never be excluded

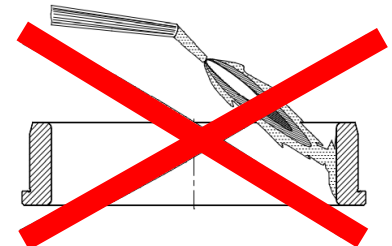


Fig. 5

2.2.4.1 Heating in oil baths

The bearings are placed in an oil bath and heated to the required mounting temperature. This provides a very uniform method heating of the parts to be mounted and allows the parts to be held at specific controlled temperatures, to equalize, by means of a thermostat.

When applying the oil bath heating method some points should be carefully considered:

- Long life thin machine oils should be used.
- Only use machine oils that feature flash points above 250°C (482°F).
- The facility to effectively control oil temperature is paramount.
- If the oil bath is not in use for long periods, the oil tank must be covered to prevent oil contamination and pollution.

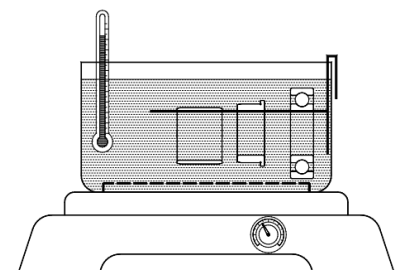


Fig. 6

2.2.4.2 Hot plates and Boxes

Especially when mounting a large number of bearings or when frequently mounting numbers of bearings of different sizes hot plates or heating boxes may be satisfactory devices. In either case temperature control is very necessary. Depending on their

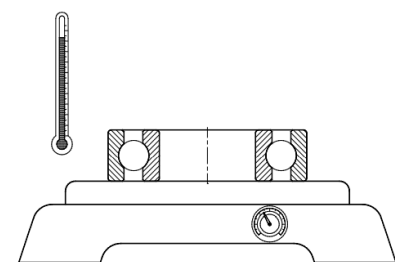


Fig. 7

dimensions, heating boxes may also be used to heat up small housings or other different machine components.

2.2.4.3 Induction heating (*preferred method by NKE*)

Induction heaters are the optimum for volume production mounting (e.g. gearboxes, brake discs, electric motors etc.) where tight or interference fits apply. Additionally, they are very efficient and effective particularly when used by maintenance and repair workshop personnel (e.g. motor rewinders).

This method is proven to be suitable for all types of rolling bearings providing economic and quick heating.

The heater has to fulfil the following minimum requirements:

- automatic demagnetization after heating
- temperature selection possibility and temperature control
 - Keep in mind that, when using a device with only one temperature sensor, this needs to be placed on the inner ring!
- automatic temperature control

Warning: All types of induction heater create a very strong magnetic field. Please read carefully the operating instructions and consider the recommendations and safety instructions provided by the supplier of your induction equipment. Never use inductive acting equipment if you use a pacemaker!

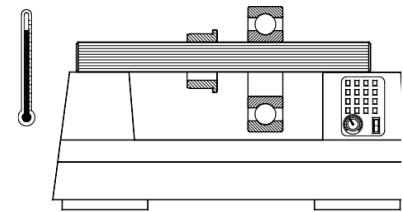


Fig. 8

2.2.5 Hybrid Bearings & Induction Heating

Temperature monitoring of both the inner and outer rings is crucial for precision and reliability. This can be ensured by using a specialized device with two sensors, readily available from us. These sensors enable you to maintain precise control over the heating process, ensuring that the temperature differential remains within acceptable limits.

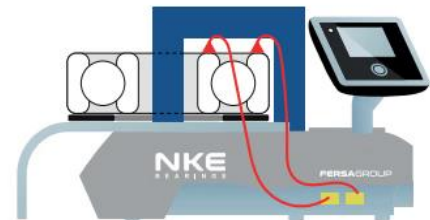


Fig. 9

In addition, for applications demanding the utmost performance and consistency, we strongly advise incorporating our Heating Disc into your heating process. The Heating Disc is designed to enhance the uniformity of heating across the entire bearing, minimizing temperature variations that could affect the bearing's properties. This results in the optimal performance and extended lifespan of your valuable hybrid bearings, ultimately contributing to the efficiency and reliability of your critical machinery. NKE strongly suggests using an Induction Heater with two sensors, to prevent a big temperature difference between the inner and outer ring.

2.3 Test run

In order to ensure that the bearings are fitted correctly, a trial operation may be performed. For compact machines the rotation may be verified manually.

If no anomalies, such as those listed below, are found, continued trial operation with a power source will continue.

- **Excessive torque:** due to mounting errors, wrong clearances, ...
- **Vibration/Knocking:** due to contamination of the raceways or defects
- **Changing running torque:** due to mounting errors or improper mounting

For equipment being too large for manual operation, idle running is accomplished by shutting off the power supply immediately after turning it on. It must be checked that bearings rotate smoothly without any abnormal vibration or noise before power operation may begin.

Operation should start with very low speed, under no load and be progressively increased until it reaches the intended speed before power operation is begun.

Check for vibration, temperature rise, and noise during power operation.

3. Specific mounting recommendations

3.1 Mounting procedure for CRB (NU)

3.1.1 Mounting outer ring with rolling elements

- *Only necessary if the outer ring has an interference fit*
- Heat the housing - usually a housing temperature of 80 to 90°C above that of the bearing is sufficient for mounting
- Push the outer ring with the roller set into the housing seat to its abutment and hold it there until it grips.

3.1.2 Mounting the inner ring

- Heat the inner ring - with ambient temperatures usually a temperature between 90 to 110°C is sufficient. (max. 120°C for standard bearings!)
- Push the inner ring onto the shaft to its abutment and hold the ring in position until it grips.

3.1.3 Assembling the shaft to the housing

- Lubricate the raceway and rollers before assembling.
- During the final assembly special care must be taken of the whole unit when the pre-assembled shaft is inserted into the housing to avoid any possible misalignments of the respective parts.
 - This damage risk can easily be avoided while mounting by rotating the shaft with care.
- Special attention must be paid to the looseness of the rollers.
 - Using a guide sleeve can help.
- This specific behaviour is unique and caused by the internal design of the bearing cages.
 - All cylindrical rollers retained by a cage require a certain clearance, the so-called "pocket clearance". The pocket allows the roller to drop and hang when it is not guided by the ring. Depending on the specific cage type this pocket clearance may be large or small.

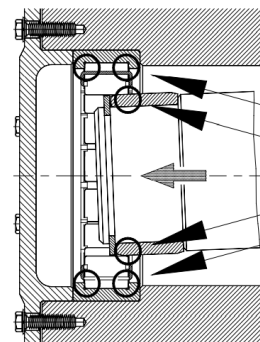


Fig. 10

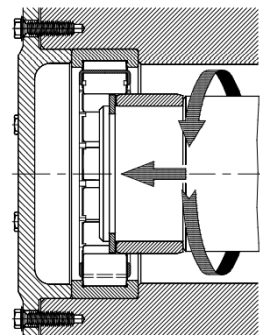


Fig. 11

3.2 Procedure for mounting a DGB (6xxx) with induction heating

3.2.1 Mounting the bearing to the shaft

- Heat the bearing - with ambient temperatures usually a temperature between 90 to 110°C is sufficient. (max. 120°C for standard bearings!)
- Push the bearing into the shaft's abutment and hold it there until it grips.
- Attach locking device if available - For example a washer
- Check that the bearing can be rotated freely
- Insert the bearing and shaft assembly into the housing

4. Dismounting Bearings

- The dismounting of bearings require some basic preparation, similar to when mounting rolling bearings, including careful study of manuals, machine plans and maintenance procedures which give appropriate information.
- To ensure the successful replacement of any bearing all machine surfaces surrounding the area to be dismounted must be cleaned to eliminate the entrance of avoidable contamination, including production swarf and waste prior to any dismounting.
- Also, all tools and auxiliary equipment to be used must be clean and in a good condition.
- It is particularly important that when bearings are frequently dismounted and remounted special care should be taken at all times to avoid damage.
- In principle, the dismounting of a bearing position is the opposite way to their mounting. This means bearings with loose fits should be dismounted first
- Several special dismounting tools and systems are available to remove bearings additional to the commonly used and proven claw pullers. The claw tools, generally used for medium and large sized rolling bearings, consist of a spindle which acts either mechanically or hydraulically, in conjunction with various different sizes of claw legs and bridges which when assembled into 2 or 3 leg pullers meet the individual application requirements

5. Greasing

Some basic rules must be considered when greasing rolling bearings:

- Only remove the bearing from its original package prior to its mounting.
- Grease them as little as possible before mounting to protect the bearings from getting contamination.
- The preservation agent adhering to the bearing may be left if using mineral lubricants as the preservation agent is compatible with all normal mineral lubricating oils and greases, such as generator bearing greases.
- When synthetic special lubricants are used the bearings should be washed out thoroughly prior to greasing and mounting.
- To clean the bearings of their preservation, adequate cleaning agents, such as benzene or kerosene should be used.
- Synthetic lubricants are used at very high or extremely low temperature applications, respectively.
- In general the preservation agent which adheres to the bearing bore and outside diameter, at least, should be removed prior to mounting. The use of a clean nonfibre

cloth or paper is recommended to remove this preservation agent. Never use cotton waste or wool.

- **The preservation agent itself is not a lubricant.** Therefore, it will not perform any lubricating features or behaviours!
- Bearings that are already greased must be carefully protected until they are mounted. The use of polythene film or similar material is suggested to protect the bearings from the various contaminates.
- The designated lubricants must always be stored in tightly closed containers to avoid any penetration of foreign matters.
- The lubricant should always be checked for its condition prior to application with particular attention to the presence of any pollution, water or signs of ageing.
- Please be aware the use of old or contaminated lubricants may cause premature bearing failures.

If there already is a well-established method of filling the bearings with grease, again, we would strongly suggest keeping it.

By default, open bearings will be delivered without any grease filling.

5.1 Re-greasing

Please note that some products at will not be delivered with any grease.

As NKE does not produce lubricants only recommendations for individual applications can be calculated and provided.

In general, the selection of a proper bearing grease for the given application requirements is within the responsibility scope of the customer.

It is strongly recommended and state of the art to contact the respective lubricant manufacturer directly for a detailed evaluation of the lubrication setup. This guarantees that the chosen grease is perfectly suitable for the operating condition as well as the re-lubrication intervals are defined precisely.

NKE wants to point out clearly that the most reliable and accurate info about re-lubrication intervals can be obtained only by practical tests. A theoretical lubrication interval calculation is only for orientation, while practical experiences e.g. obtained by laboratory and field tests can predict a more reliable re-lubrication interval. For the particular case at hand this means, that the customer should have made previous successful experience with the proposed lubricant within at least similar applications, which are operating under same conditions.

With a strong focus on e.g.:

- Power of machine
- Operation speed
- Load situation
- Initial lubrication grease quantity
- Terms of Services
- Ambient temperature in the place where the equipment operates, average degree of humidity of the environment.

In the case that the customer decides for a specific lubricant based only on theoretical calculations, it is highly recommended and state of the art to carry out a regular analysis of the bearing grease (for instance, every 1000 hrs or every year, depending what comes earlier), especially within the first operating hours. The purpose of this analysis is on the one hand to

verify that the properties of the lubricating grease will maintain and on the other hand to proof the theoretical re-lubrication interval.

6. Operation

The bearings must not be operated beyond the conditions defined for the respective bearing. For example speed, load, temperature ... These can be found in our catalogue or in the drawings. In special cases or complex applications, please contact the NKE application engineering department.