

Table 6.4 Minimum safety factor values S_o

Operating conditions	Roller bearings
High rotational accuracy demand	3.0
Normal rotating accuracy demand (Universal application)	1.5
Slight rotational accuracy deterioration permitted (Low speed, heavy loading, etc.)	1.0

Note 1 : For drawn-cup needle roller bearings, min. S_o value=3.
 2 : When vibration and/or shock loads are present, a load factor based on the shock load needs to be included in the P_o max value.

7. Bearing handling

Bearings are precision parts and, in order to preserve their accuracy and reliability, care must be exercised in their handling. In particular, bearing cleanliness must be maintained, sharp impacts avoided, and rust prevented.

7.1 Bearing storage

Most rolling bearings are coated with a rust preventative before being packed and shipped, and they should be stored at room temperature with a relative humidity of less than 60%.

7.2 Installation

When bearings are being installed on shafts or in housings, the bearing rings should never be struck directly with a hammer or a drift as shown in Fig. 8.1, because damage to the bearing may result. Any force applied to the bearing should always be evenly distributed over the entire bearing ring face.

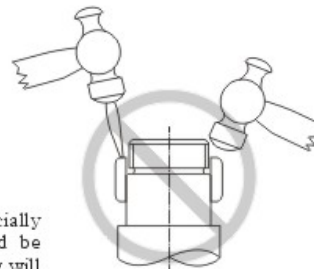


Fig 8.1

7.2.1 Installation preparations

Bearings should be fitted in a clean, dry work area. Especially for small and miniature bearings, a "clean room" should be provided as any contamination particles in the bearing will greatly affect bearing efficiency. Before installation, all fitting tools, shafts, housings, and related parts should be cleaned and any burrs or cutting chips removed if necessary. Shaft and housing fitting surfaces should also be checked for roughness, dimensional and design accuracy, and to ensure that they are within allowable tolerance limits.

Bearings should not be unwrapped until just prior to installation. Normally, bearings to be used with grease lubricant can be installed as is, without removing the rust preventative. However, for bearings which will use oil lubricant or in cases where mixing the grease and rust preventative would result in loss of lubrication efficiency, the rust preventative should be removed by washing with benzene or petroleum solvent and dried before installation. Bearings should also be washed and dried before installation if the package has been damaged or there are other chances that the bearings have been contaminated. Double shielded bearings and sealed bearings, one way clutches should never be washed.

7.2.2 Installing cylindrical bore bearings

Bearings with relatively small interference fits can be press fit at room temperature by using a sleeve against the inner ring face as shown in Fig. 7.2. Usually, bearings are installed by striking the sleeve with a hammer; however, when installing a large number of bearings, a mechanical or hydraulic press should be used.

When installing non-separable bearings on a shaft and in a housing simultaneously, a pad which distributes the fitting pressure evenly over the inner and outer rings is used as shown in Fig. 7.3. When fitting bearings which have a large inner ring interference fit, or when fitting bearings on shafts that have a large diameter, a considerable amount of force is required to install the bearing at room temperature. Installation can be facilitated by heating and expanding the inner ring beforehand. The required relative temperature difference between the inner ring and the fitting surface depends on the amount of interference and the shaft fitting surface diameter. Fig. 7.4 shows the relation between the bearing inner bore diameter, temperature differential and the amount of thermal expansion. In any event bearings should never be heated above 120°C.

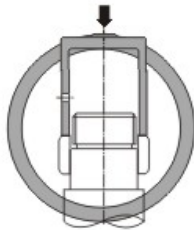


Fig. 7.2 fitting sleeve pressure against inner ring

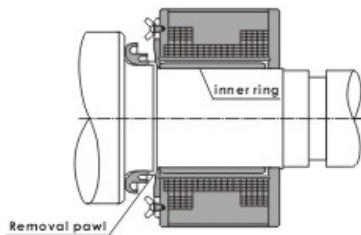


Fig. 7.4 Removal of inner ring using an induction heater

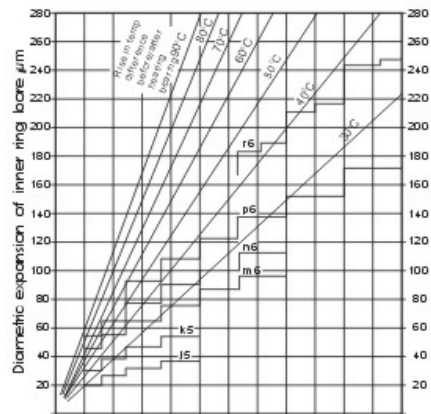


Fig. 7.3 Temperature differential required for shrinkage fit of inner ring

The most commonly used method of heating bearings is to immerse them in hot oil. However, this method should not be used for prelubricated shielded and sealed bearings. To avoid overheating parts of the bearings they should never be brought into direct contact with the heat source, but instead should be suspended inside the heating tank or placed on a wire grid. If bearings are dry-heated with a heating cabinet or hot plate, they can be mounted without drying. An induction heater can be used to quickly heat bearings in a dry state (always demagnetize). When heated bearings are installed on shafts, the inner rings must be held against the shaft abutment until the bearing has been cooled in order to prevent gaps from occurring between the ring and the abutment face.

7.2.3 Installation of outer ring

Even for tight interference fits, the outer rings of small type bearings can be installed by driving them into housings at room temperature. For large type bearings, the housing can be heated before installing the bearing, or the bearing's outer ring can be cooled with dry ice, etc. Before installing, if dry ice or other cooling agent is used, atmospheric moisture will condense on bearing surfaces, and therefore appropriate rust preventative measures are necessary.

7.3 Post installation running test

To insure that the bearing has been properly installed, a running test is performed after installation is completed. The shaft or housing is first rotated by hand and if no problems are observed a low speed, no load power test is performed. If no abnormalities are observed, the load and speed are gradually increased to operating conditions. During the test if any unusual noise, vibration, or temperature rise is observed the test should be stopped and the equipment examined. If necessary, the bearing should be disassembled for inspection. To check bearing running noise, the sound can be amplified and the type of noise ascertained with a listening instrument placed against the housing. A clear, smooth and continuous running sound is normal. A high, metallic or irregular sound indicates some error in function. Vibration can be accurately checked with a vibration measuring instrument and the amplitude and frequency characteristics measured against a fixed standard. Usually the bearing temperature can be estimated from the housing surface temperature. However, if the bearing outer ring is accessible through oil inlets, etc., the temperature can be more accurately measured. Under normal conditions, bearing temperature rises with rotation time and then reaches a stable operating temperature after a certain period of time. If the temperature does not level off and continues to rise, or if there is a sudden temperature rise, or if the temperature is unusually high, the bearing should be inspected.

7.4 Bearing disassembly

Bearings are often removed as part of periodic inspection procedures or during the replacement of other parts. However, the shaft and housing are almost always reinstalled, and in more than a few cases the bearings themselves are reused. These bearings, shafts, housings, and other related parts must be designed to prevent damage during disassembly procedures, and the proper disassembly tools must be employed. When removing inner and outer rings which have been installed with interference fits, the dismounting force should be applied to that ring only and not applied to other parts of the bearing, as this may cause internal damage to the bearing's raceway or rolling elements.

7.4.1 Disassembly of bearings with cylindrical bores

For small type bearings, the pullers shown in Fig. 7.5 or the press method shown in Fig. 7.6 can be used for disassembly. When used properly, these methods can improve disassembly efficiency and prevent damage to bearings. To facilitate disassembly procedures, attention should be given to planning the designs of shafts and housings, such as providing extraction grooves on the shaft and housing for puller claws as shown Figs. 7.7 and 7.8. Threaded bolt holes should also be provided in housings to facilitate the pressing out of outer rings as shown in Fig. 7.9.

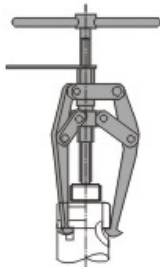


Fig. 7.5 Puller disassembly

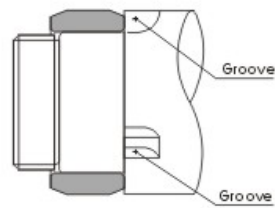


Fig. 7.7 Extracting grooves

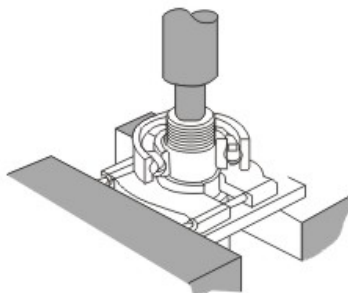


Fig. 7.6 press disassembly

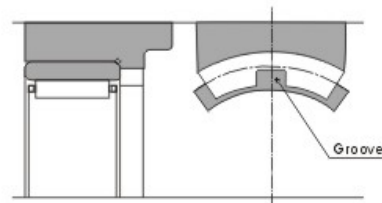


Fig. 7.8 Extraction groove for outer ring disassembly

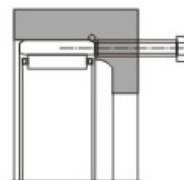


Fig. 7.9 Outer ring disassembly bolt