

Technical Data

1. Construction and Characteristics of Rolling Bearings

1.1 Rolling bearing construction

Most rolling bearings consist of rings with raceway (an inner and an outer ring), rolling elements (either balls or rollers) and a cage. The cage separates the rolling elements at regular intervals, holds them in place within the inner and outer raceways, and allows them to rotate freely. See Fig. 1-1.

Theoretically, rolling bearings are so constructed as to allow the rolling elements to rotate orbitally while also rotating on their own axes at the same time.

While the rolling elements and the bearing rings take any load applied to the bearings (at the contact point between the rolling elements and raceway surfaces), the retainer takes no direct load. The retainer only serves to hold the rolling elements at equal distances from each other and prevent them from falling out.

1.2 Deep groove ball bearings

Deep groove ball bearings are very widely used. A deep groove is formed on each inner and outer ring of the bearing enabling them to sus

tain radial and axial loads in either direction as well as well as the complex loads which result from the combination of these forces. Deep groove ball bearings are suitable for high speed applications. In addition to the open type, deep groove ball bearings come in a number of varieties, including prelubricated bearings, bearings with one or both sides sealed or shielded, bearings with snap rings and high capacity specification, etc. The construction of deep groove ball bearing is shown in Fig 1.2.

As shown in Table 1.1, pressed cages are generally used in deep groove ball bearings. However, machined cages are also used in larger sized bearings designed for high speed applications.

1.2.1 Shielded ball bearings

Shielded ball bearings are deep groove ball bearings

having the same boundary dimensions as those of open type bearings. Protection against the penetration of foreign material and the prevention of grease leakage are provided by the steel shield plates of these bearings.

There are two types: one is Type ZZ fitted with shield plates on both sides and the other is Type Z fitted with a plate on one side. Since the shields are non-contact type, friction

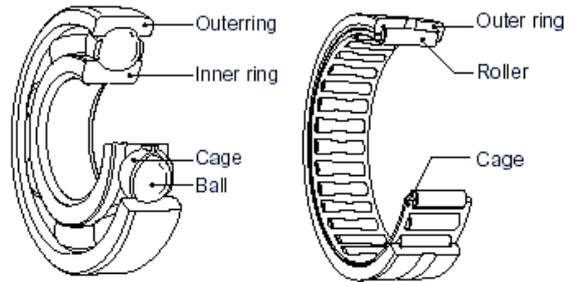


Fig 1.1 Rolling bearings

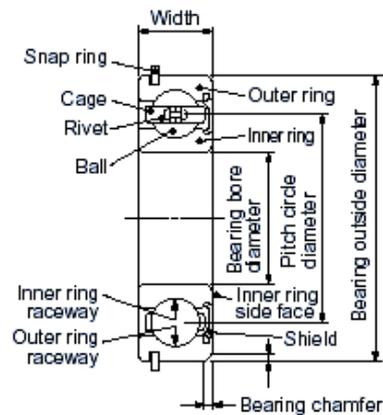
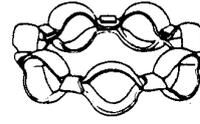
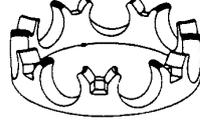
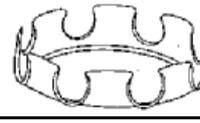


Fig 1.2 The construction of deep groove ball bearing

Table 1.1 Cage type and material

Type	
	Pressed steel riveted cage
	Pressed steel ribbon cage
	Plastic snap cage
	Stainless snap cage

torque is very low.

1.2.2 Sealed ball bearings

Like shielded ball bearings, sealed ball bearings have the same boundary dimensions as those of the open type bearings. Sealed ball bearings also have the function of keeping foreign matter out and grease

Seals consisting of synthetic rubber molded to a steel plate are incorporated into the outer rings of these ball bearings. There are two major types of sealed bearings: contact type and non-contact type sealed bearings. The LLU type uses two contact seals, one on each side of the bearings. The LLB type uses non-contact type seal instead. Similar construction to LLU type, the LLH type sealed bearings perform better low torque characteristics than that of LLU type because of its special lip design. Basically, bearings with contact seals have excellent and effective functions of dust and water proofing while bearings with non-contact seals are suitable for applications requiring low torque operation.

1.2.3 Expansion compensating bearings

Expansion compensating bearings have the same boundary dimensions as standard bearings, except that a high polymer material with a large coefficient of thermal expansion has been inserted along the outer circumference of the outer ring. Due to the extremely small difference of thermal expansion attained between the fitted surfaces of the high polymer equipped outer ring and the light alloy bearing housing, a good interference fit can be achieved with stable performance across a wide temperature range. Another advantage is a large reduction in the occurrence of outer ring creeping.

In cases where the bearing is going to be interference fit with the housing, it is very important not to damage the high polymer material. Regulations for radial internal clearance are the same as those for standard deep groove ball bearings. For standard fit and application conditions, a C3 clearance is used with this bearing.

1.2.4 CSB ball bearings

CSB bearings have the same boundary dimensions as

standard deep groove ball bearings, but have undergone a special heat treatment that considerably extends wear life. These bearings are especially effective in countering reduced wear life due to the effects of infiltration by dust and other foreign matter. CSB 62 series bearings can be used in place of standard 63 series bearings enabling lighter weight, more compact designs.

1.2.5 ESB bearings

ESB bearings have the same boundary dimensions as standard deep groove ball bearings, but have undergone a special heat treatment and surface structure stabilization with nitrogen under the proper material and conditions. ESB bearings are designed to be able to withstand in the harsh lubrication condition containing hard foreign matter. These bearings enhance wear property and fatigue life even superior to CSB bearings under such condition.

1.2.6 AC bearings (creep prevention bearings)

AC bearings have the same boundary dimensions as standard bearings with the addition of two O-rings imbedded in the outside circumference of the outer ring. This bearing has a steel housing, can withstand rotating outer ring loads, and is suitable for applications where a "tight fit" is not possible but the fear of creeping exists. With its capacity for axial load displacement, an AC bearing can also be installed as a floating side bearing to accommodate shaft fluctuations.

1.2.7 TS bearings

Special care is needed for bearings used in high operating temperature, such as 120°C and above. The TS bearings is designed to accommodate such strict condition. These TS bearings are dimension stabilized and can be withstand in operation with high temperature up to 250°C.

1.2.8 Low noise bearings

The smaller sizes of series 60 and 62 with shields and seals are also available in a special low noise quality for applications where silent running is of prime importance, such as the application of fan motors in air conditioning. The low noise bearings require good running accuracy and made by

improved washing and assembly manufacturing process. In addition, The bearings are usually prelubricated with low noise grease.

In order to prevent fretting corrosion on raceways and balls of bearings due to poor transportation condition in some areas. The grease with good fretting resistance and low noise characteristics is selected and performs well in such condition.

1.2.9 BL (maximum capacity type) ball bearings

The boundary dimensions of the maximum capacity ball bearings are the same as those of series 62 and 63 of deep groove ball bearings. In order to assemble the steel balls, filling slots are provided on both inner and outer rings of the bearings. Accordingly, more steel balls are assembled in these bearings than those of the standard type deep groove ball bearings or. Therefore, the load carrying capacity becomes 20% to 35% larger than that of standard bearings. Due to the filling slot, BL bearings are not suitable for applications that employ heavy axial loads.

1.2.9 Extra small bearings

The material used for the rings and balls in extra small bearings is either bearing steel or martensitic stainless steel. The cages used in bearings are either ribbon cages ,made of pressed steel or stainless steel, or synthetic-resin cages. Shielded bearings are those protected by a shields plate of pressed steel.

1.2.10 Angular contact ball bearings

In mechanical design, if subject to both radial and axial loads, the so-called angular contact bearings are recommended to such loading condition. According to various load ratio of axial to radial load, these bearings with appropriate contact angle may be applied. They are usually applied in duplex arrangement to gain axial rigidity. In high speed spindle application, angular contact ball bearings need to be adjusted with higher dimensional and running accuracy, precision cage, and used in an appropriate way of lubrication to reach their maximum speed.

Other types of angular contact ball bearings include thrust angular contact bearings and double row angular contact ball

bearings. Thrust angular contact bearings with a larger contact angle of 60° boast greater axial rigidity. Besides, since balls are used as the rolling elements, the starting torque of a angular contact thrust ball bearing is less than that of a roller bearing. The structure of double row angular contact ball bearings is designed by arranging two single row angular contact bearings back-to-back in duplex (DB) to form in one bearing with a contact angle of 30°. These bearings are capable of accommodating radial loads, axial loads in either direction, and have a high capacity for momentary loads as well.

1.2.11 Stainless ball bearings

Stainless ball bearings have the same boundary dimensions and ISO tolerance as standard deep groove ball bearings, but have better corrosive resistance than standard bearings in special environments.

The rings and balls of these bearings are made of martensite stainless steel with hardness at least HRC 58 , while cages and shields are made of austenite stainless steel, please refer to 8. Bearing Material for their chemical composition.

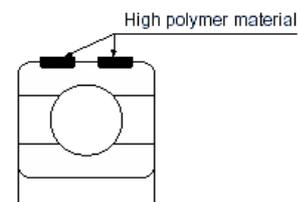


Fig 1.3 Expansion compensating bearing

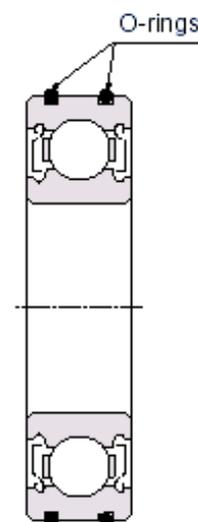


Fig 1.4 AC bearing

1.3 Cylindrical roller bearings

Cylindrical roller bearings have a larger load carrying capacity which makes them more suitable for applications requiring long life and endurance for heavy loads and shock loads.

Cylindrical roller bearings can be categorized into cylindrical roller bearings and needle roller bearings, according to its roller dimension ratio: ratio of roller length to its diameter.

1.3.1 Needle Roller bearings

Needle roller bearings have relatively smaller diameter cylindrical rolling elements whose length is much larger than their diameter.

Compared with other types of rolling bearings, needle roller bearings have a small cross-sectional height and significant load-bearing capacity and rigidity relative to their volume. Also, because the inertial force action on them is limited, they are ideal choice for oscillating motion. Needle roller bearings contribute to compact light weight machine designs. They serve also as a ready replacement for sliding bearings.

TPI offers two types of needle roller bearings commonly used in motorcycle industry: needle roller and cage assembly and drawn-cup needle roller bearing. Needle roller and cage assembly is the most commonly used needle roller bearings. It comprises needle rollers and a cage to support the rollers. It is used typically for connecting rods in reciprocating compressors and small- and mid-sized internal combustion engines such as those for motorcycles. This assembly features such a cage that is specifically optimized for severe operating conditions involving high impact loads, complicated motions, high speed revolution and/or high operating temperatures.

The drawn-cup needle roller bearing comprises an outer ring and needle rollers, which were both drawn from special thin steel plate by precision deep drawing, and a cage intended to guide precisely the needle rollers. This bearing is the type of the lowest section height, of the rolling bearings with outer ring, and a best-suited to space-saving design.