Bearings

Objectives : At the end of this lesson you shall be able to
- **state the purpose of bearings**
- **state the characteristics of plain bearings**
- **describe journal bearing & thrust bearing**
- **describe ball bearing and its types**

What are bearings?

Bearings are used in parts having relative motion. The motion may be rotational, reciprocating or a combination of these movements.

Bearings form part of an assembly or mechanism which supports or constrains another part in the assembly.

The need for bearings

A bearing is a part of an assembly, structure or mechanism which supports or acts as a constraint on another part of the assembly. The other part may be stationary but the word 'bearing' is usually used in connection with parts having relative motion which may be rotational, reciprocating or a combination of these movements.

A bearing material should have the following properties.

It should:

- offer the least possible resistance to motion
- have good wear resistance
- be able to absorb sudden loads
- be able to conduct heat away from the bearing surface
- resist corrosive conditions
- have a melting point lower than that of the shaft it supports, so that it runs before shaft seizure occurs.

These requirements may be met by the selection of suitable bearing materials and arrangements with adequate lubrication, where necessary.

Uses

Bearings are used to:

- support and hold the shaft in a fixed position (Figs 1 and 2)
- allow the shaft to run freely
- restrain moving elements
- minimise the rubbing action.

Fig 1

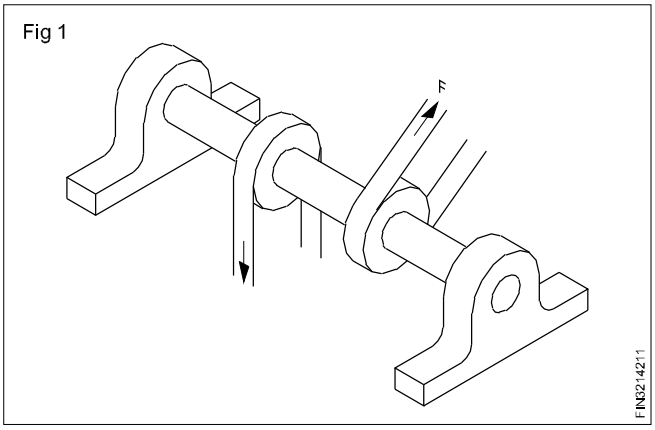
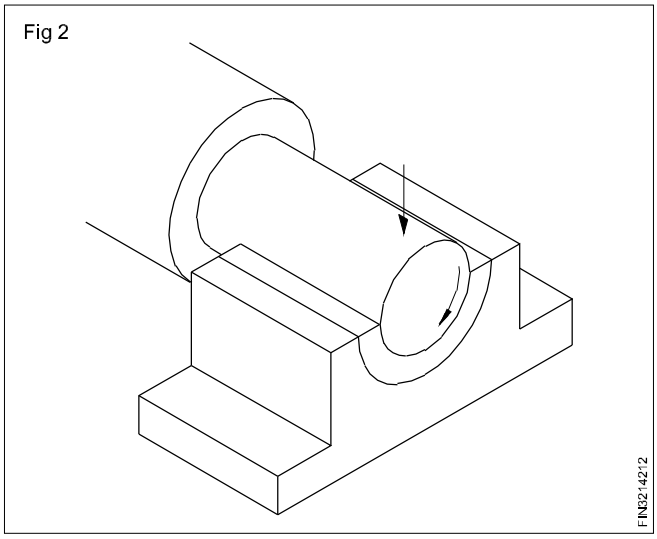


Fig 2



Bearings are generally grouped as:

- plain bearings
- anti-friction bearings.

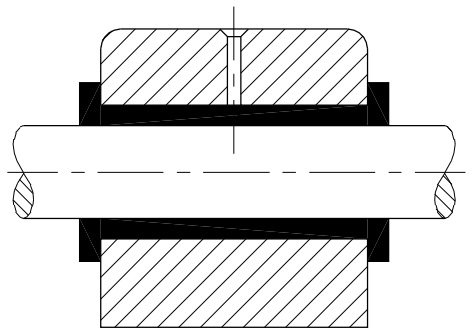
Plain bearings

Depending on the direction of load application they are called radial or journal bearings and thrust bearings.

Radial or journal bearing

In this, the loading is at right angles to the bearing axis. (Fig 3)

Fig 3



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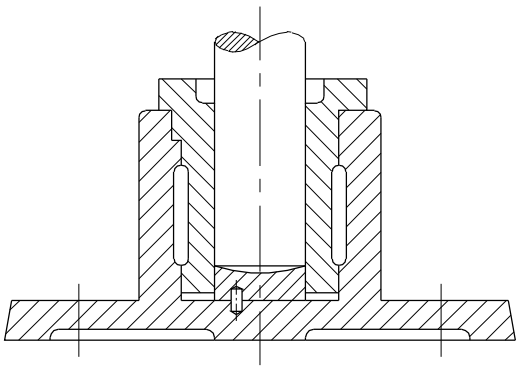
Thrust bearing

In this, the loading is parallel to the bearing axis. (Fig 4)

Fig 4



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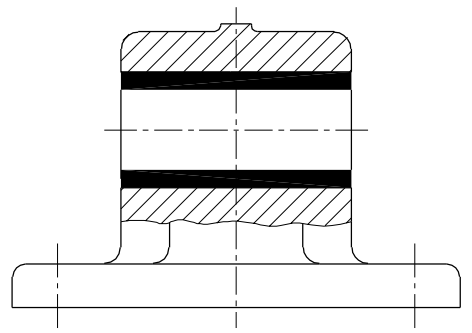
Characteristics of plain bearings

These bearings have a cylindrical shape (Figs 3 and 5) and are fitted in a housing.

Fig 5



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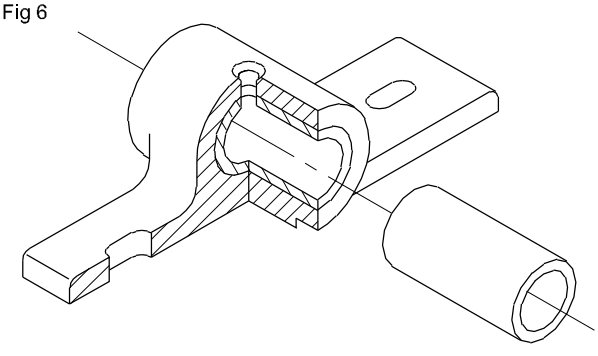
Plain bearings are kept in position without allowing them to rotate along with the shaft. For this purpose they are press fitted in the housing or provided with a key or screws. (Fig 5)

Types of plain bearings

Solid bearings (Fig 6)

These are made of bearing materials in the form of bush and are press fitted in fabricated or cast iron housings.

Fig 6



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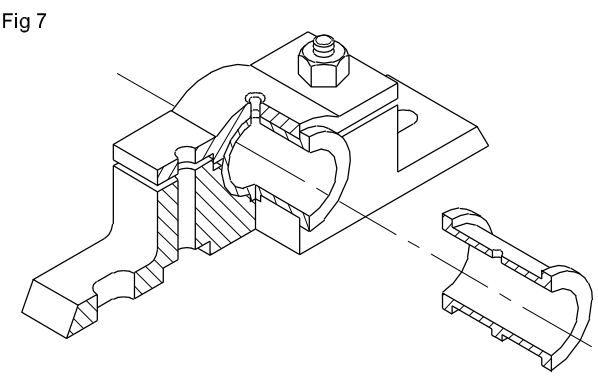
Split bearings (Fig 7)

These bearings are made in halves and assembled in special plumber blocks.

Fig 7



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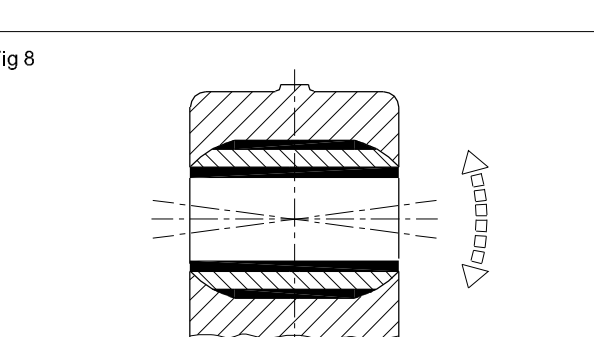
Self-aligning bush bearings (Fig 8)

In this type, the bearing bush is pressed into a special sleeve for self-aligning, in case slight angular misalignment or deflection due to the load between the bearing and the support points occurs.

Fig 8



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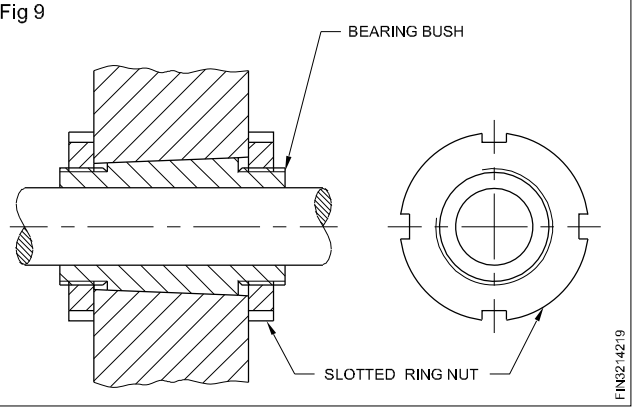
Adjustable slide bearing (Fig 9)

This type of bearing has provision for wear adjustment. The bearing is fitted in the tapered hole of the housing for adjustment of wear. The bearing is drawn inside by means of a nut.

Fig 9

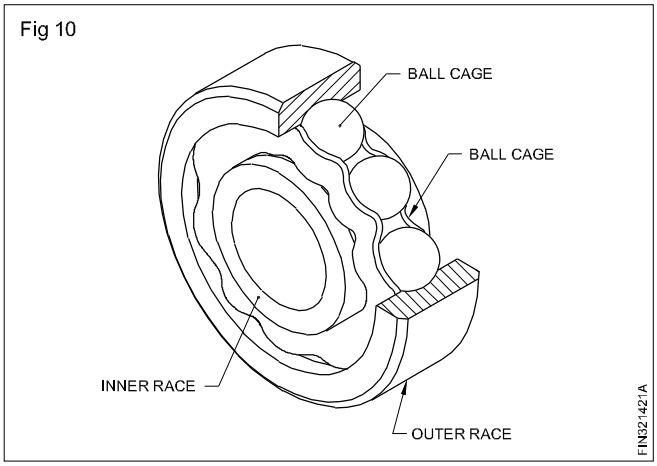


Anti-friction bearing

General features of anti-friction bearings

This bearing consists of rolling elements, races and cage. (Fig 10)

Fig 10



Rolling elements

They are available in different shapes such as balls, parallel rollers, taper rollers, barrels and needles. They are made of chromium (or) chrome-nickel steel with a ground or polished surface. The load of the rotating member is carried by the rolling elements.

Races

The inner and outer races are provided with grooves or race-ways which guide the rolling elements. They are made of high grade chromium steel or chrome-nickel steel. They are hardened, ground and polished.

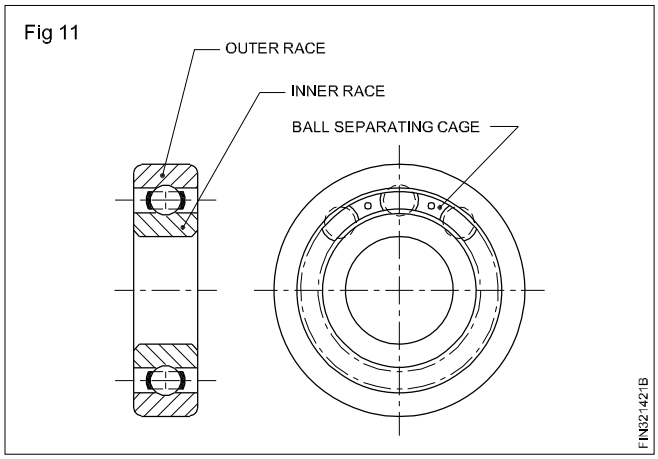
Cage

Each rolling element is separated from the other by means of a 'cage' and it keeps the rolling elements from bunching up. The rolling elements and the cage are retained between the inner and outer races. The rolling elements are retained in the cages to ensure proper fits and equal spacing between the rolling elements. They are made out of brass, steel or plastics.

Ball-bearings

Ball-bearings are the most widely used of all the bearings. (Fig 11)

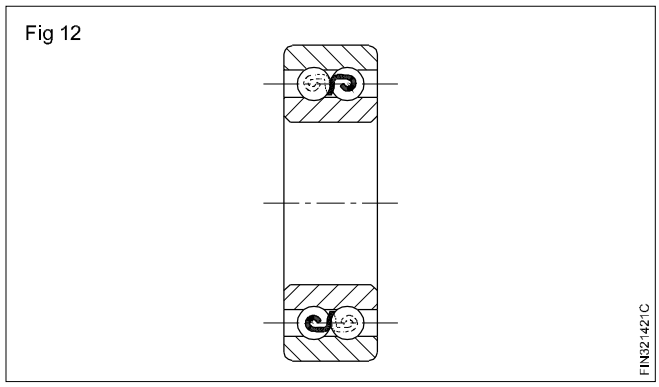
Fig 11



For any given bore diameter, there are usually two or three sizes of outside diameter width, and the load-carrying capacity. The width of these bearings is smaller than the bore diameter. The width (or length) to diameter ratio is much smaller than that of plain bearings. Although principally they are to carry journal loads, the deep groove type of ball races are capable of withstanding the axial thrust.

Self-aligning ball-bearings (Fig 12)

Fig 12



This type of bearings has a spherical bore on the outer race. This bearing can carry journal loads which are slightly inclined due to shaft misalignment.

Ball bearing types

The three most commonly used types of ball bearings are the radial bearing, the angular contact bearing, and the double row ball bearing. The radial ball bearing is designed to accommodate primarily radial loads but the deep groove type will support bidirectional thrust loads up to 35% of the radial load before bearing life becomes progressively shorter. The assembled radial bearing is inseparable and may be equipped with seals, shields, and/or snap rings

Single row ball bearing

Angular contact ball bearings are single row bearings designed so that the line of contact between the balls and inner and outer ring pathways is at an angle to a line 90º to the bearing axis of rotation. The angle between the two lines is called the contact angle. In angular contact ball bearing design. one of the pathway shoulders is removed to allow assembly of a maximum complement of balls for increased load carrying capacity. Angular contact ball bearing support both radial and high one-direction thrust loads.

Double row ball bearing (Fig 13)

This has two angular contact ball bearings mounted back-to-back. This type of mounting has good axial and radial rigidity and provide resistance to overturning moments and angular defelction of the shaft.

The two angular contact ball bearings mounted face-to-face. This type of mounting has the same axial and radial rigidity as back-to-back mounting but less resistance to overturning moments and more compilance to misalignment or bending of the shaft.

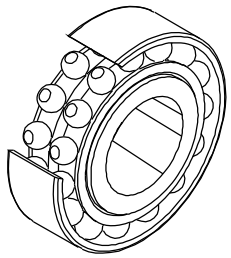
The depitcs two angular contact ball bearings mounted in tandem (face-to-face). This mounting arrangement provides resistance to high one-direction thrust loading. The total thrust capacity of the pair is 1.62 times the thrust capacity of one bearing. For even higher thrust loading, three or more angular contact bearings can be mounted in teandem.

Advantages of double row ball bearings

1 Double row ball bearings support heavy radial loads. thrust loads from either direction, or combined radial and thrust loads. They are normally used in positions where radial loads exceed the capacity of a single row bearing with a comparable bore and OD.

2 Double row bearings are designed with the bore and outside diameter the same as single row bearing but are narrower than two single row bearing.

Fig 13



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3 Double row ball bearing may offer some economic benefits as well ass handling and maintaining benefits verses single row ball bearings.

Double row angular contact ball bearings

Double row angular contact ball bearings have tow rows of balls arranged back-to-back. The lines of action of the load at the contact between balls and raceways (load lines) diverge at the bearings axis and form anangle of 30º to the radial plane. In essence, they work similarly to having a matched pair of single row angular contact ball bearings either face-to-face or back-to-back. The difference is that double row angular contact ball bearing can tacke a bi-directional axial load in one bearing where it takes a matched pair otherwise. This means the bearings are particularly suitable for accomodating simulataneously acting radial load and axial load in both directions. They are also available with seals or shields.

Double row angular contact ball bearings are available in two numerical series:

- 5200 series - Lights load,higher speed, more/smaller balls per bore diameter
- 5300 series - Heavier load, slower speed, fever/larger balls per bore diameter.