3. Bearing arrangement

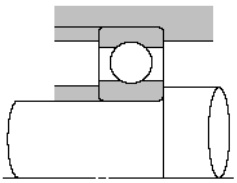
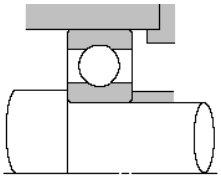
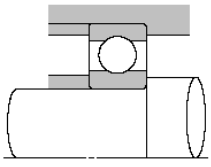
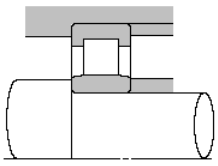
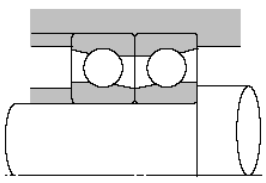
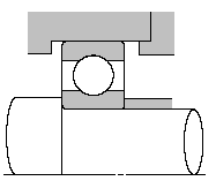
Shaft assemblies generally require two bearings to support and locate the shaft radially and axially, relative to the stationary housing. These two bearings are called the “fixed-side” and “floating-side” bearings. The fixed-side bearing “fixes” or controls movement of the shaft axially in relation to the housing. The floating-side bearing moves or “floats” axially in relation to the housing and is therefore able to relieve stress caused by the expansion and contraction of the shaft due to temperature fluctuations, and allow for misalignment caused by fitting errors.

Fixed-side bearings have the capacity to receive both axial and radial loads, and therefore a bearing which controls axial movement in both directions should be selected. Floating-side bearings receive only radial loads, and therefore bearings which are mounted to permit free axial movement, or bearings with separable inner and outer rings are most desirable. Cylindrical roller bearings are generally separable and allow for axial displacement along their raceway surfaces; deep groove ball bearings are non-separable, but can be mounted to allow for displacement along their fitting surfaces.

In applications with short distances between bearings, shaft expansion and contraction due to temperature fluctuations is slight, therefore the same type of bearing may be used for both the fixed-side and floating-side bearing. In such cases it is common to use a set of matching bearings, such as angular contact ball bearings, to guide and support the shaft in one axial direction only.

Table 3.1 shows representative bearing arrangements where the bearing type differs on the fixed side and floating side. Table 3.2 shows some common bearing arrangements where no distinction is made between the fixed side and floating side. Vertical shaft bearing arrangements are shown in Table 3.3.

Table 3-1(1) Bearing arrangement (Fixed and Floating)

Arrangement		Comment	Application
Fixed	Floating		
		1. General arrangement for small machinery. 2. For radial loads, but will also accept axial loads. 3. Preloading by springs or shims on outer ring face.	Small pumps, small electric motors, auto-mobile transmissions, etc.
		1. Suitable for high speed. Widely used. 2. Even with expansion and contraction of shaft, non-fixing side moves smoothly.	Medium-sized electric motors, ventilators, etc.
		1. Radial loading plus dual direction axial loading possible. 2. In place of duplex angular contact ball bearings, double-row angular contact ball bearings are also used.	Wormgear speed reducers, etc.

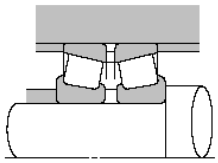
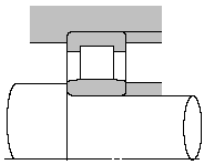
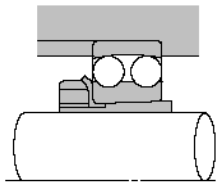
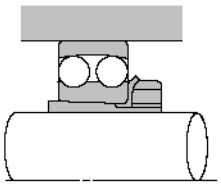
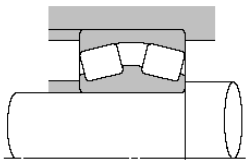
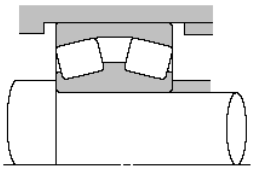
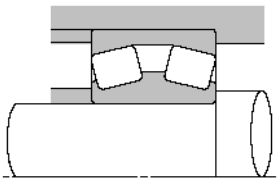
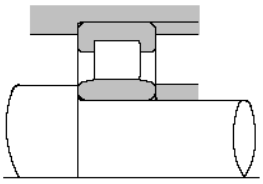
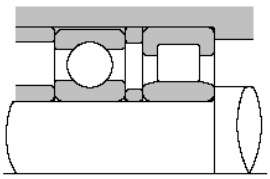
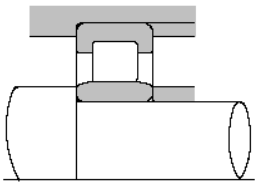
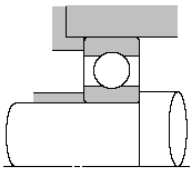
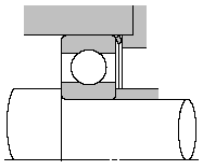
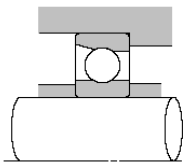
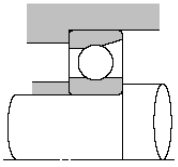
 	1. Heavy loading capable. 2. Shafting rigidity increased by preloading the two back-to-back fixed bearings. 3. Requires high precision shafts and housings, and minimal fitting.	Machine tool spindles, etc.
 	1. Allows for shaft deflection and fitting errors. 2. By using an adaptor on long shafts without screws or shoulders, bearing mounting and dismounting can be facilitated. 3. Not suitable for axial load applications.	Counter shafts for general industrial equipment, etc.
 	1. Widely used in general industrial machinery with heavy and shock load demands. 2. Allows for shaft deflection and fitting errors. 3. Accepts radial loads as well as dual direction axial loads.	Reduction gears for general industrial equipment, etc.
 	1. Widely used in general industrial machinery with heavy and shock loading. 2. Radial and dual directional axial loading.	Industrial machinery reduction gears. etc.
 	1. Capable of handling large radial and axial loads at high rotational speeds. 2. Maintains clearance between the bearing's outer diameter and housing inner diameter to prevent deep groove ball bearings from receiving radial loads.	Diesel locomotives, etc.

Table3-2 Bearing arrangement (Placed oppositely)

Arrangement	Comment	Application
 	General arrangement for use in small machines.	Small electric motors, small reduction gears, etc.
 	1. This type of back-to-back arrangement well suited for moment loads. 2. Preloading increases shaft rigidity. 3. High speed reliable.	Spindles of machine tools, etc.

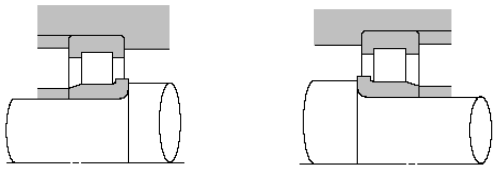
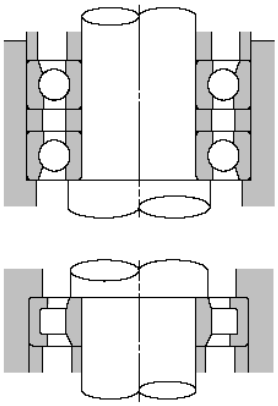
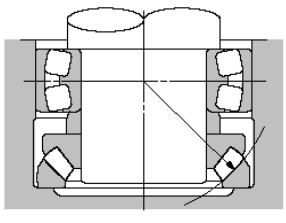
	1. Accepts heavy loading. 2. Suitable if inner and outer ring shrink-fit is required. 3. Care must be taken that axial clearance does not become too small during operation.	Construction equipment, mining equipment sheaves, agitators, etc.
 Back to back  Face to face	1. Withstands heavy and shock loads. Wide range application. 2. Shafting rigidity increased by preloading. 3. Back-to-back arrangement for moment loads, and face-to-face arrangement to alleviate fitting errors. 4. With face-to-face arrangement, inner ring shrink-fit is facilitated.	Reduction gears, automotive axles, etc.

Table 3-3 Bearing arrangement (Placed oppositely)

Arrangement	Comment	Application
	When fixing bearing is a duplex angular contact ball bearing, non-fixing bearing is a cylindrical roller bearing.	Machine tool spindles, vertical mounted electric motors, etc.
	1. Most suitable arrangement for very heavy axial loads. 2. Depending on the relative alignment of the spherical surface of the rollers in the upper and lower bearings, shaft deflection and fitting errors can be absorbed. 3. Lower self-aligning spherical roller thrust bearing pre-load is possible.	Crane center shafts, etc.