# Constrained relative motion between two or more parts engineering essay

Engineering

3. 2Types of bearingA bearing is a device used to allow constrained relative motion between two or more parts, typically rotational or linear movement. Bearings are used to support rotating shafts. There are different types, used for different applications and can be classified according to their motions, operating principles, load capacity, speed and the size that they can handle. Two types of bearing are presented in the following parts:�Plain bearings.�Tilting pad bearings. 3. 2. 1Plain bearingsThe plain bearing is the simplest type of bearing, comprising just a bearing surface and no rolling elements. It consists of a shaft, or journal, which rotates freely in a supporting metal sleeve or shell. The figure below shows some typical plain bearings: Figure 1: Typical plain bearingsA Linear Bearing can be a pair of flat surfaces designed to allow movement. It is also compact and lightweight, and it has a high load-carrying capacity. Plain bearings can include Sleeve, Plain, Shell and Babbitt bearings. The term "Babbitt" refers to the layers of soft metals (Lead, Tin and Copper) which form the metal contact surface of the bearing shell. The design of a plain bearing is dependant on the type of motion the bearing accommodates. The main types of motion are:�Journal Bearing: This is the most common type of bearing and consists of a shaft rotating within a bearing. Figure 2: Journal bearing�Thrust Bearing: a Thrust Bearing provides a bearing surface for forces acting axial to the shaft. Figure 3: Thrust bearingSpecific uses of Plain bearings�Plain bearings are intended to constrain, guide or reduce friction in rotary or linear applications.�To provide smooth operation and greater durability, plain bearings are often self-lubricating.�Plain bearings are compact, lightweight and have a high load capacity. 3. 2. 2Tilting pad bearingsTilting-pad bearings consist of a

shaft rotating within a shell made up of curved pads. Each pad is able to pivot independently and align with the curvature of the shaft. This design allows a more accurate alignment of the supporting shell to the rotating shaft and the increase in shaft stability which is obtained. A view and a schematic of a tilt-pad bearing are presented in the figures below: Figure 4: Tilting pad bearingTilting Pad bearings generally contain three to six pads. Each pad in the bearing is free to rotate about a pivot and cannot support a moment. The pads are secured individually to the housing with radial pins to prevent the shoe from moving, while allowing it to adjust to the position of the shaft. A bearing housing has five Oil Feed holes located in the annular spaces between the shoes. Specific use of tilting pad bearings�Tilting Pad bearings a high level of rotor stability due to their stiffness and damping characteristics.�They are frequently used in high speed machinery operating with low to medium loads such as turbines, turbo-compressors, pumps and high-speed gear boxes. The lubricant in Tilting Pad bearings serves two primary functions: The first is to lubricate the bearing and the second is to reduce heat generated during operation. Two commonly used methods of lubrication are Flooded Lube- where the bearing�s inner cavity is completely filled with Oil, and non-Flooded Lube- where the Oil is fed directly in front of each pad. In the flooded design, the bearing pads obtain their lubrication from the surrounding oil bath. In the Non-Flooded design, the Oil is drained by either removing the floating seals or by adding strategically placed bottom drain holes. 3. 3Bearing inspectionsThe useful life of any bearing depends to a great extent on the care and maintenance it receives. This is especially true in industrial applications, where operating

conditions tend to be harsh, loads are heavy, and contamination from dirt and scale are common. To ensure reliable operation with high equipment performance and the lowest possible maintenance costs, it is essential to follow proper maintenance procedures on bearings. In particular, alignment and clearance must be checked regularly. 3. 3. 1AlignmentMisalignment during assembly is a common cause of bearing noise, increased torque, and general poor performance. The free angle of misalignment that a small bearing can tolerate is typically less than 1°. The figure below shows this free angle of misalignment. Figure 5: Bearing misalignmentThe following methods are generally adopted to inspect the bearings:•Locating shoulders on mating components must be parallel to bearing raceway faces.•Close tolerances on diameters.•Defining assembly tools and force.•Shaft and housing bores must be concentric. This is particularly true when more than 2 bearings share a common component. There are a number of contributors to premature bearing failure: Misalignment and improper lubrication are the two major factors. Misalignment contributes to approximately 1/3 of all bearing failures. There is a misconception in the Industry that the use of flexible couplings eliminates the need for precision alignment. Flexible couplings are actually designed to allow machines to operate within in proper shaft alignment tolerances other than "Zero", which is not a practical or possible alignment goal in most industrial applications. When two machines are misaligned, the flexible element of a coupling creates forces at the coupling which are exerted on the shafts and bearings of the machines. These excessive forces contribute to early bearing failure. precision shaft alignment reduces these forces to allow bearings to last their designed life

time (the number of hours a bearing is designed to last). A common cause of bearing noise, increased torque, and general poor performance is Misalignment during assembly. The free angle of misalignment that a small bearing can tolerate is typically less than 1�. Bearing MisalignmentThe locating shoulders on mating components should be on parallel with the bearing raceway faces. Shaft and housing bores should be concentric, particularly when more than 2 bearings share a common component. For instance, if a third bearing is added to the above arrangement, the resulting assembly has almost no tolerance for misalignment of the bearing outer ring. Alignment MeasurementA simple measurement of outer race run out detects the non-perpendicular of the outer race to the shaft rotating axis as the shaft is rotated (Fig. 3). The indicator setup on the shaft measures both static and dynamic misalignment of the outer race to the shaft. A similar test can be done to measure the inner race being square on the shaft by fixing an indicator to the housing and reading on the inner race as the shaft is rotated (Fig. 4). The maximum permitted run out is 1. 0 mil/inch for a commercial ball bearing. This is reduced to 0. 5 mil/inch for roller bearings, and further reduced for precision bearings, such as machine-tool spindles. This measurement requires access to the outer race with a dial indicator when the bearing is installed.