Basic Knowledge of Bearings

Structure and Function

Bearings—the staple of industry. A surprisingly large number of them can be found all around us. Bearings are used in all kinds of machinery, such as automobiles, airplanes, washing machines, refrigerators, air conditioners, vacuum cleaners, photocopy machines, computers and even in satellites far away in outer space. Bearings enhance the functionality of machinery and help to save energy. Around 100 bearings are used in the average household and 100 to 150 or more are in an automobile. They play an active role in making our lives smoother everywhere in the world, from everyday life to offices, factories and cutting-edge science laboratories. Bearings are utilized in tough environments and in hidden places, such as inside machinery, so we do not usually get the opportunity to see them. Nevertheless, bearings are crucial for the stable operation of machinery and for ensuring top performance.

The term bearing incorporates the meaning of “to bear,” in the sense of “to support,” and “to carry a burden.” This refers to the fact that bearings support and carry the burden of revolving axles.

Steel Balls: The World’s Roundest Balls

Introducing steel balls, one of the important components that make up the basic structure of bearings.

● What Are Steel Balls?

As their name indicates, steel balls are balls made from steel. Generally, the name refers to balls used in bearings and other products. Technically, these balls are called steel balls for rolling bearings. Bearings are rolling parts that are attached to the rotating parts of machines; they comprise multiple steel balls inserted between a large and small ring. Thanks to the steel balls, friction is reduced, enabling the bearing to roll extremely smoothly. Steel balls simply need to be round, hard, and tough. It is also essential that the steel balls inserted in bearings are all of uniform excellence. Continuous research day and night has enabled us to achieve the world’s roundest steel balls.

● Evaluation of Their Roundness

One index that evaluates the roundness of a ball is sphericity, as prescribed under the Japanese Industrial Standards (JIS). General bearing steel balls have a sphericity of 99.999%. Although it is difficult to understand how round steel balls for bearings are in numerical terms, all becomes obvious when they are compared with pachinko balls (Japanese pinball), which look round in appearance.

● Production Process: The general production process for steel balls is as follows

1. Heading
   - Cut a wire short and mould into a ball with dies
   - Coiled wire
   - Dies
   - Moulded ball
   - Cut a wire to the required length to make one steel ball, cold forge using a hemispherical mould, and compress into a ball. The moulded ball has a surplus protruding band generated in the heading process.

2. Flashing
   - Remove bands by applying pressure to the moulded balls
   - Casting plates
   - We remove the protruding bands by feeding the spherical balls into two casting plates fitted with grooves and then rotating the machine while applying pressure.

3. Heat Treatment
   - Heat treatment is used to create the necessary hardness and durability required
   - Carrying out quenching and tempering gives steel balls sufficient strength and durability.
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Structure

The ball bearings and roller bearings pictured to the right represent two typical types of the most basic category of bearings, known as rolling bearings. Rolling bearings are made up of four elements—an outer ring, an inner ring, a cage as well as rolling elements—and have an extremely simple basic structure.

Function

The basic function of bearings is principally to reduce mechanical friction. Reducing friction means:

1. Machinery will run more efficiently
2. There will be less frictional wear, extending the operating life of the machinery
3. Preventing abrasion burn and avoiding mechanical breakdown

Bearings also contribute to lower energy consumption by reducing friction and allowing the efficient transmission of power. This is just one way in which bearings are environmentally friendly.

Types of Steel Materials

Various kinds of steel materials are used for steel balls, and the materials are selected according to the environments in which they are to be used, such as load, rotation speed, and temperature. The main materials used for steel balls are as follows:

- **High-carbon chromium bearing steel**
  This is the material that is widely and generally used for bearings. Featuring exceptional resistance to wear, this type of steel supports the rotating parts of all machines, including those in automobiles.

- **Stainless steel**
  Featuring excellent corrosion resistance, this material is mainly utilized for bearing steel balls that will be used in corrosive environments. Having many uses, stainless steel is used not only for bearings but also valves.

- **Heat-resistant steel**
  Made of special heat-resistant material, this type of steel is mainly utilized in bearings exposed to high-temperature environments of around 300°C, such as airplane jet engine bearings.

Balls Other Than Steel Balls

Balls other than steel balls are also used all around us as elemental components. There have a wide variety of uses, including for bearings and ball-point pen nibs. There are many different uses, and just a few of them are listed below.

- **Ceramic balls**
  Applications: Bearings and other products that require high-speed rotation, such as machine tools, etc.
  Features: High strength and wear resistance even at high temperatures.

- **Carbide balls**
  Applications: The tips of ball-point pens, etc., where resistance to wear is required
  Features: Ball-point pens can be broadly divided into two types, those that use oil- or water-based inks. Since the inks used also come in a variety of colors, excellent quality in terms of corrosion resistance and wettability for each ink is required.

- **Brass balls**
  Applications: Used to fill the holes of carburetors for motorcycles and cars
  Features: Copper alloys with good electric and thermal conductivities are used

- **Nylon balls**
  Applications: Gas leak prevention valves for gas cocks, etc.
  Features: Lightweight is the primary feature of nylon balls. Their properties include low electric and thermal conductivities and resistance to acids and alkalis.

- **Grinding**
  Adjust the dimensions of the steel balls and improve the surface roughness
  Feeding the prescribed steel balls into two polishing plates fitted with grooves and then rotating the machine while applying pressure removes the oxide film that will have formed during heat treatment and improves the precision of the steel balls.

- **Lapping**
  As in [4], the steel balls are fed into two polishing plates fitted with grooves, which are rotated while applying pressure to improve the precision of the steel balls. In lapping, the quality of steel balls is greatly affected by the grindstone and polishing oil used as well as by the process conditions. The optimization of the lapping conditions is indispensable in improving the precision of the steel balls.

- **Visual Inspection/Packing**
  Steel balls produced by means of the process shown on the left are packaged and shipped following a visual inspection process.