

Combined Bearings

Detail Introduction :

The role of the bearing should be mainly to support, that is, the literal interpretation used to bear the shaft, but this is only part of its role, support is actually able to bear the radial load. It can also be understood that it is used to fix the shaft, that is, to fix the shaft so that it can only achieve rotation, and control its axial and radial movement.

Combined Bearings refers to NTN this bearing type, it includes a variety of types of bearings, mainly deep groove ball bearings, miniature and small ball bearings, angular contact ball bearings, spherical ball bearings, cylindrical roller bearings, tapered roller bearings, spherical roller bearings, thrust bearings, etc..

Features of Combination Bearings?

1? Good wear resistance, small friction coefficient, long service life.

2? It can make machinery reduce vibration, reduce noise, prevent pollution and improve labor conditions.

3? It has the advantages of high precision, good rigidity, low temperature rise, high speed, easy to install and dismantle, etc.

4? Simple structure, easy to use, is the production of large quantities, a wide range of applications of a class of bearings.

5, bearing friction loss is small, the limit speed is high, light and medium series of bearings allowed speed can be as high as tens of thousands of revolutions per minute.

Application of Combination Bearings?

NTN bearing is the most representative rolling bearing, mainly bear radial load, but also can bear a certain amount of axial load, combination bearings are very versatile, can be used in the production of precision machinery for all fields of use, suitable for high speed or even very high speed operation, and very durable, without frequent maintenance.

Combined Bearings size range and form variation, applied in precision instruments, low-noise motors, automobiles, motorcycles and general machinery and other industries, is the most widely used type of bearings in the machinery industry. Also has begun to use in orbiting satellites, aviation, railway and automotive, paper-making equipment, office equipment and food machinery and other industrial sectors in various fields.

Combined Bearings mounted on the shaft, in the bearing axial clearance range, can limit the shaft or shell two directions of axial displacement, so can be in both directions for axial positioning. In addition, this kind of bearing also has certain adjusting ability, when relative to the shell hole tilt $2^\circ \sim 10^\circ$, still can work normally, but the bearing life has some influence.

Select a larger radial clearance when the axial load carrying capacity increases, bearing pure radial force when the contact angle is zero. When there is axial force, the contact angle is greater than zero. Generally use the stamping wave keep frame, car system entity keep frame, sometimes also use nylon frame. bearing keep frame more steel plate stamping wave keep frame, large combination bearing more car system metal entity keep frame.

In short, there are many kinds of combination bearings, no matter which one, its working performance is excellent, each one also has its own unique advantages, you can choose the right type of bearing according to your actual needs, among the many types, you can always find the one that suits you.

More Details about Combination Bearings are as Follows:

1. Bearing selection

Rolling element bearings are available in a variety of types, configurations and sizes. When selecting the correct bearing for your application, several factors must be considered and analyzed in a variety of ways.

A comparison of the performance characteristics of each bearing type is shown in Table 2.1. As a general guideline, the basic procedure for selecting the most suitable bearing is shown in the flow

chart below.

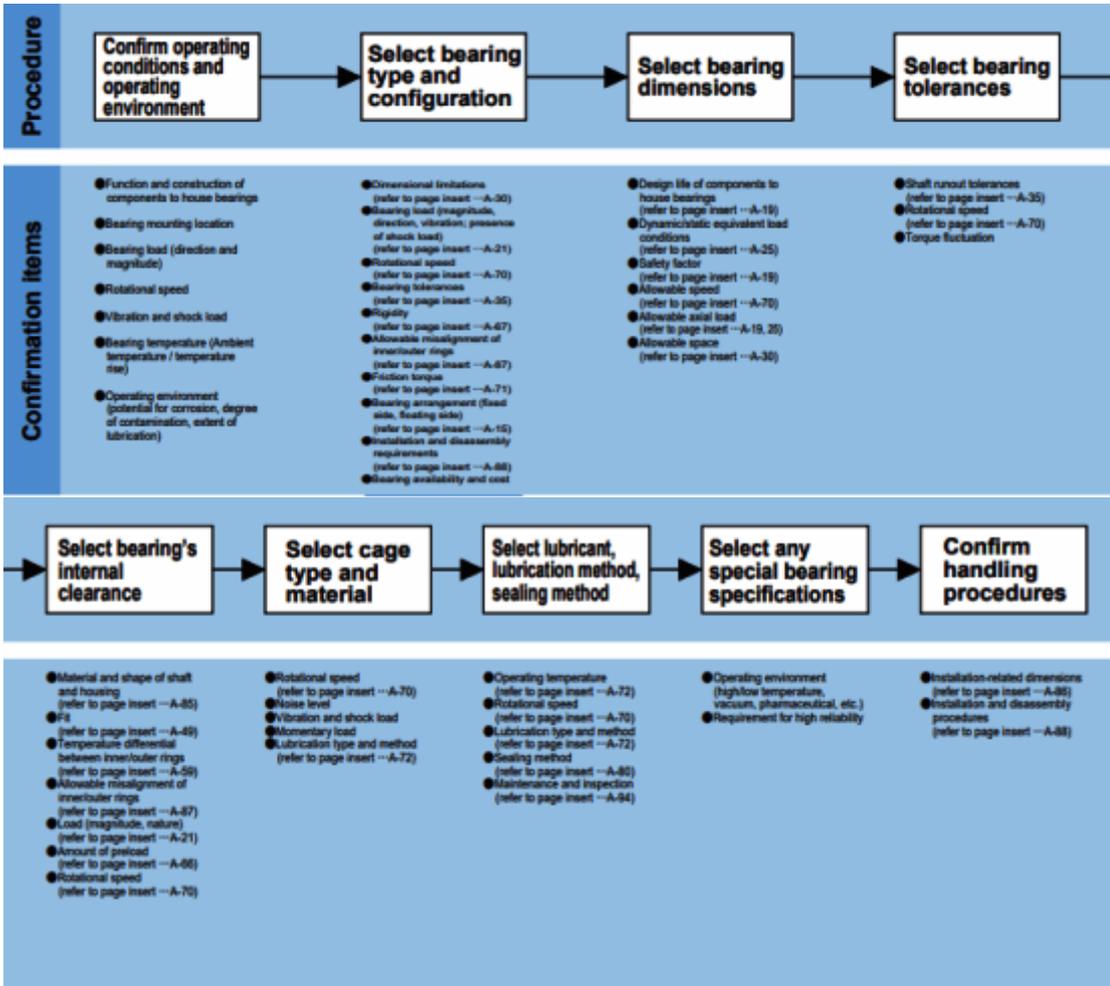


Table 2.1

(1) Dimensional limitations

The allowable space for bearings is usually limited. In most cases, the shaft diameter (or bearing bore diameter) is determined based on other design specifications of the machine. Therefore, the type and size of the bearing is determined by the bearing bore diameter. For this reason, all dimension tables are organized according to standard bore diameters. The range of standardized bearing types and sizes is very wide: the right bearing for a specific application can usually be found in these tables.

(2) Bearing loads

The characteristics, size and direction of the loads acting on the bearings are extremely variable. In general, the basic load ratings shown in the bearing size tables indicate their load capacity. However, in determining the appropriate type of bearing, it must also be considered whether the load acting is only a radial load or a combination of radial and axial loads, etc. When considering the same size series of ball bearings and roller bearings, roller bearings have greater load carrying capacity and can also withstand greater vibration and shock loads.

(3) Rotational speed

The allowable rotational speed of a bearing will vary depending on the bearing type, size, tolerance, cage type, load, lubrication conditions and cooling conditions. The permissible speeds listed in the table for grease and oil lubricated bearings are for bearings with normal tolerances. Generally speaking, deep groove ball bearings, angular contact ball bearings and cylindrical roller bearings are most suitable for high speed applications.

(4) Tolerances of bearings

The dimensional accuracy and working tolerances of bearings are defined by ISO and JIS standards. For equipment that requires high tolerances for shaft runout or high speed operation, bearings with class 5 or higher tolerances are recommended. Deep groove ball bearings, angular contact ball bearings and cylindrical roller bearings are recommended for high rotational tolerances.

(5)Stiffness

Elastic deformation occurs on the contact surfaces of the rolling element and raceway surfaces of the bearing, under load. For certain types of equipment, it is necessary to minimize this deformation as much as possible. The elastic deformation of roller bearings is smaller than that of ball bearings. In addition, in some cases, the bearing is given a load in advance (preload) to increase its rigidity. This procedure is usually applied to deep groove ball bearings, angular contact ball bearings and tapered roller bearings.

(6) Inner ring and outer ring misalignment

Shaft bending, shaft or bearing seat accuracy changes and fit errors can lead to a certain degree of misalignment of the inner and outer rings of the bearing. In the case of a relatively large degree of misalignment, self-aligning ball bearings, spherical roller bearings or bearing units with a self-aligning function are the most suitable choice. (Refer to Figure 2.1)

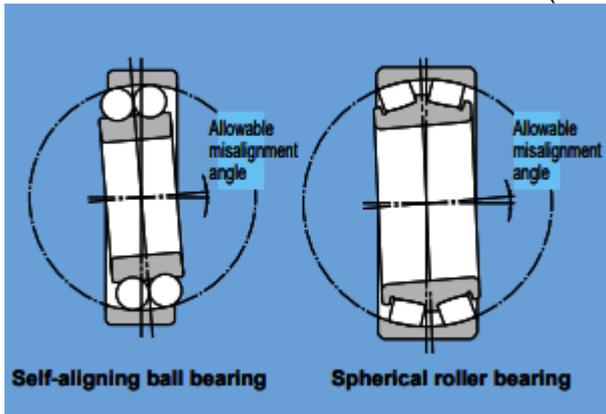


Figure 2.1

(7) Noise and torque level

Rolling bearings are manufactured and machined to high precision standards and therefore generally produce only slight noise and torque. For applications requiring particularly low-noise or low-torque operation, deep groove ball bearings and cylindrical roller bearings are most suitable.

(8) Installation and disassembly

Some applications require frequent disassembly and reassembly to enable periodic inspections and repairs. For such applications, bearings with separable inner/outer rings, such as cylindrical roller bearings, needle roller bearings, and tapered roller bearings are most appropriate. Incorporation of adapter sleeves simplifies the installation and disassembly of self-aligning ball bearings and spherical roller bearings with tapered bores.

2. Boundary dimensions

The main dimensions of rolling bearings are called "boundary dimensions", as shown in Figures 5.1-5.3. In order to promote international interchangeability of bearings and economy of bearing production, the boundary dimensions of bearings have been standardized by the International Standards Organization (ISO). In Japan, the boundary dimensions of rolling bearings are defined by the Japanese Industrial Standard (JIS B 1512).

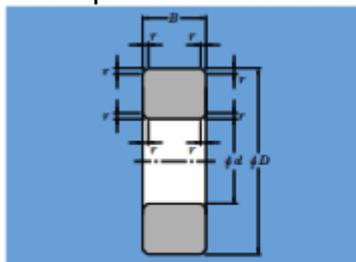


Fig. 5.1 Radial bearings (excluding tapered roller bearings)

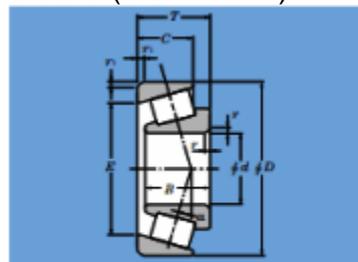


Fig. 5.2 Tapered roller bearings

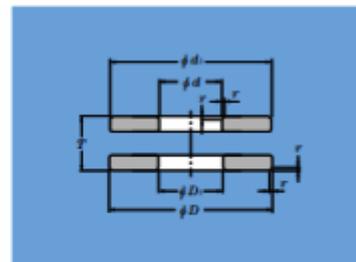


Fig. 5.3 Single direction thrust bearings

These standardized boundary dimensions include: bearing bore, outside diameter, width/height and chamfer dimensions - all of which are important when considering the compatibility of shafts, bearings and housings. In general, however, the internal construction dimensions of the bearing are not included in these dimensions.

For rolling bearings of the metric series, there are 90 standardized bore diameters (d) in sizes from 0.6 mm to 2500 mm. The outer diameter dimensions (D) of the standardized bore sizes of radial

bearings are included in the "diameter series"; their corresponding width dimensions (B) are included in the "width series". For thrust bearings, there is no width series; instead, these dimensions are contained in the "height series". The combination of all these series is called a "size series". All series numbers are shown in Table 5.1.

Table 5.1 Dimension series numbers

	Dimension series				Reference diagram
		Diameter series (outer diameter dimensions)	Width series (width dimensions)	Height series (height dimensions)	
Radial bearings (excluding tapered roller bearings)	number	7, 8, 9, 0, 1, 2, 3, 4	8, 0, 1, 2, 3, 4, 5, 6	—	Diagram 5.4
	dimensions	small ← large	small ← large		
Tapered roller bearings	number	9, 0, 1, 2, 3	0, 1, 2, 3	—	Diagram 5.5
	dimensions	small ← large	small ← large		
Thrust bearings	number	0, 1, 2, 3, 4	—	7, 9, 1, 2	Diagram 5.6
	dimensions	small ← large		small ↔ large	

Although many rolling bearing sizes are standardized and are listed here for future standardization, there are many standard bearing sizes that are not currently in production. The boundary dimensions of radial bearings (excluding tapered roller bearings) are shown in the attached table.

3. Allowed speed

As the bearing speed increases, the temperature of the bearing will also rise, which is due to the heat generated by the internal friction of the bearing. This will lead to damage to the bearing, such as jamming, the bearing will not be able to continue stable operation. Therefore, the maximum speed at which it is possible for a bearing to run continuously without generating more heat than the specified limit is called the permissible speed (min-1).

The permissible speed of a bearing depends on the type of bearing, bearing size, type of cage, load, lubrication conditions and cooling conditions.

Bearing size tables give approximate permissible speeds for grease and oil lubrication. These values are based on the following points.

1. The bearing must have the proper internal clearance as specified in the Engineering Standard Design Specification and must be properly mounted.
2. A high quality lubricant must be used. The lubricant must be replenished and replaced when necessary.
3. The bearing must be operated under normal operating temperature and under normal load conditions ($P \leq 0.09 C_r$, $F_a / F_r \leq 0.3$).

If the load is $P \leq 0.04 C_r$, the rolling element may not rotate smoothly. If this is the case, please contact Engineering for more information. The allowable rotational speed of deep groove ball bearings with contact seals (LLU type) or low torque seals (LLH type) is determined by the circumferential speed of the seal.

For bearings to be used under heavier than normal loads, the permissible speed values listed in the bearing tables must be multiplied by an adjustment factor. The adjustment factors f_L and f_C are given in figures 9.1 and 9.2.

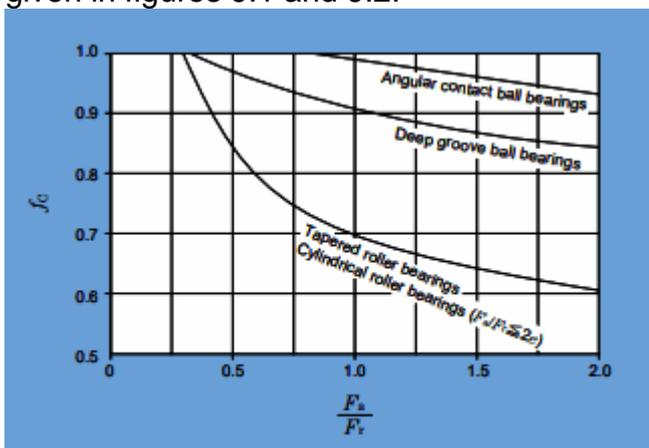


Fig. 9.2 Value of adjustment factor f_c depends on combined load

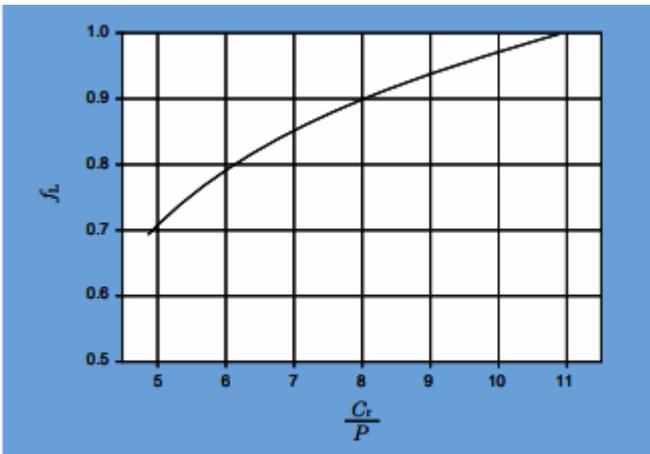


Fig. 9.1 Value of adjustment factor f_L depends on bearing load

Also, when radial bearings are mounted on vertical shafts, lubricant retentions and cage guidance are not favorable compared to horizontal shaft mounting. Therefore, the allowable speed should be reduced to approximately 80% of the listed speed.

For speeds other than those mentioned above, and for which data is incomplete, please consult NTN Engineering.

If rotational speed is to exceed allowable rotational speed given in the dimensions table, it will require special considerations such as using a bearing for which cage specifications, internal clearance and precision have been thoroughly checked. It will also require adopting forced circulation, jet oil or mist oil lubrication as the lubrication method.

Under such high speed operating conditions, when special care is taken, the standard allowable speeds given in the bearing tables can be adjusted upward. The maximum speed adjustment values, f_B , by which the bearing table speeds can be multiplied, are shown in Table 9.1. However, for any application requiring speeds in excess of the standard allowable speed, please consult NTN Engineering.

Table 9.1 Adjustment factor, f_B , for allowable number of revolutions

Type of bearing	Adjustment factor f_B
Deep groove ball bearings	3.0
Angular contact ball bearings	2.0
Cylindrical roller bearings	2.5
Tapered roller bearings	2.0

4. Friction and temperature rise

Friction One of the main functions required of a bearing is that it must have low friction. Under normal operating conditions rolling bearings have a much smaller friction coefficient than the slide bearings, especially starting friction.

The friction coefficient for rolling bearings is expressed by formula (10.1).

$$\mu = \frac{2M}{Pd} \dots\dots\dots (10.1)$$

where,

- μ : Friction coefficient
- M : Friction moment, N · mm (kgf · fmm)
- P : Load, N (kgf)
- d : Bearing bore diameter, mm

Although the dynamic friction coefficient for rolling bearings varies with the type of bearings, load, lubrication, speed, and other factors; for normal operating conditions, the approximate friction coefficients for various bearing types are listed in Table 10.1.

Table 10.1 Friction coefficient for bearings (reference)

Bearing type	Coefficient $\mu \times 10^{-3}$
Deep groove ball bearings	1.0~1.5
Angular contact ball bearings	1.2~1.8
Self-aligning ball bearings	0.8~1.2
Cylindrical roller bearings	1.0~1.5
Needle roller bearings	2.0~3.0
Tapered roller bearings	1.7~2.5
Spherical roller bearings	2.0~2.5
Thrust ball bearings	1.0~1.5
Thrust roller bearings	2.0~3.0

Temperature rise Almost all friction loss in a bearing is transformed into heat within the bearing itself and causes the temperature of the bearing to rise. The amount of thermal generation caused by friction moment can be calculated using formula (10.2).

$$Q = 0.105 \times 10^{-6} M n \text{ N} \quad \left. \begin{array}{l} \\ = 1.03 \times 10^{-6} M n \text{ [kgf]} \end{array} \right\} \dots\dots\dots (10.2)$$

where,

Q : Thermal value, kW

M : Friction moment, N · mm [kgf · fmm]

n : Rotational speed, min⁻¹

Bearing operating temperature is determined by the equilibrium or balance between the amount of heat generated by the bearing and the amount of heat conducted away from the bearing. In most cases the temperature rises sharply during initial operation, then increases slowly until it reaches a stable condition and then remains constant.

The time it takes to reach this stable state depends on the amount of heat produced, heat capacity/diffusion of the shaft and bearing housing, amount of lubricant and method of lubrication. If the temperature continues to rise and does not become constant, it must be assumed that there is some improper function.

Possible causes of abnormal temperature include bearing misalignment (due to moment load or incorrect installation), insufficient internal clearance, excessive preload, too much or too little lubricant, or heat produced from sealed units. Check the mechanical equipment, and if necessary, remove and inspect the bearing.

Complete guide to combined bearings?

Do you know anything about combined bearings? If you are interested in this content, you can take a look at the following knowledge, this guide provides detailed information about combined bearings, it will bring you some help and let you know more.

1?Industries using combined bearings

Combined Bearings are used in a wide range of applications and can be used to produce precision machinery for use in all fields. At present, specialized manufacturing is carried out in industries such as automotive motor bearings, home appliance motor bearings, motorcycle bearings, and health care motor bearings, so that the noise and life of combined bearings can be optimized.

2?Future of combined bearings

With the development and growth of the bearing industry, the bearing industry's outward-looking degree is increasing, in recent years, NTN bearing products industry export base public service platform construction project, built a bearing quality testing center, public technology research and development platform, public display platform, in technological innovation, product testing, product certification, domestic market information, etc., for bearing enterprises to provide convenient and fast public services.

3?Benefits of combined bearings

- (1) The starting friction coefficient is small, and the difference between the dynamic friction coefficient is small.
- (2) can be more convenient in the case of high or low temperature use.

- (3) International standards and specifications are unified, easy to get interchangeable products.
- (4) Easy lubrication, less lubricant consumption, can improve the rigidity of the bearing by applying pre-pressure.
- (5) In general, a set of bearings can simultaneously withstand radial and axial loads in both directions.

4?Types of combined bearings in the Market

(1) Thrust tapered roller bearings

As the thrust tapered roller bearings in the rolling body for the tapered roller, in the structure due to the rolling bus and gasket raceway bus are intersected in the bearing axis line a point, so the rolling surface can form a pure rolling, limit speed higher than the thrust cylindrical roller bearings.

Thrust tapered roller bearings can withstand one-way axial load. Due to the production of thrust tapered roller bearings, the factories have been produced for the models of non-standard dimensions, and standard dimensions of the series, varieties of production less, and thus there is no national standards for the size of the bearing.

(2) thrust angular contact ball bearings

Thrust angular contact ball bearings contact angle is generally 60° commonly used thrust angular contact ball bearings are generally two-way thrust angular contact ball bearings, mainly for precision machine tool spindle, generally used with double row cylindrical roller bearings together, can withstand two-way axial load, with high precision, good rigidity, low temperature rise, high speed, easy to install and disassemble and other advantages.

(3) Double-row tapered roller bearings

Double row tapered roller bearing structure, the most large number of 35000 type, there is a double raceway outer ring and two inner ring, two inner ring between a spacer, change the thickness of the spacer can be adjusted clearance. This type of bearing in bearing radial load at the same time can bear two-way axial load, can be in the bearing axial clearance range to limit the axial displacement of the shaft and shell.

(4) Tapered roller bearings

Tapered roller bearings are separated type bearings. The angle of the outer ring and the outer raceway diameter size has been standardized with the same size, not allowed to change in the design and manufacture, so that the outer ring of the tapered roller bearing and the inner component can be in the world general interchangeable.

Tapered roller bearings are mainly used to bear radial load mainly radial and axial combined load. Compared with the angular contact ball bearings, the bearing capacity is large, the limit speed is low. Tapered roller bearings can withstand a direction of the axial load, to limit the shaft or shell a direction of axial displacement.

(5) Deep groove ball bearing

In the structure of deep groove ball bearings, each ring has a cross section of about one-third of the equatorial circumference of the ball continuous groove raceway. Deep groove ball bearings are mainly used to bear radial load, but also can bear a certain axial load. When the radial clearance of the bearing increases, with angular contact ball NTN bearing properties, can withstand two directions of the alternating axial load.

Compared with other types of bearings of the same size, this type of bearing has a small coefficient of friction, high limit speed, high precision, and is the bearing type preferred by users when selecting the type. Deep groove ball bearing structure is simple, easy to use, is the largest production volume, the widest range of applications of a class of bearings.

5?How to choose combined bearings ?

(1) the choice of model: bearing model is generally selected by the user's technical staff according to the conditions of use of the supporting products and bearing the load on the bearing. Sales staff mainly understand the user's actual load is consistent with the selected bearing, if the bearing can not meet the use of the requirements, should be as soon as possible to advise customers to change the model, but unless the special products in the selection of the model generally will not have any problems.

(2) grease selection: grease selection is generally based on speed, temperature resistance, noise

requirements and starting torque and other aspects of the choice, requiring sales staff to understand the performance of various grease.

(3) clearance selection: users in the purchase of bearings will generally only inform in what type, grade, rarely will the bearing clearance requirements, business personnel must ask the bearing use conditions, which bearing speed, temperature, with tolerance are directly related to the choice of bearing clearance. Generally in 3500 rpm below the speed of most of the motor using CM clearance, such as high temperature high speed motor is required to use relatively large clearance.

(4) the choice of seal type: bearing lubrication can be divided into oil lubrication and grease lubrication. Oil lubrication bearing is generally the choice of form bearings, grease lubrication bearing generally choose dust cover or rubber seal seal. Dustproof cover is suitable for high temperature or the use of good environmental parts, seals are divided into contact sealing and non-contact sealing, contact sealing dustproof performance is good but the starting torque is large, non-contact sealing starting torque is small, but the sealing performance is not contact good.

6?How to install combined bearings?

Since the bearings are rust-proofed and packed, do not open the packing until you are ready to install them. In addition, the anti-rust oil coated on the bearings has good lubricating properties, so for general purpose bearings or bearings filled with grease, they can be used directly without cleaning. However, for bearings for instrumentation or bearings used for high-speed rotation, clean cleaning oil should be applied to wash away the antirust oil, when the bearings are prone to rust and should not be left for a long time.

Clean the bearing and shell, make sure there is no scar or burr left by mechanical processing. There must not be abrasive (SiC, Al₂O₃, etc.) type sand, chips, etc. in the housing. Next, check whether the size, shape and machining quality of the shaft and housing are in accordance with the drawings. Before mounting the bearings, apply mechanical oil to each mating surface of the inspected shaft and housing.

It varies depending on the type of bearing and mating conditions. As most of them are generally shaft rotating, so the inner ring and outer ring can adopt interference fit and clearance fit respectively, while the outer ring adopts interference fit when the outer ring is rotating. Press into the installation generally use the press, can also use the bolt and nut, as a last resort, the use of hand hammer into the installation. The hot sleeve installation method of heating the bearing in oil to make it expand and then install it on the shaft can make the bearing avoid unnecessary external force and complete the installation work in a short time.

7?Combined Bearing Maintenance Process

(1) Use the installation carefully, do not allow strong stamping, do not allow direct knocking of the bearing with a pendant, do not allow the transmission of pressure through the rolling body.

(2) Use suitable and accurate installation tools, try to use special tools, and strongly avoid using cloth and short fibers and other things.

(3) Try to keep the bearing and its surrounding environment clean, even if the tiny dust invisible to the naked eye enters the bearing, it will increase the wear, vibration and noise of the bearing.

(4) to prevent bearing rust, directly by hand to pick up the bearing, to fully wash the hands of the liquid, and coated with high quality mineral oil before operation, in the rainy season and summer especially to pay attention to prevent rust.

(5) In some special operating conditions, combination bearings can obtain a longer life than the traditional calculation, especially in the case of light load. These special operating conditions are, when the rolling surface is effectively separated by a lubricant film and limit the surface damage that may be caused by contaminants.

8?How can I avoid corrosion of combined bearings?

NTN bearing corrosion damage refers to the bearing and the surrounding media chemical or electrochemical reaction resulting in damage, damage phenomenon, which is a widespread natural phenomenon. Corrosion damage can be divided into two categories: chemical corrosion and electrochemical corrosion. Electrochemical corrosion is the metal and electrolyte material in contact with the corrosion, in the metal corrosion accounted for the majority. It differs from chemical corrosion

in that the corrosion process has a current generation. Its root cause is the formation and existence of corrosion cells.

Measures to reduce corrosion hazards are mainly:

(1) the correct choice of materials. According to the working environment, the choice of corrosion-resistant materials, such as alloy steel, in the conditions appropriate to the choice of non-metallic materials, such as engineering plastics, ceramics and other substitutes.

(2) cover protective layer. Find ways to change the surface structure of bearings to prevent corrosion, such as painting non-metallic protective layer, brushing alloy materials, the use of appropriate anti-rust oil, grease, etc..

(3) Improve environmental conditions. Reduce the corrosive medium in the environment, reduce the corrosion effect, such as controlling the relative humidity (< 60%), try to use ventilation measures, blowing away harmful gases and moisture, etc..

Need to be clear is that cavitation also belongs to the category of corrosion damage to parts.

Cavitation often occurs in the pump, hydraulic pump, hydraulic turbine blades, etc.. It is a more complex damage phenomenon, not only mechanical stripping effect, there are chemical, electrochemical effect. When the transported liquid does not put the net, such as containing tiny particles and other impurities will intensify the damage process. After a long period of cavitation, can be extended to pores, the formation of cracking and penetration damage, so cavitation is also known as cavitation.

9?How much combined bearings Cost

The selection of bearings needs to consider the bearing material, the number of rolling element rows, the type of raceway, the rolling elements, the cage and its materials, the sealing cover, the characteristics of use, the type of rolling elements, the sealing and dust-proof form and other factors. Combined Bearings are produced in line with the principle of quality first, so overall, the quality is very good, the price is relatively favorable, and the price/performance ratio is very advantageous.