



Precision Ball Bearing

LUOYANG HUIGONG BEARING TECHNOLOGY CO., LTD.

Company Profile

Luoyang Huigong Bearing Technology Co., Ltd (CHG) was established in 1998. It is a professional bearing company mainly engaged in design, development, manufacture and sales service for uniform-section thin-section bearings, thin-section cross-roller bearings, large precision high-speed ball bearings, and other high precision bearings. With the customer satisfaction as the goal and with the strict quality control as the product protection, CHG researchers have developed many types of high-precision, high-performance and high-quality bearings. Currently, the products have been widely used in industrial robotics, aviation, aerospace, national defense, medical equipment, radar antennas, optical device and other fields, and have won the praises from customers.

The light series precision ball bearings produced by CHG can be divided into 4 series: 618 series、619 series、718 series、719 series. With the inner diameter range from 100mm to 950mm, and the precision is divided into P6, P5, P4 and P2.

The use of thin-section bearings can save the space, lower the weight, reduce significantly the friction, and provide the good rotation accuracy. Without affecting the performances and service lives of bearings, their use can reduce the external dimensions of the device and cut the production costs effectively.

Adhering to the concept of “Collect Elites and Develop Boutique”, our company is committed to providing customers with high quality products. CHG has a technical team with more than ten years of research and development experiences for bearings, and they have achieved the outstanding results and more than 20 patents in design, manufacture and detection of uniform-section thin-section bearings, thin-section cross-roller bearings, large precision high-speed ball bearings, military bearings and other precision bearings. In 2008, CHG became the first private cooperation enterprise and teaching practice base for Henan University of science and technology in Luoyang. The computer design and analysis software system established after several tests and improvements has become a reliable guarantee, to develop the high-precision and high-performance bearings in our company.

The company's production technologies have passed through ISO9001: 2008 quality management system certification and can be tested by SGS, ASIA or other third-party international testing organizations according to the customer requirements.

After many years of accumulation and development, our company has been widely recognized on markets and in societies, and awarded with “Outstanding Private Enterprise”, “Key Protection Enterprise”, “Class A Taxpayer” in many times in Henan province and Luoyang city. With good reputation and pragmatic style, our company has been widely praised in the field. With good product quality, integrity attitude, and continuous technological progress, our company has entered into a professional development path. Our company has owned a large number of customers with well-known brands, and our products have exported to more than thirty countries and regions, such as United States, Germany, Spain, Austria, Netherlands, Japan, India, with a steadily increasing of sales achievement.



Product Introduction / directory

Structure and features of CHG precision bearing	0 1
Precision bearing selection principles	02
Bearing preload and rigidity	03
Bearing lubrication	04
Bearing assemblies	05
Allowable bearing operating temperature	06
Bearing installation sizes	07
Bearing installation and adjustment	07
Example of bearing installation on machine tool	09
Example of light series bearing code	1 1
Bearing catalogue	12
Deep groove ball bearing	12
Angylar contact ball bearing	15

Structure and features of CHG precision bearing

1.1 Deep groove ball bearing

The deep groove ball bearing is a kind of rolling bearing with most representatives, and it has features of small friction coefficient, high limiting speeds, simple structure, low cost, and high manufacturing precision. It has various sizes and structures, and is used in precision instruments, low noise motors, automobiles, motorcycles and general machinery industries, and a kind of bearing with most applications in the machinery industry. The bearing can bear mainly the radial load, but also can bear a certain axial load.

With larger radial clearance, the axial carrying load can be increased. When it only bears the radial load, the contact angle should be zero; when it bears an axial load, the contact angle should be greater than zero. A stamped ribbon cage is commonly machined as the solid cage; sometimes the nylon cage can also be used.

After the deep groove ball bearing is mounted on the shaft, within the axial clearance of the bearing, the axial displacement of the shaft or the housing in both directions can be limited, so it can be used for axial positioning in both directions. In addition, the bearing has also some self-aligning capability; when it is tilted to $2' \sim 10'$ corresponding to the housing, it still can be operated normally, but there may be a certain influence on the bearing life. The deep groove ball bearing cage is commonly the stamped steel ribbon shape, and the machined metal solid cage is also used for large bearing.

The deep groove ball bearing is the most commonly used rolling bearing. It has simple structure and is easy to use. It is mainly used to bear the radial load; when the radial clearance of bearing is increased, it will show a certain performances of the angular contact ball bearing and can withstand radial and axial integrated load. When the speed is too high and the thrust ball bearing can not be used, it can also bear only the axial load. Compared with other types of bearings with the same sizes, it has small friction coefficient and a high limiting speeds, but it can not bear the impact and is not suitable to bear a big load.

1.2 Angular contact ball bearing

The single-row angular contact ball bearing can bear a radial load and an axial load in one direction, and it can bear only an axial load in one direction; under the radial load, its axial component load will be caused. Therefore, the single row angular contact ball bearing should be matched with the other bearing to bear the axial load in the opposite direction. So, 2, 3, 4 or even 5 angular contact ball bearings are usually matched together for use, and the angular contact ball bearing has a high limiting speeds.

There are two series (718 and 719) of CHG light precision angular contact ball bearings; they have the same inside diameter and the outside diameter and width are increased successively.

The contact angles of CHG light series precision angular contact ball bearings are 15° (Code C), 25° (Code AC) and 40° (Code B); for the angular contact ball bearings, the contact angle is greater, the axial load capacity is larger, but the bearing limiting speeds is lower. Therefore, the bearing with the contact angle of 15° is used on the shaft with high speeds and small axial load; on the contrary, the angular contact ball bearings with the contact angle of 25° or 40° should be used.

CHG precision angular contact ball bearings can be divided into 3 series of high-speed angular contact bearings (standard series), ultra high-speed angular contact ceramic ball bearings, and high speed sealed angular contact ball bearings.

For the roller bearings used under common conditions, the inner and outer rings and rolling elements should be made of high carbon chromium bearing steel; but in some applications, such as in ultra-high speed, wear resistance, low temperature rise, long life and high reliability and other places, the steel bearing performances can not meet the requirements of the use conditions, they should be made of bearing material with more excellent performances, among which, the silicon nitride ceramic is considered as the best alternative for roller bearing steel material.

CHG can also offer angular contact hybrid ceramic ball bearings with wide applications for high-speed precision machine tool spindle and other high-speed precision machinery spindle, in which, the inner and outer rings should be made of high quality bearing steel material, and the rolling elements should be made of silicon nitride ceramics.

Compared with standard steel angular contact ball bearings with the same structure and size, the angular contact hybrid ceramic ball bearings have excellent high-speed performances, high rigidity, low friction heat, long life and other advantages.

CHG precision hybrid ceramic ball bearings (Code HQ1) can significantly increase the spindle speeds, rigidity, reliability and productivity, and dramatically reduce the friction heat of the spindle and extend the host life.

Precision bearing selection principles

Each bearing has its own specific use locations; based on the following bearing performances, it should be selected from different bearing types and structures depending on the operating conditions.

2.1 Size series

The precision deep groove ball bearings and angular contact ball bearings with the outside diameter series of 18 and 19 corresponds to the gradually increased outer diameters and widths.

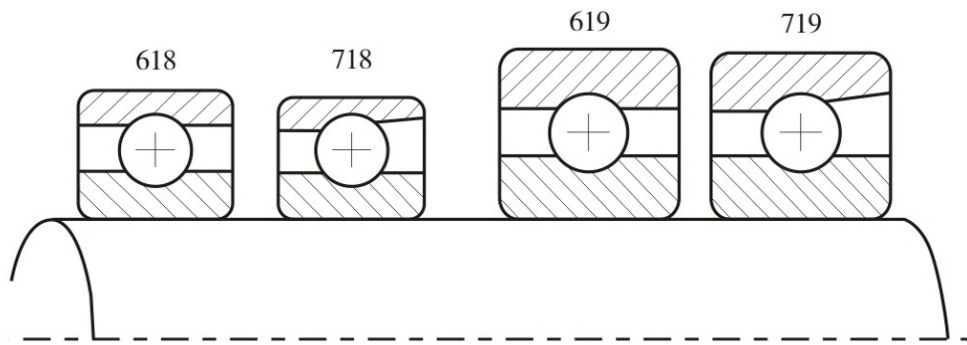


Figure 1

For angular contact ball bearings, if the radial space for bearing installation is limited or the spindle speed requirements is high, the bearings with the size of 19 should be preferred.

The spindle diameter is greater, its rigidity is higher. To increase the bearing rigidity, the increased number of balls is more favorable than the increased ball diameter.

2.2 Bearing precision

2.2.1 Rotation accuracy

The bearing rotation precision directly determines the rotation and machining precision of the machine tools, especially for the radical runout of the bearing inner ring. Of course, the precision of spindle and bearing base to be matched with the bearing must also match with the bearing precision.

For high-speed precision angular contact ball bearings, the standard accuracy level is ISO4 (equivalent to ABEC 7); P4A level (with the size accuracy equivalent to ISO4 level and the rotation accuracy of higher than ISO4 level) and ISO2 level (equivalent to ABEC 9) of super precision bearings also available;

2.2.2 Size accuracy

For high precision bearings, especially for the bearings with sizes of 18 and 19, due to the small wall thickness of bearing rings, when it is matched with the shaft and bearing base, the matching statue has significant impact on the rotation precision, internal clearance or preload on the bearing. Therefore, not only the bearing should have high size accuracy, but also the matched spindle diameter and the housing must have corresponding size accuracy and surface quality. For more details, please consult CHG technical department.

2.3 Limiting speeds

In all roller bearings under the same conditions, the angular contact ball bearing has the highest limiting speeds.

The limiting speeds of roller bearing depends on the structure, size series and size of bearing, the structure and material of cage, the bearing precision, internal clearance and preload, external load, lubrication method and lubrication conditions, the permissible operating temperature, cooling measures and matching accuracy with the shaft and the bearing base, and etc. The limiting speeds for bearings with grease and oil lubrications (oil gas or oil mist lubrication) given in the samples are for reference only. The speed limit applies to the following conditions:

- (1) Bearing precision: P4 for deep groove ball bearings and angular contact ball bearings.
- (2) Single set of bearings, light preload.
- (3) Under normal installation, the matching of bearing and shaft and bearing base should be appropriate, and the rotation parts should be balanced dynamically.
- (4) Lubricate it with appropriate volume of high quality grease.
- (5) Or lubricate it with high quality oil with appropriate viscosity and adequate volume.
- (6) The bearing can not be over loaded, and operated at the normal operating temperature.

The speed limit given in the samples refers to the maximum speed under ideal conditions; due to the limit from a variety of conditions, the speed in actual uses is generally lower than the value given in the samples.

The limiting speeds of matched bearings should be determined on base of matching mode, pre-load and bearing precision; the limiting speeds should be reduced for use, and the reduced coefficient is shown in the table as follows:

Limiting speed reduction factor

Common group ways	Preload grade	Tolerance grade		
		2	4	5
DT	A	0.99	0.9	0.81
	B	0.88	0.8	0.72
	C	0.7	0.65	0.58
DB、DF	A	0.88	0.8	0.72
	B	0.77	0.7	0.63
	C	0.6	0.55	0.5
TBT、TFT	A	0.77	0.7	0.63
	B	0.6	0.55	0.5
	C	0.38	0.35	0.31
QBC、QFC	A	0.83	0.75	0.68
	B	0.66	0.6	0.54
	C	0.50	0.45	0.41

2.4 Rigidity

Under an external load, the corresponding elastic deformation can be formed in the contact area between the rolling elements and the ring raceway of the bearing, and this capacity to resist the deformation under external load is called as the bearing rigidity.

There are two types of point contact and line contact between the rolling elements and the ring raceway of the bearing under no load; regardless of the contact types, the contact area will be increased with the increase of the load, so the tendency of the two contacted objects is not linear to the load, which means that the bearing rigidity is not a constant, and varies with the load change. In general, with the load increase, the bearing rigidity is also increased.

The angular contact ball bearing is usually used to bear the axial load; the greater the contact angle is, the axial load carrying capacity is stronger and the corresponding axial rigidity is the higher. It can improve the bearing rigidity by applying an appropriate preload. In addition, the matching of angular contact ball bearings can also increase the radial and axial rigidity of the bearing.

For the bearing rigidity, the number of rolling elements have much effect than the bearing size; for the bearings with the same inside diameter, although the diameter of rolling elements in the bearings with the sizes of 18 and 19 is small, the number of rolling elements is large; for the bearings with high radial rigidity, please consult CHG technical department.

Bearing preload and rigidity

The high-speed precision angular contact ball bearing must be pre-loaded axially under normal operating conditions; its main purpose is to improve the rotation accuracy of the bearing, reduce the sliding of rolling elements at high speed, improve the bearing rigidity, reduce the axial and radial runouts of the support, improve the bearing damping, reduce its noise and improve its service life.

4.1 Angular contact ball bearing preload and rigidity

The angular contact ball bearing pre-load is usually divided into light (A), intermediate (B) and heavy (C) levels; if there is the special requirements, CHG can offer the precision bearing with a special preload.

The bearing can be preloaded on the specified position or with specified load, as shown in Fig. 2 and Fig. 3.



Figure 2 Bearing preloaded at the specified position

Unified Service Hotline: +86-379-65793878

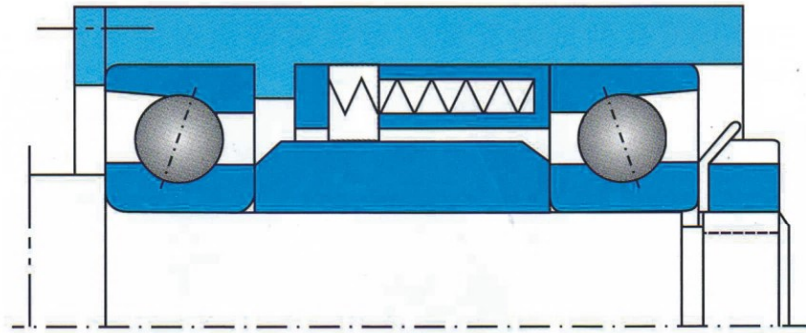


Figure 3 Bearing preloaded with the constant load

In the use of the bearing preloaded on the specified position, the relative position of the parts between the supports is fixed. When the angular contact ball bearing is under high-speed rotation, due to the centrifugal force, the rolling elements have a trend of “Throwing Outside”, which can cause a tendency of relative axial movement formed on the inner and outer rings of the bearing; but because that the location is relatively fixed, this result would increase the bearing preload and the friction heat. In addition, the operating temperature change can also affect the changes of the bearing base size and the two bearing parts, so as to affect the bearing preload. Therefore, when the bearing is preloaded on the specified position, the effect on the bearing performances from the preload change should be noticed.

The preload with a constant load is to use a helical coil spring, disc spring or any other elastic element to preload appropriately the bearing at the support. Because the rigidity of the preload spring is generally much smaller than the bearing rigidity, the preload with the constant load depends on the preload device itself and its value is constant; in addition, the preload degree of bearing support is not affected by the operating temperature.

Generally, the preloading on the specified position can improve the bearing rigidity, and the preloading with constant load is applicable to the bearing with high-speed rotation.

The actual pre-load on the bearing depends on bearing size series, contact angle, size and etc. For specific pre-loads on the angular contact ball bearing back-to-back or face-to-face in pairs and multiple pairs, please consult CHG technical department.

Bearing lubrication

The main purpose of bearing lubrication is to form the lubricant films on the friction surfaces among the rings, rolling elements and cage to reduce bearing friction and wear and prevent sintering, so as to extend the bearing life. In addition, the lubricant use can also prevent the bearing corrosion, reduce its noise and vibration, cool the bearing and prevent the intrusion of foreign matters.

5.1 Grease lubrication

Because it is easy to use and simple to maintain, the grease lubrication has become the most commonly used lubrication method.

The most commonly used roller bearing grease is lithium grease based on mineral oil; the grease has a good adhesion and can play a good lubrication role within the wide temperature and speed ranges. The applicable temperature range is $-30^{\circ}\text{C} \sim +110^{\circ}\text{C}$.

When the high precision bearing is lubricated with the grease, the grease filling volume should be 5% ~ 20% of the free space inside the bearing.

The grease lubricated bearings must run-in in the early, to allow the excess grease to be forced into the bearing raceway, and evenly distributed inside of the bearing, which can ensure the bearing thermal equilibrium temperature is maintained as minimum under normal operation.

The normal running step is to increase the speed successively, and the next stage will start until the bearing temperature is stabilized at the current stage. If there is more stages or the bearing speed limit it too high, the running-in time will be long.

The running-in can be started from 20% ~ 25% of the speed limit, the bearing temperature is stabilized, the speed can be increased until it reaches the limiting speeds and its temperature is stabilized. Particularly, in the run-in process, the bearing temperature should be monitored always; if possible, the temperature on the bearing outer ring should be directly monitored. When the temperature exceeds 60°C , the bearing rotation should stop; until the temperature drops to about 10°C , the rotation can be restarted at the same speed, until the running-in is completed.

The grease should be complemented and replaced in the specified periods. When the grease is filled, it should be noted that different types grease can not be mixed for use; otherwise the grease performances will be decreased. In addition, when replacing the grease, the old grease must be cleaned completely.

5.2 Oil lubrication

When the grease lubrication can not meet the performance requirements of high-speed machines, the oil lubrication can be used.

Bearing assemblies

In order to increase the bearing load capacity and bearing rigidity, two or more angular contact ball bearings are usually matched for use.

In addition that any single bearing in the bearing assemblies from CHG should meet the requirements of relevant dimension tolerances and rotation accuracy, there are strict control requirements for the following several performance parameters between any two bearings in the bearing assemblies:

- (1) Average inner diameter difference between any two bearings.
- (2) Radial runout difference between any two bearing inner rings.
- (3) Average outer diameter difference between any two bearings.
- (4) Radial runout difference between any two bearing outer rings.
- (5) Actual contact angle difference between any two bearings.
- (6) Projection difference between any two adjacent bearings.

7.1 Two-bearing assemblies

The two-bearing assemblies have three forms of back-to-back (DB), face-to-face (DF) and tandem (DT) with the structure and features as follows:

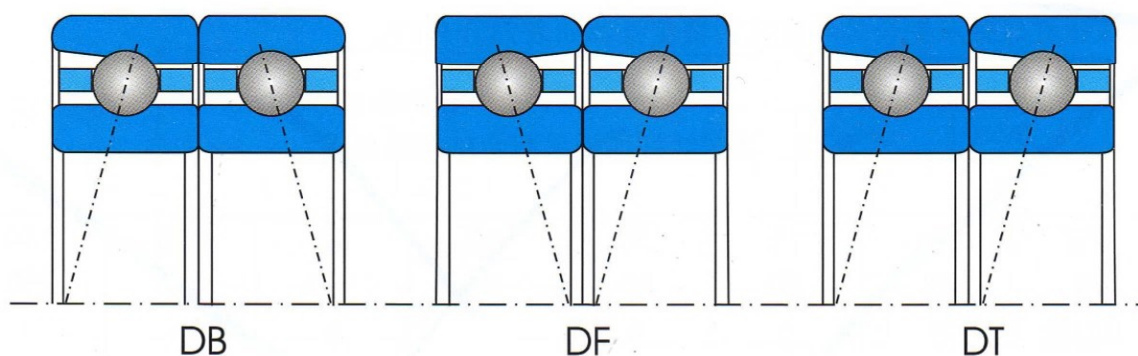


Figure 4 Double configuration of bearing

Features of both bearing assemblies

Form of bearing assemblies	Code	Features
Back-to-back	DB	● Installed symmetrically ● Can bear the radial load ● Can bear the axial load in both directions ● Can bear the high overturning moment
Face-to-face	DF	● Installed symmetrically ● Can bear the radial load ● Can bear the axial load in both directions ● Has a certain self-aligning performance, and a poor ability to bear the overturning moment
Tandem	DT	● The both bearing assemblies are same ● Arranged in the same direction ● Can bear the radial load ● Can bear a greater axial load in one direction

7.2 Multiple-bearing assemblies

In order to obtain higher loading capacity and rigidity, 3, 4, 5 and more angular contact ball bearing assemblies can be used on the machine spindle, among which, the configurations for 3 and 4 bearing assemblies are shown in Fig. 5.

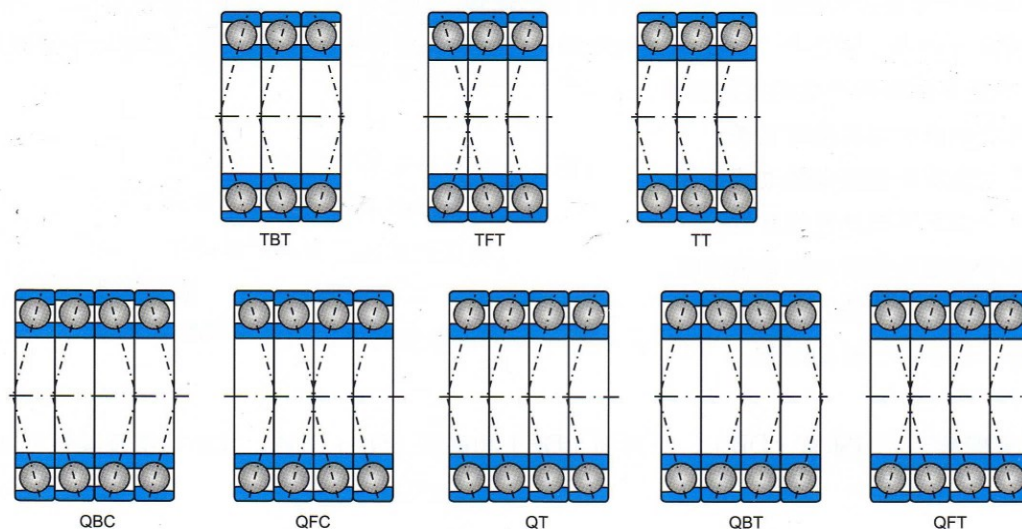


Figure 5 Configuration of common multiple bearing assemblies

For the bearing assemblies, in different load directions, the performances of bearing assemblies are also different. Thus, the bearing assemblies, especially for the bearing assemblies with asymmetrical arrangement, have a fixed installation direction. For this reason, there is the mark “V” in the axial direction on the outer ring of the bearing assemblies; the opening of the mark “V” is against the axial load direction on the inner ring, which means that the corner of the mark “V” is consistent with the axial load direction on the inner ring. If the load on the bearing inner ring is bidirectional, the corner of the mark “V” should be consistent with the bigger axial load direction on the bearing inner ring.

7.3 Various bearing assemblies

In addition to the above bearing assemblies, CHG also offer other various bearing assemblies, with the forms of back-to-back, face-to-face or tandem. The protrusions at both ends of the bearing assemblies should be equal.

Similarly, the preload on various bearing assemblies can be divided into light, intermediate, heavy and special preloads.

Allowable bearing operating temperature

The operating temperature of angular contact ball bearing is related to bearing material, preload, operating load, rotation speed, lubrication method, cooling form and the ambient temperature and etc. Typically, under big load or/and high speed or/and for grease lubricated bearings, the operating temperature is high.

Generally, for the precision angular contact ball bearings from CHG used on machine, the rings can withstand the high temperature of 150℃; if it is equipped with the cage made of high quality phenolic cloth laminated tube, the operating temperature should not exceed 120℃; if it is equipped with the cage made of copper or aluminum, the maximum allowable operating temperature can be up to 150℃.

Typically, if the bearing is not cooled artificially and not impacted by any external heat source, the temperature of inner ring is always higher than the temperature of outer ring, and the temperature of rolling elements is higher than the temperature of inner ring.

Too high temperature will change the internal state of the bearing. During high-speed rotation of the precision angular contact ball bearing, due to the temperature difference between the inner and outer rings, the actual preload on the bearing is greater than its assembling preload, resulting in the bearing wear blocking or damage, so the bearing operating temperature must be controlled.

When oil mist or oil gas is used for lubrication, the bearing operating temperature can be much higher than the grease lubricated bearing based on its lubrication and cooling conditions.

For high temperature bearings, please contact CHG.

Bearing installation sizes

To ensure that the bearing end face can contact with the shoulder, it should be avoided the fillet interferes with the bearing chamfer;

In the determination of shoulder height, not only the full contact with the bearing end face, but also the use of installation and removal tools, should be considered.

For unidirectional maximum radius of shaft and housing and the minimum height of shoulder, please consult CHG technical department.

Bearing installation and adjustment

The machine performance depends largely on the accuracy and dynamic performances of the spindle assembly, which has a direct relationship with the bearing installation and adjustment on the spindle.

During the installation and adjustment process, any precision part with rolling bearings on the machine are particularly sensitive to any improper operation, if it is installed improperly, the bearings may be damaged and the bearing accuracy may be decreased. If it is adjusted inappropriately, there may be low rigidity, high temperature rise, large noise, big vibration and other poor phenomenon. Therefore, there must be the strict procedures for installation and adjustment of precision bearings, and the appropriate installation and adjustment tools must be prepared.

1 Preparations prior to installation

It is recommended to open the package of precision bearings only before installation.

The preparations prior to installation of precision bearings include mainly the following items:

(1) Bearing cleaning

To prevent bearing corrosion occurred in the transportation and storage processes, the precision bearing surface in the package has usually been coated with a thin layer of anti-rust oil. To prevent any adverse lubrication phenomenon caused by the incompatibility between oil or grease with anti-rust oil, it is recommend to clean carefully the precision bearings after opening the package; if the conditions are permitted, the operator can wear disposable plastic gloves, to avoid direct contact with the bearing.

① The bearing cleaning fluid should be clean and high-purity gasoline, preferably for 90# , even for 120# gasoline.

② The bearing cleaning should include two steps. Two clean containers should be prepared, containing enough cleaning solution, and equipped with a metal mat in one container. First, take out the bearing from the package and place it into the container with mat or use a brush to remove the anti-rust oil film on the bearing surface; second, rotate and clean completely the bearing in the other container. It is noted that the cleaning solution should be replaced timely during the cleaning process, to ensure it is clean.

The sealed bearings can not be cleaned, and should be installed directly for use.

③ After cleaning, the bearing should be air-dried or dried; after which the subsequent operations can be performed.

④ If the bearing is lubricated with oil, it should be installed under no rotation condition; if the bearing is lubricated with grease, it should be supplemented with the grease after installation.

⑤ For the smooth installation of bearing, it is recommended to coat a thin layer of lubrication oil on the bearing installation surface.

(2) Grease injection

(2) Grease injection

For grease lubricated bearing, if improper grease is selected or an inappropriate volume is injected or the grease injection method is not correct, the bearing operation, even the service life will be affected; therefore, the grease injection regulations must be prepared strictly.

① Select an appropriate grease and prepare an injection device with a suitable size.

② Fill the specified volume of the grease into the injection device.

③ Use the injection device to inject evenly the grease into the bearing raceway between two adjacent rolling elements. Inject 80% of the specified volume of the grease onto the inner ring raceway, the surfaces of rolling elements and cage pocket surfaces, and the remaining 20% onto the outer ring raceway in the bearing base.

④ Gently rotate the bearing, to evenly distribute the grease on the bearing raceway, cage guiding face, cage pocket surface and surfaces of rolling elements.

2 Precision inspections for relative bearing parts

(1) The matched shaft and the bearing base should be cleaned and there should be no burrs bumps and other defects on the shaft, bearing base and spacer.

(2) Inspect whether the size of shaft and bearing base is matched with the bearing size. See the bearing matching section.

(3) Inspect whether the maximum runout point is marked at the matching position of shaft or bearing base and the bearing.

(4) Check the parallelism at both ends of between the socket and the spacer and the verticality between the end face the shaft centerline, which are usually

controlled within 0.003mm.

3 Bearing installation

Based on the bearing structure, matching conditions with shaft and bearing base, as well as the existing installation conditions, appropriate bearing installation method should be specified. Regardless of the installation methods, the necessary principle is that the rolling elements of the precision bearing can not bear any load during the entire installation process.

There is generally an interference fitting between the bearing inner ring and the shaft, and is a clearance fit or a trace interference fitting between the outer ring and the bearing base.

There are several commonly used methods to install the bearing onto a spindle as follows:

(1) Use of hand-hammer and socket wrench

This method is used for installation of small and medium sized bearings with no too tight fit between the bearing ring and the shaft journal or the housing. When selecting a socket, its size should correspond with the size of the bearing ring. For the installation of inner ring, the inner diameter of the socket should be slightly bigger than the spindle diameter; for the installation of outer ring, the outer diameter of the socket should be slightly smaller than the housing diameter. Do not allow to tap the outer ring for installation of the inner ring or tap the inner ring for installation of the outer ring; otherwise, the impact force will be transmitted from one ring to the other ring through the rolling elements and the raceway, resulting in damage to the raceway and rolling elements. If there is an interference fit between the inner or outer ring of the separation bearing and the shaft journal or the housing, the end face of the socket should simultaneously contact with the end faces of inner and outer rings, and the end face of the socket must be flat and perpendicular to the centerline of the socket.

(2) Use of pressure device

The pressure devices used for this installation method include mainly presser, pressing machine, hydraulic fixtures and hydraulic nut and etc. the characteristic of this method is that the bearing can avoid the direct tapping effect, so the bearing less susceptible to damage; however, with this method, the pressure line must be coincided with the bearing centerline, to prevent the bearing tilting.

(3) Use of heating installation method

If there is a big interference fit for the bearing, it will be difficult for the installation with a pressing device and will be easy to damage the mating surface of the bearing, so, the bearing can be more easily installed into the spindle only the bearing inner ring is expanded by heating.

The current heating installation method is often to use a magnetic induction heater to heat the bearing inner ring.

The heating temperature of the bearing should not exceed 120℃, and the specific heating temperature should depend on the sizes of bearing and its interference fitting.

When the bearing is heated, the bearing outer ring width will be increased, after it is cooled, there may be axial clearance between the bearing and the shaft shoulder, but interference fitting between the bearing and the spindle; so, with the heating installation method, after the bearing is cooled, the axial clearance between the bearing and the shaft shoulder should be eliminated with a nut or other suitable method.

(4) Pressure oil injection onto the matching surfaces

If there is an interference fit between the shaft and the bearing, the friction between the mating surfaces will be very big; if the interference fit is large, the mating surfaces may be damaged. If the pressure oil is injected between the mating surfaces, to form a thin layer of oil film and allow a slight modification of the two mating parts, the friction between the mating surfaces will be greatly decreased. Thus, a small force can drive the relatively sliding of two mating parts.

4 Installation of angle contact ball bearing assemblies

The single row angular contact ball bearing can bear an axial load in one direction, therefore, during the installation or removal process, the load direction on the bearing must be noticed. Fig. 6 shows the load directions on angular contact ball bearings with different structure.

For back-to-back and face-to-face installations of the bearing assemblies, the preloading clearance positions are different, so the pressing position of bearing assemblies must be noticed, as shown in Fig. 7.

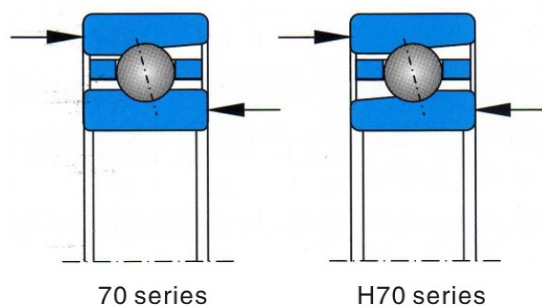


Figure 6 Load direction of angular contact ball bearing

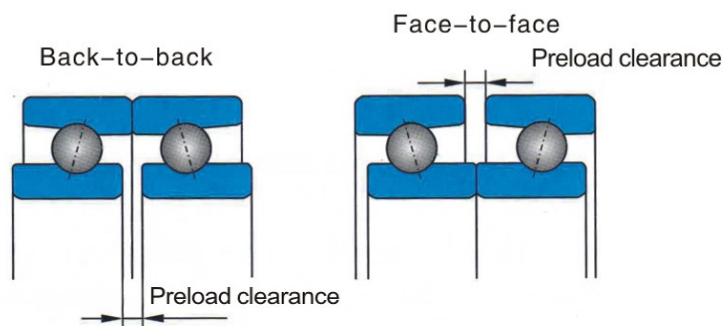


Figure 7 Preloaded clearance of two bearing assemblies

In addition, in order to ensure the smooth rotation of the spindle assembly, it is recommended to install the precision bearings in the specified direction as possible. There are the maximum radial runouts of inner and outer rings marked separately on the end faces of inner and outer rings of CHG precision angular contact ball bearing. During the bearing installation, firstly, align separately the maximum radial runout positions of inner and outer rings on the same bearing assemblies in the shaft direction; secondly, adjust the circumferential position of bearing assemblies to allow the maximum radial runout positions on the bearing inner ring and the spindle journal in a radial symmetry state when the bearing is installed onto the spindle; similarly, to allow the maximum radial runout positions on the bearing outer ring and the spindle journal in a radial symmetry state; finally, preload the bearing assemblies according to the design requirements.

4.1 Back-to-back installation of bearing assemblies

- (1) Adjust the maximum radial runout position on the bearing inner ring, and install the bearing onto the specified position of the spindle.
- (2) Tighten the locking nut, and apply the preload on the bearings.
- (3) Adjust the circumferential position of bearing outer ring, install the spindle assembly into the bearing base, and then install the end cover and etc.

4.2 Face-to-face installation of bearing assemblies

- (1) Adjust the maximum radial runout position on the bearing outer ring and install the bearing into the specified position of the bearing base.
- (2) Install the end cover and apply the preload on the bearings.
- (3) Install the spindle into the bearing inner ring, tighten the lock nut and then perform subsequent operations.

5 Bearing fastening

5.1 inner ring fastening

In order to fasten the bearing inner ring onto the spindle, the thread is generally designed on the spindle, and the bearing is located with a nut. The verticality between the thread shaft on the nut and the end face and the thread mating precision are very important; if the manufacturing precision of nut is not high, the locked nut will be tilted, leading easily to the spindle bending and uneven bearing preload, which will direct impact the rotation accuracy, rigidity and load capacity of the bearing. Therefore, in order to ensure the spindle rotation accuracy, the lock nut must be adjusted and fastened, to prevent any loosening.

Corresponding to different preloads, the locking force applied on the bearing lock nut should be determined with the test under the actual operating conditions.

In order to eliminate or reduce the impact from part positioning resistance during the installation process, it is recommended to tighten the lock nut with 2–3 times of the normal tightening force, and then loosen and re-tighten and lock it with the normal locking force.

If a lock nut is used, the thread must be processed on the spindle, a high-precision nut must be matched, and the rotation imbalance must be formed from the lock nut. For these reasons, on many spindles of high-speed precision CNC machine tools or machining centers, the assemblies with an interference fit are used as the axial positioning elements of the bearing onto the spindle. For the uses of related assemblies with interference fits, please contact with CHG.

5.2 Outer ring fastening

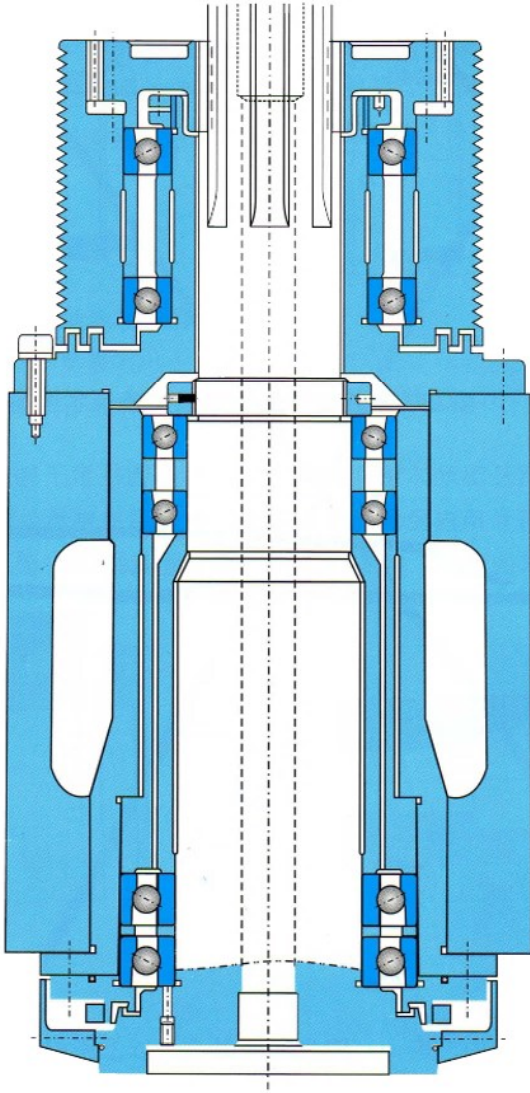
Most of the bearing outer rings are positioned in the housing with the tightening bolts on the end cover; if the bolt tightening force is too large or the force applied on the end cover is uneven, the bearing outer ring raceway will be easy to produce a deformation. Therefore, the tightening force of the bolts must be controlled. In addition, to ensure the correct positioning of the bearing outer ring, the axial preload clearance between the compressed end cover and the bearing base end face must also be controlled.

Example of bearing installation on machine tool

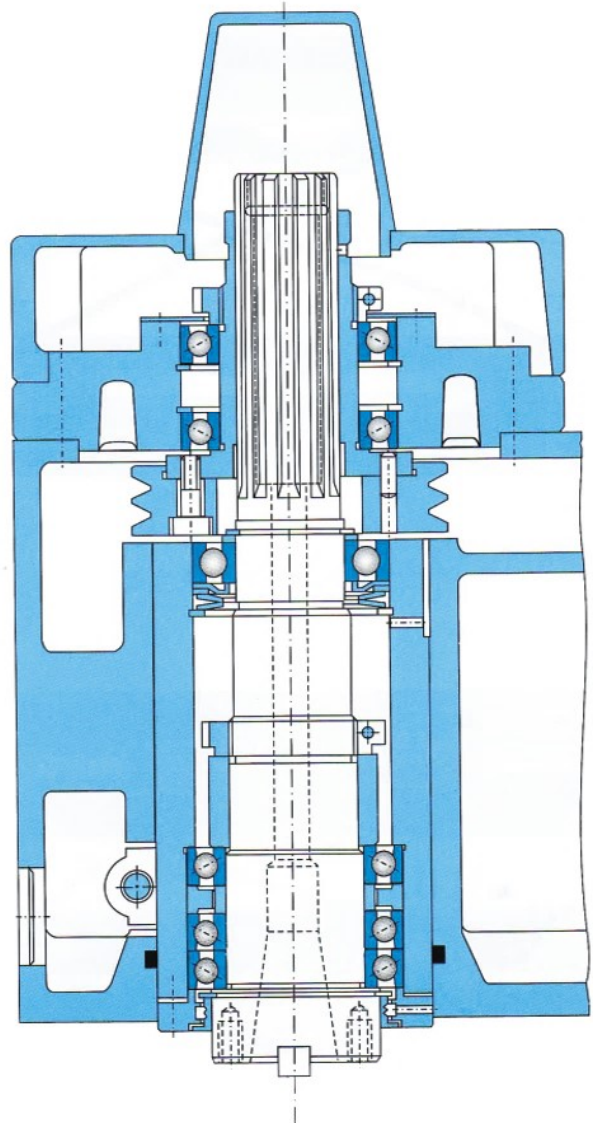
Typically, the most basic requirements for the spindle are as follows:

- | | |
|------------------------------|--------------------------|
| (1) High rotation precision; | (2) High rotation speed; |
| (3) Wide speed range; | (4) High rigidity; |
| (5) Low temperature rise; | (6) High reliability. |

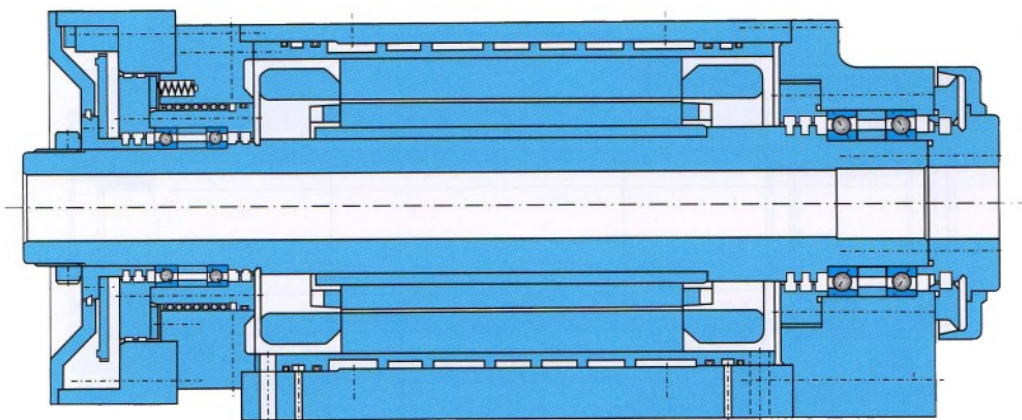
There are some conflicts among the above requirements; therefore, it is almost impossible to meet all these requirements for the spindle. So, in the design of the spindle support structure, the main performances of the machine should be considered. Based on different performances of the machine tool, different types of bearing and forms of bearing assemblies can be selected as the support structure for the spindle.



Vertical lathe spindle

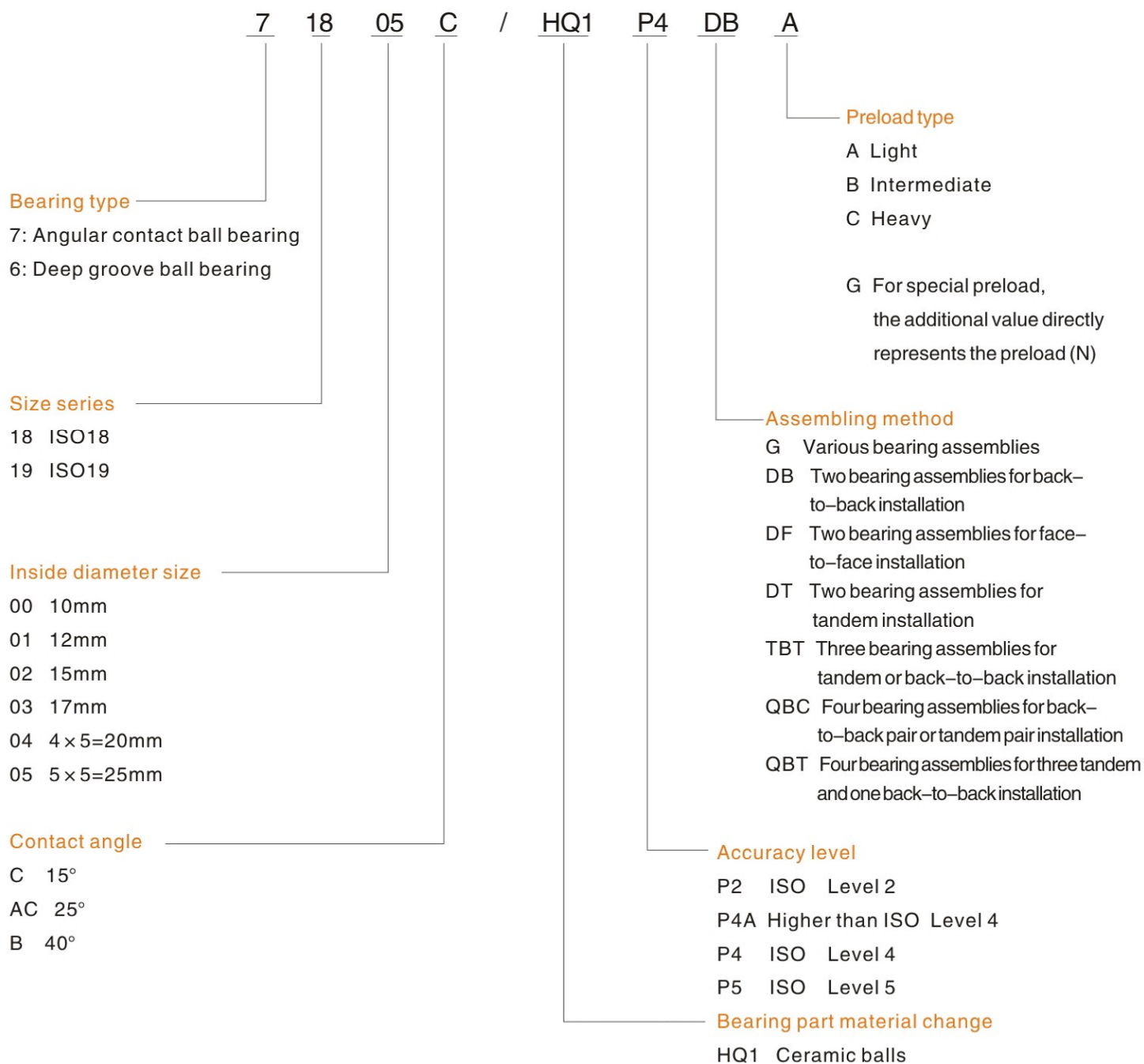


Vertical high speed milling spindle

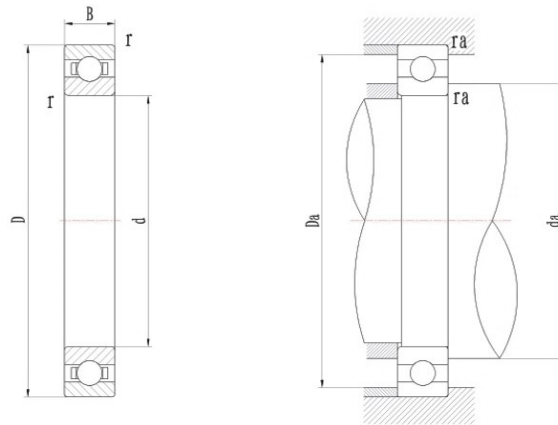


Vertical high speed milling spindle

Example of light series bearing code

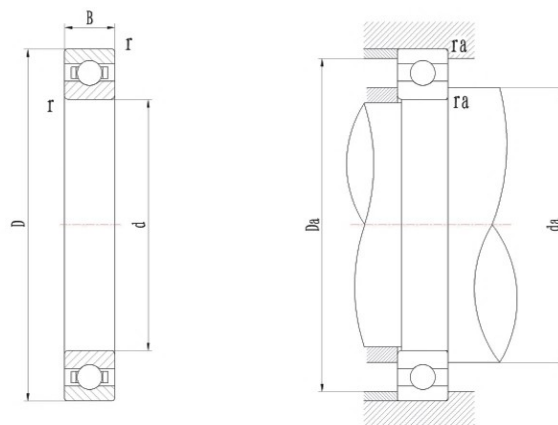


Deep groove ball bearing



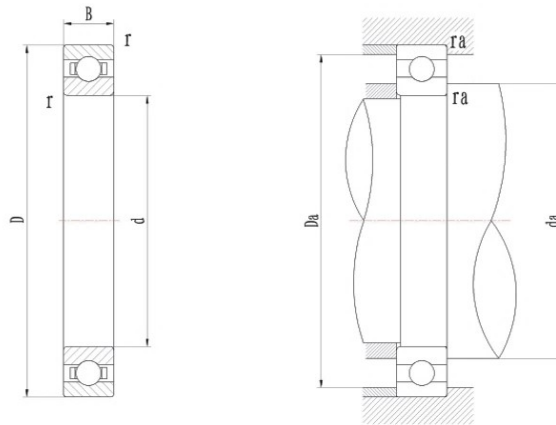
Dimensions				Basic Load Rating		Designation	Weight	Installation Size			Limiting Speed	
mm				kN			kg	mm			r/min	
d	D	B	r _{min}	Cr	Cor			d _{amin}	D _{amax}	r _{amax}	Grease	Oil
100	125	13	1	19.6	21.2	61820	0.31	105	120	1	4800	5700
	140	20	1.1	45	41.9	61920	0.96	106.5	133.5	1	4500	5300
110	140	16	1	28.1	30.7	61822	0.61	115	135	1	4300	5100
	150	20	1.1	47.9	47.8	61922	1.04	116.5	43.5	1	4100	4900
120	150	16	1	29.0	33.0	61824	0.66	125	145	1	4000	4700
	165	22	1.1	57.2	56.9	61924	1.41	126.5	158.5	1	3800	4400
130	165	18	1.1	36.9	41.2	61826	0.94	136.5	158.5	1	3600	4300
	180	24	1.5	69.6	70.0	61926	1.86	138	172	1.5	3400	4100
140	175	18	1.1	38.2	44.4	61828	1.0	146.5	168.5	1	3400	4000
	190	24	1.5	71.3	74.8	61928	1.98	148	182	1.5	3200	3800
150	190	20	1.1	49.1	58.5	61830	1.15	156.6	183.5	1	3000	3600
	210	28	2	85	90.5	61930	2.59	159	201	2	2800	3400
160	200	20	1.1	48.5	61	61832	1.23	166.5	193.5	1	2800	3400
	220	28	2	87	96	61932	2.71	169	211	2	2600	3200
170	215	22	1.1	61.5	78	61834	1.9	176.5	208.5	1	2600	3200
	230	28	2	88.8	100	61934	2.85	179	221	2	2400	3000
180	225	22	1.1	62.3	78.5	61836	1.72	186.5	218.5	1	2400	3000
	250	33	2	119	133	61936	4.16	189	241	2	2200	2800
190	240	24	1.5	75.1	93.5	61838	2.53	198	232	1.5	2200	2800
	260	33	2	117	133	61938	5.18	199	251	2	2200	2800
200	250	24	1.5	74	98	61840	2.67	208	242	1.5	2200	2800
	280	38	2.1	149	168	61940	7.28	211	269	2	2000	2600
220	270	24	1.5	76.5	97.8	61844	2.9	228	262	1.5	1900	2400
	300	38	2.1	152	178	61944	7.88	231	289	2	1900	2400
240	300	28	2	83.5	108	61848	4.48	249	291	2	1800	2200
	320	38	2.1	154	190	61948	8.49	251	309	2	1800	2200
260	320	28	2	101	148	61852	4.84	269	311	2	1700	2000
	360	46	2.1	210	268	61952	14	271	349	2	1600	1900
280	350	33	2	133	191	61856	7.2	289	341	2	1600	1900
	380	46	2.1	209	272	61956	15.1	291	369	2	1500	1800

Deep groove ball bearing



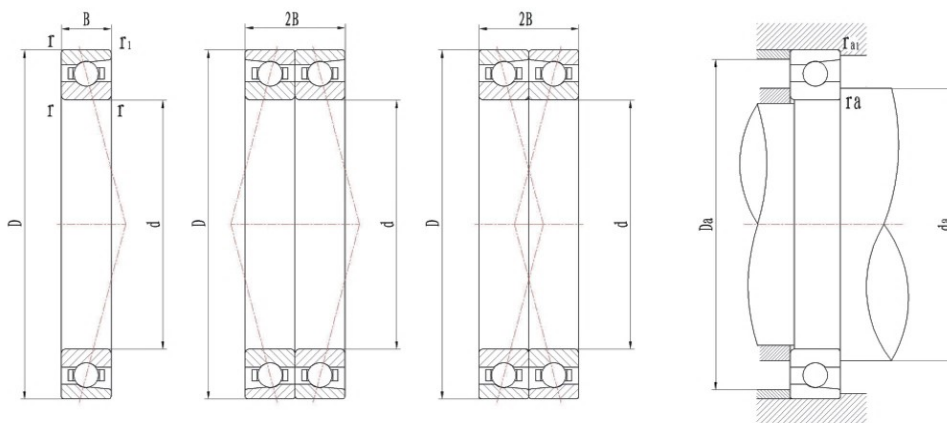
Dimensions				Basic Load Rating		Designation	Weight	Installation Size			Limiting Speed	
mm				kN			kg	mm			r/min	
d	D	B	r _{min}	Cr	Cor			d _{amin}	D _{amax}	r _{amax}	Grease	Oil
300	380	38	2.1	166	233	61860	10.3	311	369	2	1400	1700
	420	56	3	270	375	61960	24.5	313	407	2.5	1300	1600
320	400	38	2.1	168	244	61864	10.8	331	389	2	1300	1600
	440	56	3	275	392	61964	25.3	333	427	2.5	1200	1500
340	420	38	2.1	175	265	61868	11.5	351	409	2	1200	1500
	460	56	3	292	418	61968	26.6	353	447	2.5	1100	1400
360	440	38	2.1	192	290	61872	11.8	371	429	2	1100	1400
	480	56	3	280	425	61972	27.9	373	467	2.5	1100	1400
380	480	46	2.1	238	375	61876	19.5	391	469	2	1000	1300
	520	65	4	338	540	61976	40	425	475	3	1000	1300
400	500	46	2.1	241	390	61880	20.5	411	489	2	1000	1300
	540	65	4	335	540	61980	42	416	524	3	950	1200
420	520	46	2.1	245	410	61884	21.4	431	509	2	950	1200
	560	65	4	340	570	61984	43.6	436	544	3	900	1100
440	540	46	2.1	249	425	61888	22.3	451	529	2	900	1100
	600	74	4	395	680	61988	60.2	456	584	3	900	1100
460	580	56	3	310	550	61892	34.3	473	567	2.5	900	1100
	620	74	4	405	720	61992	62.6	476	604	3	850	1000
480	600	56	3	315	575	61896	35.4	493	587	2.5	850	1000
	650	78	5	450	815	61996	73.5	500	630	4	800	950
500	620	56	3	320	600	618/500	37.2	513	607	2.5	800	950
	670	78	5	460	865	619/500	82	520	650	4	750	900
530	650	56	3	325	625	618/530	39.8	543	637	2.5	750	900
	710	82	5	455	870	619/530	89.8	550	690	4	750	900
560	680	56	3	330	650	618/560	41.5	573	667	2.5	700	850
	750	85	5	525	1040	619/560	105	580	730	4	670	800
600	730	60	3	355	735	618/600	50.9	613	717	2.5	670	800
	800	90	5	550	1160	619/600	120	620	780	4	630	750

Deep groove ball bearing



Dimensions				Basic Load Rating		Designation	Weight	Installation Size			Limiting Speed	
mm				kN			kg	mm			r/min	
d	D	B	r _{min}	Cr	Cor			d _{amin}	D _{amax}	r _{amax}	Grease	Oil
630	780	69	4	420	890	618/630	71.3	646	767	3	630	750
	850	100	6	625	1350	619/630	163	654	826	5	600	700
670	820	69	4	435	965	618/670	75.4	686	807	3	560	670
	900	103	6	675	1460	619/670	181	694	876	5	530	630
710	870	74	4	480	1100	618/710	92.6	726	854	3	530	630
	950	106	6	715	1640	619/710	220	734	926	5	500	600
750	920	78	5	525	1260	618/750	110	770	900	4	500	600
	1000	112	6	785	1840	619/750	245	774	976	5	480	560
800	980	82	5	530	1310	618/800	132	820	960	4	450	530
	1060	115	6	825	2050	619/800	275	824	1036	5	430	500
850	1030	82	5	559	1430	618/850	140	868	1012	4	410	470
	1120	118	6	832	2160	619/850	310	873	1090	5	380	440
900	1090	85	5	618	1532	618/900	160	920	1070	4	350	410
	1180	122	6	852	2280	619/900	350	923	1157	5	320	380
950	1150	90	5	637	1730	618/950	190	968	1132	4	290	350
	1250	132	6	1010	2800	619/950	390	978	1222	5	260	320

Angular contact ball bearing

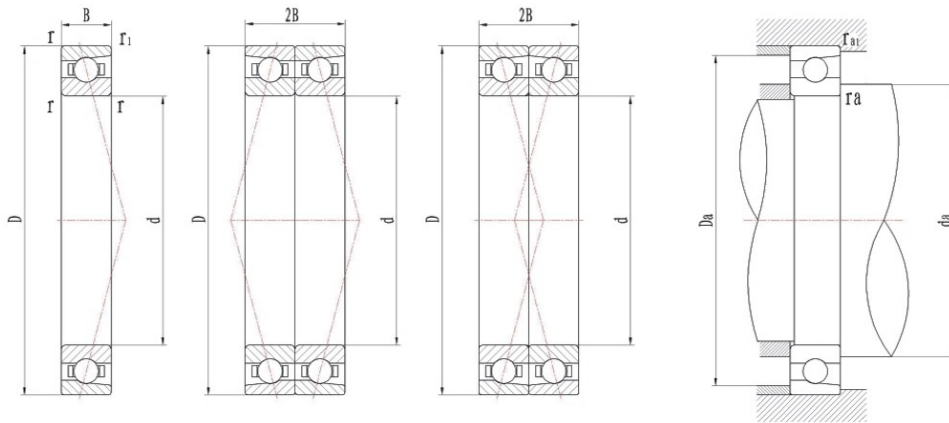


Dimensions					Basic Load Rating		Designation	Weight	Installation Size				Limiting Speed	
mm					kN			kg	mm				r/min	
d	D	B	r _{min}	r _{1min}	Cr	Cor			da	Da	r _a	r _{a1}	Grease	Oil
100	128	13	1	0.3	21.2	27.5	71820	0.2	104.6	120.4	1	1	8500	13000
	140	20	1.1	0.6	60.6	65.5	71920	0.8	106	134	1	1	8500	14000
110	140	16	1	0.3	31.9	40.5	71822	0.51	114.6	135.4	1	1	8000	13000
	150	20	1.1	0.6	62.4	72	71922	0.86	116	144	1	1	8000	13000
120	150	16	1	0.3	33.2	45	71824	0.55	124.8	145.4	1	1	7500	12000
	150	20	1.1	0.6	24.7	25.5	71924	1.15	116	144	1	1	10000	15000
130	165	18	1.1	0.6	39	53	71826	0.7	136	159		1	7000	11000
	180	24	1.5	0.6	92.3	108	71926	1.55	137	173	1.5	1.5	7000	11000
140	175	18	1.1	0.6	44.9	62	71828	0.8	146	169	1	1	6300	10000
	190	24	1.5	0.6	95.6	116	71928	1.65	147	183	1.5	1.5	6700	10000
150	190	20	1.1	0.6	53.5	74.5	71830	1.32	156	184	1	1	6300	9500
	210	28	2	1	90	120	71930	3	160	200	2	1	6300	9500
160	200	20	1.1	0.6	54	78	71832	1.25	166	194	1	1	5600	8500
	220	28	2	1	109	129	71932	3	170	210	2	1	6000	9000
170	215	22	1.1	0.6	80	110	71834	2	175	210	1	1	5600	8500
	230	28	2	1	110	140	71934	3.3	179	221	2	2	5600	8500
190	260	33	2	1	139	177	71938	4.45	199	255	2	2	5000	7500

Note: 1. Rate and speed in the catalogue is changed with the change of contact angle, please consult CHG technical department.

2. Our company can also produce diameter series 7 bearings (Super thin-section), please consult CHG technical department.

Angular contact ball bearing

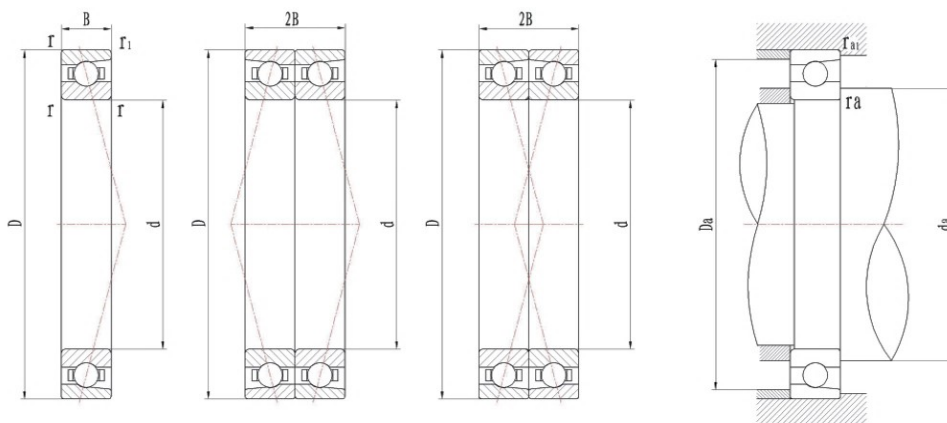


Dimensions					Basic Load Rating		Designation	Weight	Installation Size				Limiting Speed	
mm					kN			kg	mm				r/min	
d	D	B	r _{min}	r _{1min}	Cr	Cor			da	Da	r _a	r _{a1}	Grease	Oil
200	250	24	1.5	1	90	130	71840	2.5	208.5	241.5	1.5	1	4300	6000
	280	38	2.1	1.1	150	210	71940	7.1	212	268	2	1	4300	6000
220	270	24	1.5	1	151	263	71844	2.5	228.5	261.5	1.5	1	3800	5600
	300	38	2.1	1.1	200	250	71944	7.2	232	288	2	1	3800	5600
240	300	28	2	1	128	175	71848	4.1	250	290	2	1	3200	4800
	320	38	2.1	1.1	203	285	71948	8.37	252	308	2	1	3200	4800
260	320	28	2	1	127	190	71852	4.85	270	310	2	1	1400	1900
	360	46	2.1	1.1	242	345	71952	13.5	272	348	2	1	1300	1800
280	350	33	2	1	140	216	71856	7.2	290	340	2	1	1200	1700
	380	46	2.1	1.1	226	337	71956	15	292	368	2	1	1100	1600
320	400	38	2.1	1.1	190	290	71864	10	332	388	2	1	800	1000
	440	56	3	1.1	350	550	71964	25.5	334	426	2.5	1	800	1000
340	460	56	3	1.1	292	510	71968	27.5	354	446	2.5	1	800	1000
	440	38	2.1	1.1	219	345	71872	11.1	372	428	2	1		
360	480	56	3	1.1	350	600	71972	29					800	1000
	480	46	2.1	1.1	261.9	450	71876	18	392	468	2	1	1700	2400
380	520	65	4	1.5	369	661.5	71976	40.5	395	505	3	1	850	1200
	500	46	2.1	1.1	292	501	71880	19.5	412	488	2	1		
400	540	65	4	1.5	380.7	702	71980	42	415	525	3	1	800	1100

Note: 1. Rate and speed in the catalogue is changed with the change of contact angle, please consult CHG technical department.

2. Our company can also produce diameter series 7 bearings (Super thin-section), please consult CHG technical department.

Angular contact ball bearing



Dimensions					Basic Load Rating		Designation	Weight	Installation Size				Limiting Speed	
mm					kN			kg	mm				r/min	
d	D	B	r _{min}	r _{1min}	Cr	Cor			d _a	Da	r _a	r _{a1}	Grease	Oil
420	520	46	2.1	1.1	294	513	71884	20.4	432	508	2	1	750	1000
	560	65	4	1.5	327	603	71984	44.5	435	545	3	1	700	950
440	540	46	2.1	1.1	301	540	71888	21.1	452	528	2	1	750	1000
	600	74	4	3	456.3	936	71988	61	455	585	3	1	750	1000
460	580	56	3	3	334	689	71892	34.5	474	566	2.5	1	850	1000
	620	74	4	1.5	456	936	71992	58	475	605	3	1	750	900
480	600	56	3	1.1	415	820	71896	35.5	494	686	2.5	1	850	1200
500	620	56	3	1.1	351	765	718/500	38	514	606	2.5	1	670	900
530	670	78	5	2	498	1098	719/500	78	518	652	4	1	630	850
	650	56	3	1.1	369	837	718/530	39.5	544	636	2.5	1	1100	1600
560	710	82	5	2	556	1206	719/530	92	558	692	4	1	1000	1500
	680	56	3	1.1	341	837	718/560	41.5	574	666	2.5	1	600	800
600	750	85	5	2	533	1161	719/560	105	578	732	4	2	560	750
	730	60	3	1.1	421	1044	718/600	47	614	766	2.5	1	560	750
630	800	90	5	2	644	1557	719/600	125	618	782	4	2	900	1300
	780	69	4	1.5	518	1160	718/630	69.7	648	715	3.1	1.5		
670	820	69	4	1.5	498	1161	718/670	77	688	802	3	1.5	850	1200
710	870	74	4	1.5	546	1467	718/710	93.5	725	855	3	1	800	1100
750	950	106	6	3	767	1980	719/710	195	733	927	5	2	800	1100
	920	78	5	2	585	1620	718/750	110	768	902	4	2	400	530
850	1030	82	5	2	620	1674	718/850	140	868	1012	4	2	340	450

Note: 1. Rate and speed in the catalogue is changed with the change of contact angle, please consult CHG technical department.

2. Our company can also produce diameter series 7 bearings (Super thin-section), please consult CHG technical department.

CHG[®] LUOYANG HUIGONG BEARING TECHNOLOGY CO., LTD.

ADD: No.19, Guanlin West Road, Luoyang City, Henan province, China

Code: 471023

Tel: +86-379-65793878

Fax: +86-379-65793877

E-mail: lyhg@lyhgbearing.com