CSC Bearing Europe GmbH

SUPER PRECISION BEARINGS

TECHSPEC

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SPBTS-V1/2021

CSC TECHSPECS

CSC Bearing Europe GmbH

R&D Center in Wiesentheid
Technical Support
Sales & Marketing

Application Engineering
Testing & Measurement Lab
Warehousing & Logistics

www.csc-bearing.eu

Welcome to CSC in Europe

CSC is a global manufacturer of bearings with a turnover of almost 100 Mio USD woldwide. As a certified supplier in all areas of industry CSC is looking back on more than 50 years of successful corporate history.

In our own 130.000 m² plant we are producing high performance bearings with a quality according to European standards for all fields of industry. A 2nd factory with another 25.000 m² will be finished by the end of 2021 - focusing mainly on super precision bearings.

As a reliable producer, we permanently monitor and audit all processes to guarantee highest quality. CSC production is certified according to DIN-EN-ISO 9001:2000 and ISO/TS 16949:2002.

CSC bearings are used by famous producers of drives, gearboxes, main spindles, machine tool spindles, machines for construction, etc.

For super precision bearings like the series B719xx, B70xx, B72xx as well as HCB – hybrid version and NN30xx we are continuously enlarging the stock in our European CSC Headquarter to realize short delivery times. With focus on the machine tool industry we also have ball screw support bearings of the series BSB, 760xx, ZKLN/ZKLF and ZARN/ZARF as well as bearings for rotary tables and spindle heads (comparable to YRT) in our product program.

A own R&D center and a warehouse in Germany guarantee high performance, great support, fast logistics, maximal comfort and the highest level of support for you as a customer. Not just bearings – CSC offers a variety of engineering services to support the development of perfect solutions for customer's needs.

Designed in Germany

In recent years, CSC has transferred the design and construction – especially of spindle bearings - to Germany. German engineers with decades of experience in bearing-design develop products for the world market. CSC products follow the DIN ISO guidelines in order to achieve fast testing and approval processes at the customer's site.

Besides the design feature "made in Germany", good equipment is also very important. CSC buys production and testing equipment from leading manufacturers such as G&N, Thielenhaus, Hembrug or AICHELIN, to name just a few. High performance equipment is essential for CSC to produce continuously high quality and meet international standards.

CSC what can we do for you?

Fast delivery times, low minimum order quantities, and customized bearing designs are always possible at CSC.

These include special seals, customer-specific materials, a variety of different greases as well as more complex adjustments such as individual ring shapes or special contact angles for angular contact ball bearings.

Continuous development and optimizations are firmly established processes at CSC. Our standard are bearings with low noise level, reduced friction and maximum efficiency to contribute to more energy-saving applications, for example.

AVAILABILITY

In our European warehouse, located in Germany, we have many items available from stock. Shipment all around Europe with super fast parcel services.

Please ask for our stock list or subscribe to our monthly stock mail.

Technical Support

Customized Solutions

High Availability

In order to ensure a comprehensive quality control, the measuring equipment was "mirrored": Identical high-precision measuring instruments are used in production in Asia as well as in the CSC Center in Germany.

The success of the investment in quality is evident from the comprehensive certifications. In addition to DIN ISO 9001, DIN ISO 14001, CSC is also certified to IATF 16949, AS9100D and AS9104/1:2012.

CSC Highest Precision

CSC LAB GERMANY

Product range | Dimensions | Materials

Highest quality at attractive prices.

CSC manufactures from a bore of 10 mm up to an outer diameter of 300 mm.

Different materials such as GCr15 / 100Cr6, 440C, 420 or Cronidur are available at CSC. The main focus is on precise, low-noise bearings with high load ratings that are used in many industrial applications such as electric motors, gears, motor spindles or in robotics.

Deep groove ball bearings, the series 60..., 62..., 63. . ., angular contact ball bearings, ball screw support bearings as well as rotary table bearings are also part of the product portfolio.

Focus on super precision bearings

A major focus is in the area of spindle bearings. Especially for the European market there is a comprehensive stock of immediately available items.

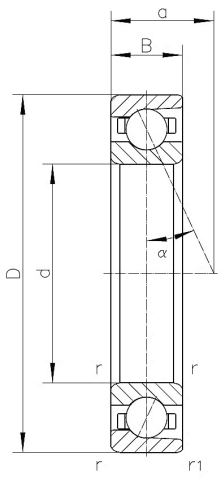
The series B70xx, B72xx, B718xx, B719xx are offered with steel as well as with ceramic balls (HCB70xx, HCB72xx, HCB718xx, HCB719xx) as open and sealed versions.

ZKLF, ZKLN, ZKLFA, ZARN, ZARF and bearings of series NN complete the product portfolio in the field of super precision bearings.

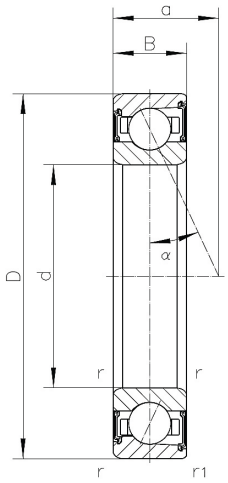
CSC supplies to well-known international companies and is worldwide known as a reliable partner in terms of quality and delivery reliability.

2021 New additional CSC factory for super precision bearings

Super Precision Angular Contact Ball Bearings



Open Version



RSD / HSS / HCS Version (Sealings)

CSC spindle bearings are available as open and sealed version

RSD = Sealed version for B and HCB series
HSS = Sealed version with small steel balls (highspeed)
HCS = Sealed version with ceramic balls (highspeed)

All table show open version
Values are identical for sealed (RSD / HSS / HCS) bearings
Speed limits are identical to open version with grease

Datasheets for RSD items are available on request

Information on our labels

All spindle bearings boxes have labels with additional information. Same informations can be found on the bearing rings.

B71905-E-T-P4S-UL 123456
ID -3
OD -2 / -75 / -1

ID: actual deviation of nominal bore diameter in µm
OD: actual deviation of nominal outer diameter in µm
2nd Nr.: actual deviation of width in µm
3rd Nr.: actual deviation from nominal projection in µm

Packaging and marking

CSC Spindlebearings are single packed for UL versions
Sets of bearings arrangements are welded
Marking and tolerances can be found on the bearing and the box-label

Super Precision Angular Contact Ball Bearings (ACBB)

CSC super precision angular contact ball bearings (spindle bearings) are designed for highest accuracy applications, lowest noise-level and low-vibration. Due to the angular contact design they can take high axial forces from one direction as well as radial forces and can be installed in bearing arrangements to withstand axial forces from both sides.

CSC spindle bearings are available with three different contact angles:

C = 15° for higher radial loads
D = 18° for higher radial loads
E = 25° for higher axial loads

Customized contact angles can be produced on request.

CSC spindle bearing dimensions are produced in P4S as standard quality (B718.. series in P4).
Higher levels like P2 or special requests like K5 are also available.

Bearing materials

The performance and reliability required from high-precision bearings implies the use of adequate materials for rings, rolling elements and cages.

All-steel bearings
Steels used for high-precision bearing rings and rolling elements are capable of being adequately hardened and have high fatigue strength and wear resistance. Moreover they have the structural and dimensional stability to satisfy the spindle operating temperatures. CSC high-precision bearing rings and rolling elements are generally made of through-hardened carbon chromium steel

Hybrid Bearings
Machine tools, especially machining centers, can have higher machining efficiencies and higher machining accuracies when operated at higher speeds. For this reason, there have been ever-greater demands for higher speed performance of their spindle bearings. If the performance required is close to all-steel bearing limits, or if higher rigidity or longer life are needed, hybrid high precision bearings can be used. Hybrid high-precision bearings consist of outer and inner rings made of bearing steel and ceramic (silicon nitride Si3N4) rolling elements.

Comparing with steel rolling elements, ceramic rolling elements have following benefit :
- Lower heat generation
- A density as light as 40% of bearing steel, thus centrifugal forces of rolling elements is reduced
- The thermal expansion is lower
- A great rigidity, which is more suitable for machine tools
- Better resistance to damage

Due to these reasons, the service life of the bearings is extended.

Material for cages

The main purpose of the cage is to keep the rolling elements at an appropriate distance from each other and to prevent immediate contact between two neighbouring rolling elements, in order to keep friction and consequently heat generation at a minimum. Materials and the shape of cages for high-precision bearings have been developed parallel to the development of the bearings and to the requirements they have to satisfy.

High-precision bearing cages are mechanically stressed by frictional strain and inertia forces. They might also be subjected to chemical action of certain lubricants and the influence of usage temperature. Thus, the design and choice of material are of paramount importance for the performance of the cage, as well as for the operational reliability of the bearing as a whole.

Phenolic resin cage

This material is lightweight resulting in minimal centrifugal forces and having the capability of retaining part of the lubricant, ensuring optimum lubrication. Fabric reinforced phenolic resin cages should not be used at temperatures exceeding 80°C for a long term. It can be able to bear the instantaneous temperature of 120 degrees. Phenolic cages have a very good high-speed capability.

Engineered polymers

They are used for high temperature resistance having good self-lubricating property and lower friction.

Numbering system

Design

B = Steel balls
HS = Small steel balls
HSS = Small steel balls sealed version

HCB = Ceramic balls
HC = Small ceramic balls
HCS = Small ceramic balls sealed version

XCB = Chronidur steel with ceramic balls
XC = Chronidur steel with small ceramic balls

Bearing type

7 = Angular contact ball bearing

Dimension

18 = Extra light series
19 = Light series
0 = Medium series
2 = Heavy series

Bore dimension

00 = 10 mm
01 = 12 mm
02 = 15 mm
03 = 17 mm
04 = 4 x 5 = 20 mm

Preload

L = Light preload
M = Medium preload
H = High preload

Arrangement symbol

U = Universal arrangement
DB = Two bearing back to back
DT = Two bearing in tandem
DF = Two bearing face to face
TFT = Three bearing / face to face + tandem
TBT = Three bearing / back to back + tandem
More information "Bearing Arrangement table"

Accuracy symbol

P2 / P4 / P4S
According to the referring ISO classes

Cage

T = Outerring guided phenolic cage

Contact Angle

C = 15 degree
D = 18 degree
E = 25 degree

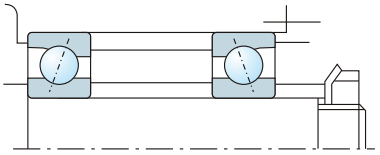
RSD / 2RSD = Non friction sealings

Preload

Depending on the application, it is necessary to have a positive or a negative operational clearance in a bearing arrangement. In the majority of high precision bearing applications a negative operational clearance i.e. a preload is desirable in order to enhance the stiffness of the bearing arrangement, or to increase the running accuracy. The application of a preload is also recommended where bearings are to operate without load, or under very light load and at high speeds. In such cases the preload serves to guarantee a minimum load on the bearing and thus prevents bearing damage resulting from sliding movements.
Depending on the type of bearing the preload may be either radial or axial. Cylindrical roller bearings can only be radial preloaded and thrust ball bearings can only be axially preloaded. The distance between the pressure centres of two angular contact ball bearings is longer when the bearings are arranged back-to-back and shorter when they are arranged face-to-face. This means that the bearings arranged back-to-back can accommodate large tilting moments even if the distance between bearing centres is relatively short.

Preloading methods

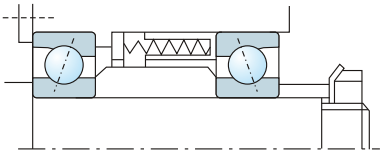
Position preload



A position preload is achieved by fixing two axially opposed bearings in a position that remains unchanged while in operation.
a) preload
b) By using a spacer to obtain the required spacing and preload
c) Fastening is the way to adjust the screw and the nut.

The action of measuring starting friction torque and adjusting must be down at the same time to get a suitable preload. But it is hard to control the preload and may generate inclination for the method to fit the spindle of machine tool.

Constant pressure preload



A constant pressure preload is achieved using a cylinder spring or belleville spring. Even if the relative position of the bearings changes during it operation, the magnitude of the preload remains relatively constant. It's generally used in angular contact Ball Bearings for high rotation speed

Purpose of the Preload

- Enhance stiffness
- Reduce running noise
- Enhance the accuracy of shaft guidance
- Compensate for wear and settling (bedding down) processes in operation
- Give a long service life.

The bearings with preload are good for the spindle of machine tools.

Preload Adjustment

Adjustment of axial clearance depends on the spacer width. For back-to-back arrangement, increasing preload indicate the decrease of the spacer width of inner ring; Decreasing preload indicate the decreaseof the spacer width of outer ring.

Information providedwithout guarantee

Bearing rigidity

Rigidity means the elastic deformation in the bearing under load. Bearing rigidity influences the rigidity of a bearing arrangement and thus the rigidity of the complete spindle/bearing system. It is of particular importance in machine tool applications, as the magnitude of the deflection under load determines the machining accuracy of a machine tool.

Apart from the bearings, other components might influence the rigidity of a system i.e. bending of the spindle itself, position and number of support bearings, and tool overhang. The stiffness of a bearing depends on its type and size. The most important parameters are

- Type of rolling elements (balls or rollers)
- Number and size of rolling elements
- Contact angle.

Roller bearings are stiffer than ball bearings because of the contact conditions between the rolling elements and raceways. The influence due to number of rolling element.

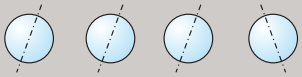
To enhance the rigidity of the bearing arrangement, or to increase running accuracy, bearings can be preloaded. These are two important reasons why machine tool spindles are almost always fitted with preloaded bearings or bearing sets.

Information providedwithout guarantee

Unloading Force

The bearing will have deformation when the combination of angular contact ball bearings is under an axial force from the axis. The bearing which from the opposite direction to the direction of the load will be unload and it will be failure soon.

The unloading force of bearing combination

Matching Type	Matching	Unit N
DB		3Fv
TBT		6Fv
QBC		6Fv
QBT		9Fv
PBC		9Fv

Fv:Preload

Bearing arrangements

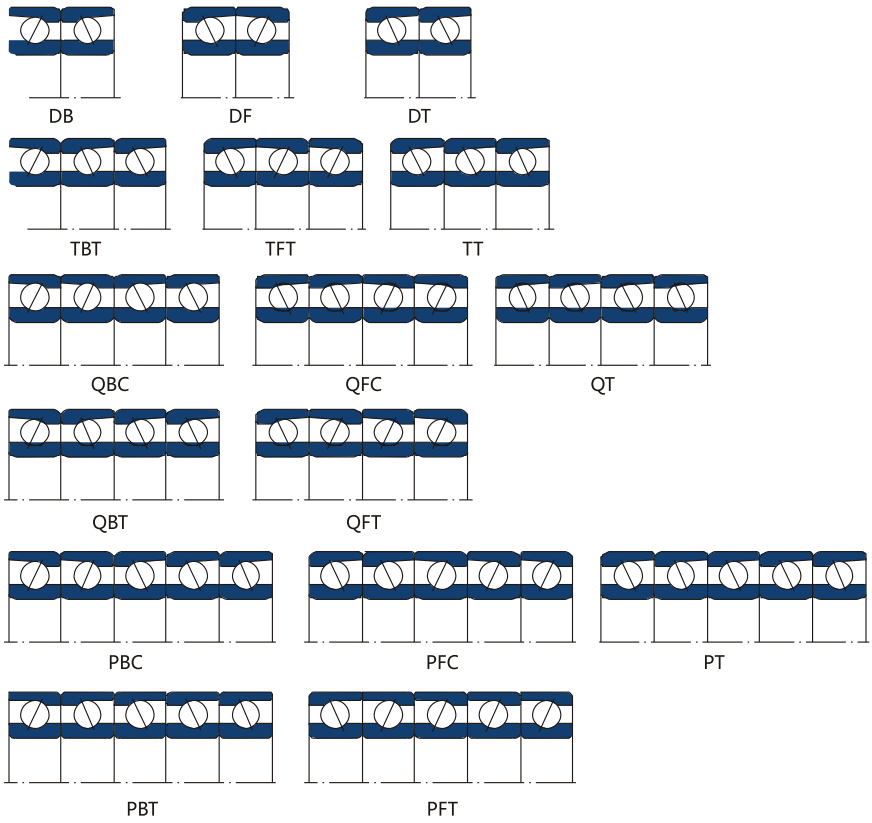
CSC angular contact ball bearings can be supplied as required in complete sets of two, three or four matched bearings in the arrangements.

The bearings of a set are matched in production so that when they are mounted immediately adjacent to each other in the prescribed order, a given preload will be obtained or the load will be evenly distributed. The bore and outside diameters of the bearings of a set differ from each other by one third of the permissible diameter tolerance.

In a back-to-back bearing arrangement, the load lines diverge toward the bearing axis. Axial loads acting in both directions can be accommodated, but only by one bearing or bearing set in one direction each. Bearings mounted back-to-back provide a relatively rigid bearing arrangement that can also accommodate tilting moments.

In a face-to-face bearing arrangement, the load lines converge toward the bearing axis. Axial loads acting in both directions can be accommodated, but only by one bearing or bearing set in one direction each. Face-to-face arrangements can accommodate small amounts of deflection.

In a tandem bearing arrangement, the load lines are parallel so that radial and axial loads are shared equally by the bearings in the set. The bearing set can only accommodate axial loads acting in one direction. For higher loads or requirements for high rigidities, bearings are assembled and installed in sets of 3 or 4. 2 or 3 of them are installed in tandem arrangement.



Bearing arrangements

The classic application field for high precision bearings is machine tools spindles, which may have different requirements depending on the working operations they are designed for. Generally, lathe spindles are used to cut metals at rather low speeds and in combination with relatively large cutting loads.
Such types of spindles usually have the driving torque transmitted through a pulley or toothed gears. This means that loads at the rear side of the shaft are also rather heavy. For such applications, the requirements in terms of speed are not so tough; the more important parameters are rigidity and load carrying capacity. It is quite common to have, at the front side of the spindle, a double row cylindrical roller bearing in combination with a double row angular contact thrust ball bearing, while having a double row cylindrical roller bearing at the rear end of the shaft. This type of arrangement ensures a long calculated life and an excellent rigidity, so that a good quality of the work piece is obtained.

Also, from a kinematic point of view, the bearings run in a stable way, as there are two types of bearing (radialand axial) that carry independently, the loads applied on the shaft (in fact, to avoid that angular contact thrust ball bearings carry radial loads, the outer ring outside diameter has a special tolerance so that it is never in contact with the housing). When designing these types of spindles (this applies in general when rather heavy loads are involved) a good rule of thumb concerning the position of the bearings along the shaft, is to have the distance between the centre of the front and rear support in the range of 3–3.5 times the bearing inner diameter.

When higher speeds are requested (i.e. high-speed machining centre or internal grinding) different bearing solutions need to be found. Obviously, in such cases something has to be paid in terms of rigidity, as well as carrying capacity. High-speed applications usually have direct-driven spindles driven by direct coupling and/or electrical motors (i.e. the so called motorised spindles).

There are no loads due to transmission of power and consequently single row angular contact ball bearings paired in sets or single (for extremely high speed) and single row cylindrical roller bearings are frequently adopted, if enhanced performances are required, equipped with silicon nitride rolling elements. The front side bearing set is axially located, whilst mounting a cylindrical roller bearing at the rear side permits axial displacement, due to spindle elongation.

When very high speeds are involved (n dm factor over 2 million) it is quite common to see angular contact ball bearings on both sides, preloaded by springs. This is done to control the heat generation. If sets of angular contact ball bearings arranged in a constant position are chosen, preload would increase with the speed, and at high speed produce an amount of heat which is not sustainable.
Conversely, spring preload remains constant with the speed, thus ensuring a more correct kinematic behaviour and a limited amount of heat generation.

An even better solution is represented by the possibility to preload the bearings (angular contact) by a hydraulic system. In such a case, the amount of preload can be adjusted according to the speed of the spindle, thus reaching the best possible combination among rigidity, heat generation and theoretical life of the bearings.

Bearing arrangements

Radial location of bearings

In order to work properly, bearings must have their rings or washers fully supported around their complete circumference and across the whole width of the raceway. The support must be firm and even, and can be provided by a cylindrical or tapered seating or, for thrust bearing washers, by a flat (plane) support surface. This means that the seatings must be made with adequate accuracy and that their surface should be uninterrupted by grooves, holes or other features. This is particularly important with high-precision bearings since they have relatively thin-walled rings, which adapt themselves to the form of the shaft or housing bore. In addition, the bearing rings must be reliably secured to prevent them from turning on or in their seatings under load.

A satisfactory radial location and an adequate support can generally be obtained when the rings are mounted with an appropriate degree of interference. Inadequately or incorrectly secured bearing rings generally cause damage to the bearings and associated components. However, when easy mounting and dismounting are desirable, or when axial displacement is required with a non-locating bearing, an interference fit cannot be used. In certain cases where a loose fit is employed it is necessary to take special precautions to limit the inevitable wear, for example, surface hardening of the seating and abutments.

Axial location of bearings

An interference fit alone, is inadequate for the axial location of a bearing ring. As a rule, therefore, some suitable means of axially securing the ring is needed. Both rings of locating bearings should be axially secured at both sides. For non-locating bearings, on the other hand, where they are of a non-separable design, it is sufficient if the ring having the tighter fit- usually the inner ring-is axially secured; the other ring must be free to move axially with respect to its seating.

In machine tool applications, usually, the work side bearings ensure the shaft location to support the axial load transmission from the shaft to the housing. Generally, then, work side bearings are axially located, while rear side supports are axially free.

Methods of location
Bearing rings having an interference fit are generally mounted so that the ring abuts a shoulder on the shaft or in the housing at one side. At the opposite side, inner rings are normally secured using a lock nut. Outer rings are usually retained by a housing end cover.

Instead of integral shaft or housing shoulders, it is frequently more convenient to use spacer sleeves or collars between the bearing rings or between a bearing ring and an adjacent component, e.g. a gear. Other methods of axial location which are suitable, above all, for high precision bearing arrangements involve the use of press fits, e.g. in the form of stepped sleeve arrangements.

Bearings with a tapered bore, mounted directly on tapered journals, are generally secured on the shaft by lock nuts.

Factors limiting speeds

The limiting speed of the bearing, inside of the spindle, is affected by the following operating conditions.

1) Lubrication method
The thickness of the lubricating film created by the oil-air oil mist lubrication replenishment method is larger compared to the thickness created by the grease lubrication method. Therefore the limiting speed is higher when the oil-air or oil mist lubrication method is used.
In the case of jet lubrication, the large volume of oil supplied into the bearing for lubrication also removes heat efficiently so that much higher operating speeds are possible.

2) Combination
If bearings are used as multiple bearing sets, the number of bearings in the set affects the limiting speed.
As the number is increased, the limiting speed becomes lower because the ability to dissipate that heat becomes lower.

3) Preload
If the preload after mounted is high, the contact surface pressure between the rolling elements and raceways increases, which causes extra heat generation. As a result of this heat, the preload during operation increase further and the risk of bearing failure will be higher. To avoid this type of bearing failure, the limiting speed is reduced. Also in case of cylindrical roller bearing, when the radial clearance is reduced and the preload increases during operation, the limiting speed is reduced.

4) Drive method
The limiting speed of a bearing will also change depending on the spindle drive system.
In the case of motor built-in spindles the heat inside if the spindle is higher. If there is also a jacket-cooling system, the temperature difference between the inner ring and the outer ring becomes higher, so the preload is increased and the limiting speed becomes lower.
Jacket cooling also affects the clearance between the bearing and the housing. Therefore, the clearance between the bearing and the housing could become negative, in which case the preload would be increased.

Limiting speeds

The limiting speeds listed in the bearing dimensional tables are guideline values. They are based on a single bearing that is lightly preloaded by means of a spring and subjected to relatively light loads withgood heat dissipation.

The attainable speeds for oil-air lubrication can be used to estimate attainable speeds for other oil lubrication methods. For batch lubrication, a reduction factor of 0.3 to 0.4 should be considered. For fog lubrication, a reduction factor of 0.95 is adequate.

In situations where the lubricating oil is used as a means to remove heat, higher speed can be achieved, however a large amount of oil must be pressure fed through the bearing, so there is a significant loss of power.

When single bearings are used in two, three or four row combinations, or the preload is increased to improve spindle rigidity, limiting speeds will be lower than those listed.

Speed ratings

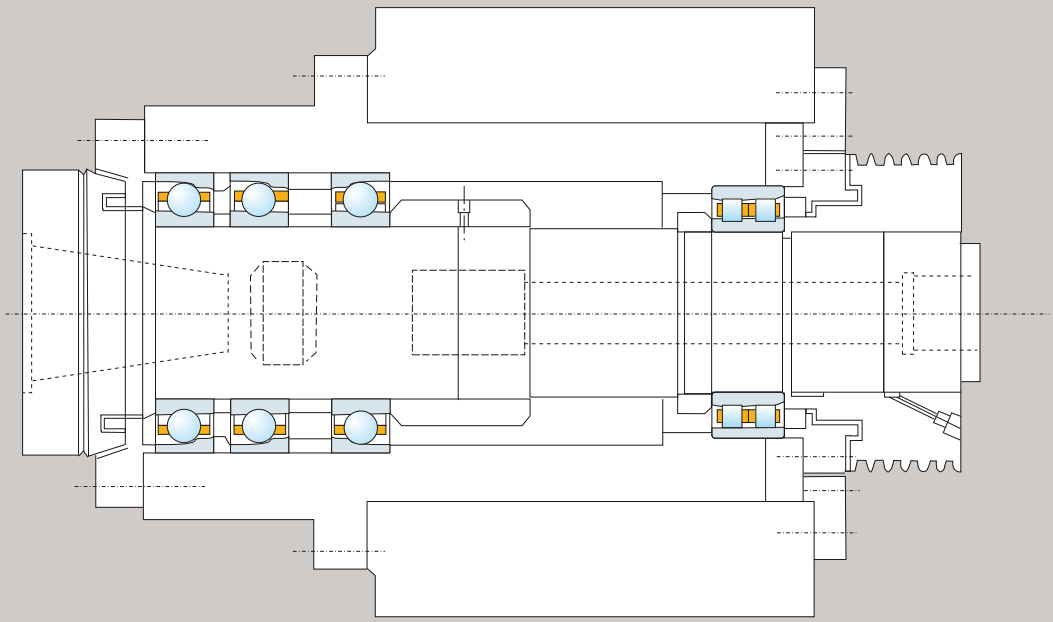
The limiting speed of a matched bearing set operating under position preload conditions is calculated by multiplying the limiting speed of a single bearing in the set by the appropriate adjustment factor listed in following table:

Bearing arrangement	Bearing preload			
	L	A	B	C
DB	0.85	0.80	0.65	0.55
QBC	0.80	0.75	0.60	0.45
TBT	0.75	0.70	0.55	0.40

Application examples

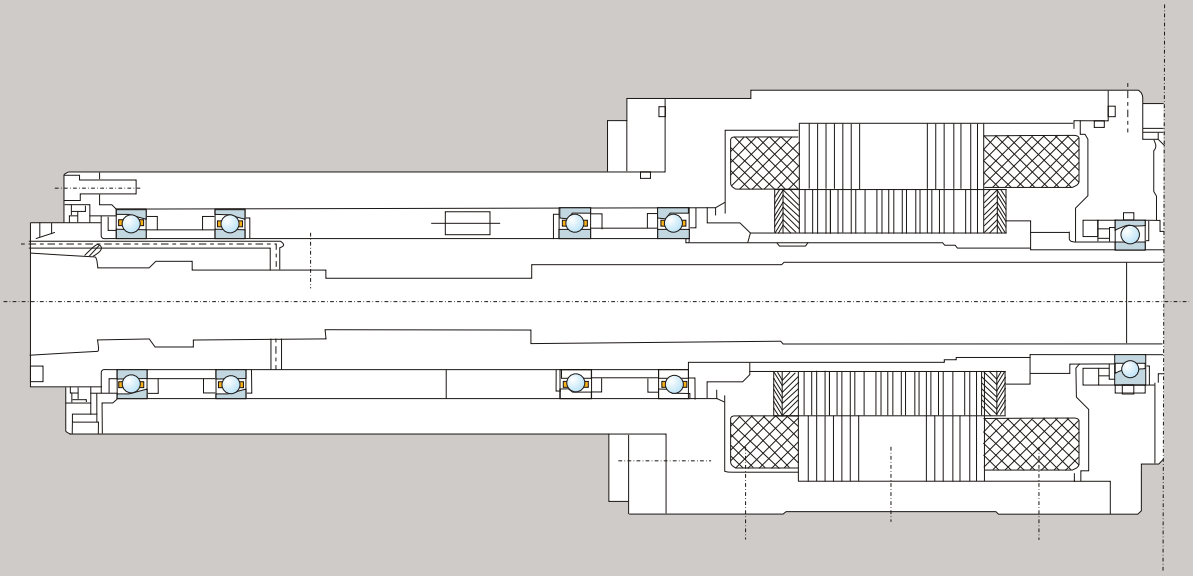
Spindle arrangements for heavy machining, CNC lathes and conventional milling machines

Bearing arrangement work side: 70 E/P4S TBT; drive side NN 30 K



Application examples

Bearing arrangement work side: 70 C/P4S QBC; rear side 70 C/P4S



Lubrication

Good lubricating is a basic condition for roller bearings. The analysis of bearing damage showed that about 40% damages are related to poor lubrication.

Seen from the results, oil lubrication is better than grease lubrication, but due to the complexity of lubrication system and device, the hardship of seal and the trouble with maintenance, the application of oil lubrication is limited in many occasion. CSC precision bearing have open type and closed type for satisfy customer's requirement. CSC choose long life, low temperature grease in high rotation condition for spindle bearing.

Grease lubricating :

- Lubrication device is sample
- Not easy to leak, seal structure is sample
- Easy for maintenance
- Grease can prevent the dust water and other impurity from going into the bearings
- Increase cleanness

Oil lubrication :

Advantages:

- Suitable for high speed rotation
- Suitable for high temperature
- Have good heat dispersion
- Easy to remove wear and dust for bearing

More products from CSC

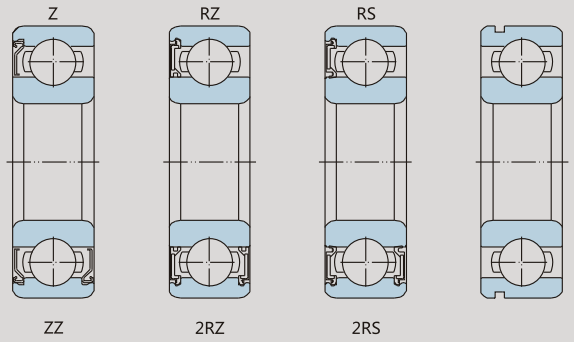
Deep Groove Ball Bearings (DGBB)

- 60xx series
- 62xx series
- 63xx series

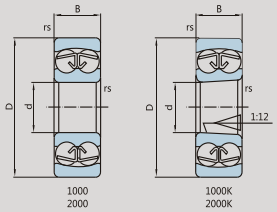
- 617xx series
- 618xx series
- 619xx series
- 160xx series

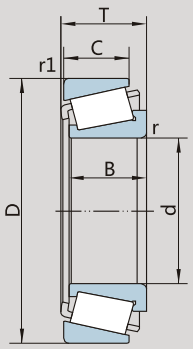
EMQ versions
P6, P5, P4
From Z1 to Z4
From V1 to V4

Steel balls
Ceramic balls

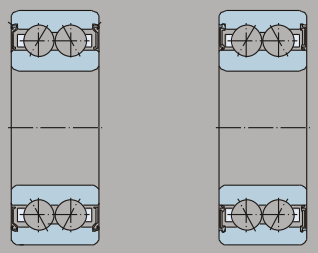


Tapered roller bearings
Self aligning ball bearings

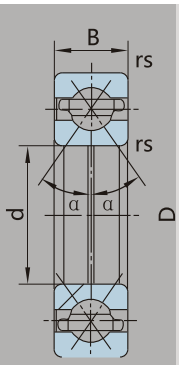




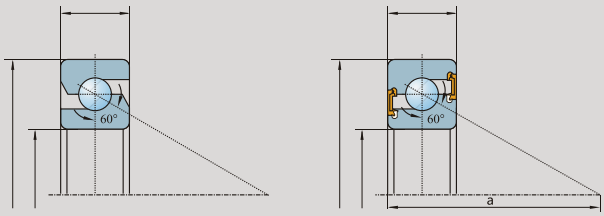
Double row angular contact ball bearings



Four point contact ball bearings



Axial contact ball bearings



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