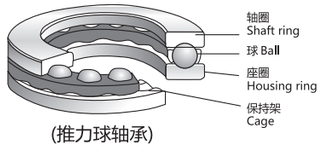
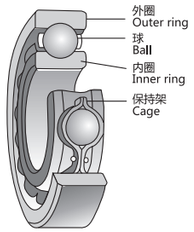
滚动轴承的结构
Structure of roller bearing

滚动轴承一般由套圈(内圈、外圈)，垫圈(轴圈、座圈)，滚动体和保持架构成。内圈与外圈之间装有若干滚动体，通过保持架使滚动体保持一定间隔，进行圆滑的滚动。图1.1

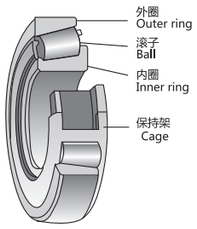
A roller bearing usually consists of rings (inner and outer), washers (shaft, housing), rolling bodies and cage. A number of rolling bodies are installed between inner and outer rings, which are kept by cage at a certain distance for smooth rolling. Figure 1.1



(推力球轴承)
(Thrust ball bearing)
图1.1结构示例
Figure 1.1 Structure example



(深沟球轴承)
(Deep groove ball bearing)
图1.1
Figure 1.1



(圆锥滚子轴承)
(Tapered roller bearing)
图1.1
Figure 1.1

套圈(内圈、外圈)、垫圈(轴圈、座圈)
Rings(inner, outer), washers(shaft, housing)

套圈上滚动体滚动的部分称做滚道，其表面称做滚道面， 球轴承套圈的滚道又称沟道。
一般来说，套圈中的内圈和外圈分别与轴和外壳配合。
推力轴承的垫圈分别称做轴圈和座圈。

The part on rings on which rolling bodies roll on is called raceway, the surface is called raceway surface, the raceway on a ball bearing ring is also called ball race.

Generally speaking, for rings, the inner and outer rings fit with shaft and housing respectively.

The washers of thrust bearing are called shaft washer and housing washer respectively.

滚动体
Rolling body

滚动体分为球和滚子两大类，滚子根据其形状不同又分为圆柱滚子、滚针、圆锥滚子、球面滚子等等。

Rolling body is divided into such two major categories as ball and roller. Roller is divided into cylindrical roller, needle roller, conical roller, spherical roller, etc.

保持架
Cage

保持架是将滚动体部分包围，使其在圆周方向保持一定的距离。
保持架有冲压保持架，车制实体保持架，工程塑料成型保持架。
与无保持架的满装型球(滚子)轴承相比，带保持架的轴承摩擦阻力较小，适用于高速旋转。

The cage encircles partially rolling bodies so that a certain distance is kept in circumferential direction between them.

The cage includes pressing, solid cage from turning and forming cages engineering plastic.

In comparison with full-loaded type ball (roller) bearing without cage, bearings with cages have less frictional resistance and are suitable for rotation at a high speed.

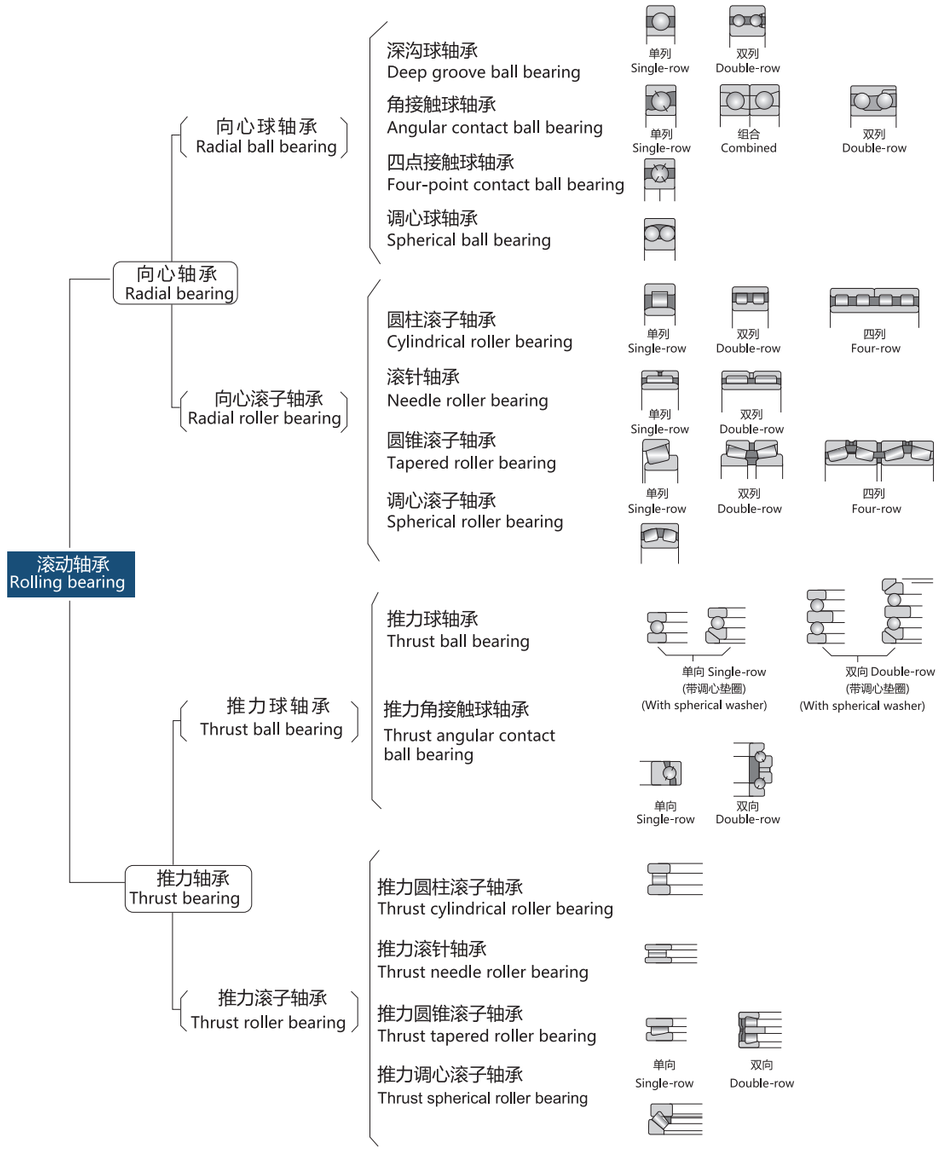
A

滚动轴承的分类
Classification of roller bearing

滚动轴承按接触角的不同，主要分为向心轴承，推力轴承，按滚动体和套圈的结构可分为深沟球轴承，调心球轴承，角接触球轴承，推力球轴承，圆柱滚子轴承，滚针轴承，调心滚子轴承，圆锥滚子轴承，推力调心滚子轴承等。
滚动轴承按滚动体的列数，可以分为单列，双列和多列(三列、四列)，总之，滚动轴承的分类可按图1.2。

Rolling bearing is mainly divided by contact angle into radial bearing, thrust bearing, by the structure of rolling bodies and rings into deep groove ball bearing, spherical ball bearing, angular contact ball bearing, thrust ball bearing, cylindrical roller bearing, needle roller bearing, spherical roller bearing, tapered roller bearing, thrust spherical roller bearing, etc.

Rolling bearing is divided by rows of rolling body into single-row, double-row and multi-row (three-row, four-row) bearing. In summary, rolling bearing classification is as shown in Figure 1.2.



滚动轴承的结构特点
Structural features of roller bearing

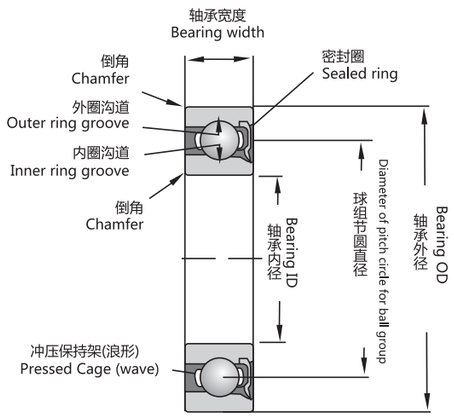
深沟球轴承
Deep groove ball bearing

这是最具代表性的滚动轴承，用途广泛。其内外圈滚道都呈弧状沟型，可承受径向载荷与双向轴向载荷，适用于高速旋转及要求低噪声，低振动的场合。
带防尘盖和橡胶密封圈的密封型轴承内预先充填了适量的润滑脂。
带装球口的轴承，钢球数量增加，提高了额定载荷。
此类轴承广泛应用于汽车，电气，仪表，建筑机械，铁路车辆，农业机械及各种专业机械。

This is the most typical kind of roller bearing with a wide range of applications. The raceways of both its inner and outer rings are in arc groove form capable of bearing radial load and bi-directional axial load. It is suitable for rotation at a high speed and occasions requiring low noise, and low vibration.

Sealed type bearing with dustproof cover and rubber seal ring is pre-filled with moderate grease.
Bearing with ball loading entrance results in increased balls and rated load.

Such bearings are widely used in automobile, electrical equipment, instrument, building machinery, railway vehicle, agricultural machinery and various specialized machineries.



基本型
Basic type

一般对安装、密封没有特殊要求的场合，均可多用此种轴承。

Such bearing can be used in occasions without special requirement for installation and sealing.

外圈有止动槽深沟球轴承(-N)
Deep groove ball bearing with stop groove on outer ring

可利用止动环做轴向定位，简化了在外壳内的安装。

The stop ring can be used for axial positioning to simplify installation in housing.

保持架
Cage

深沟球轴承一般采用钢板冲压保持架或黄铜实体保持架。当外径小于等于400毫米时，采用钢板冲压保持架不加后置代号， 当外径大于等于400毫米时，多用黄铜实体保持架不加后置代号。

Deep groove ball bearing usually has pressed steel cage or brass solid cage. When the OD is less than or equal to 400mm, pressed steel cage will be adopted without suffix. When the OD is more than 400mm, brass solid cage is mostly used without suffix.

允许角度误差
Allowed angle error

深沟球轴承允许内外圈相对倾斜的角度误差，按径向游隙，列表如下。

Inclination angle error between inner and outer rings is allowed for deep groove ball bearing, which is listed below by radial play:

按径向游隙 By radial clearance	允许角度误差 Allowed angle error
0组 Group 0	8'
3组 Group 3	12'
4组 Group 4	16'

当量动载荷 Equivalent dynamic load | $P=XFr+YFa$ [N]

式中 Where | Fr:径向载荷· N Fr: Radial load, N
Fa:轴向载荷· N Fa: Axial load, N

X.Y系数见表
Please refer to the following table for coefficients X,Y

Fa/Cor	0组游隙 Clearance for group 0					3组游隙 Clearance for group 3					4组游隙 Clearance for group 4				
	Fa/Fr ≤ e		Fa/Fr >e		e	Fa/Fr ≤ e		Fa/Fr ≤ e		e	Fa/Fr ≤ e		Fa/Fr ≤ e		e
	X	Y	X	Y		X	Y	X	Y		X	Y	X	Y	
0.025	1	0	0.56	2.0	0.22	1	0	0.46	1.74	0.31	1	0	0.44	1.42	0.39
0.04	1	0	0.56	1.8	0.24	1	0	0.46	1.61	0.33	1	0	0.44	1.36	0.41
0.07	1	0	0.56	1.6	0.27	1	0	0.46	1.46	0.36	1	0	0.44	1.27	0.44
0.13	1	0	0.56	1.4	0.31	1	0	0.46	1.30	0.41	1	0	0.44	1.17	0.46
0.25	1	0	0.56	1.2	0.37	1	0	0.46	1.14	0.47	1	0	0.44	1.05	0.53
0.5	1	0	0.56	1.0	0.44	1	0	0.46	1.00	0.54	1	0	0.44	1.00	0.56

当量动载荷 Equivalent dynamic load | $Po=Fr$ [N] Fa/Fr≤ 0.8
$Po=0.6Fr+0.5Fa$ [N] Fa/Fr>0.8

角接触球轴承 Angular contact ball bearing

单列角接触球轴承，在承受径向载荷时，会产生轴向分力，因此应将两个轴承背对背或面对面配置使用。
套圈与球之间有接触角,标准的接触角为15°,25°和40°接触角越大承受轴向载荷能力也越大，接触角越小则越有利于高速旋转。
单列轴承可承受径向载荷与单向轴向载荷。
双列角接触球轴承分为一个外圈两内圈和一个外圈一个内圈两种结构。
DB组合，DF组合及双列轴承可承受径向载荷与双向轴向载荷。DT组合适用于单向轴向载荷较大，单个轴承的额定载荷不足的场合。
结构上为背面组合的两个单列角接触球轴承共用内圈与外圈，可承受径向载荷与双向轴向载荷。
角接触球轴承适用于高速及高精度旋转。
此类轴承主要应用于机床主轴，高频马达，燃汽轮机，油泵，空气压缩机，印刷机械等。

Single-row angular contact ball bearing will have axial component force when bearing radial load. For this reason, two bearings should be used back to back or face to face.

A contact angle exists between rings and balls. The standard contact angles are 15°, 25° and 40°. The more the contact angle is, the higher the capability to bear axial load will be. The less the contact angle is, the more advantageous to rotation it will be.

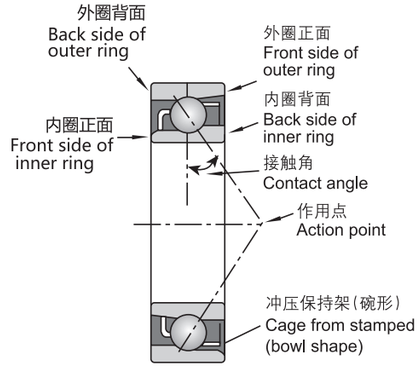
Single-row bearing can bear axial load and unidirectional axial load.

Double-row angular contact ball bearing has such two types of structure as one outer ring and two inner rings and one outer ring and one inner ring.

DB combination. DF combination and double-row bearing can bear radial load and bi-directional axial load. DT combination is applicable to occasions where unidirectional axial load is high and the rated load of a single bearing is not sufficient. Two single-row angular contact bearings combined back to back in structure have common inner and outer rings, capable of bearing axial load and bi-directional axial load.

Angular contact bearing is suitable for rotation at a high speed and accuracy.

Such bearing is mainly applied to main spindle machine tool main shaft, high frequency motor, internal combustion turbine, oil pump, air compressor, printing machinery, etc.



四点接触球轴承
Four-point contact ball bearing

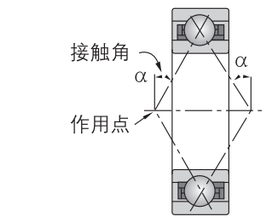
此类轴承主要应用于飞机喷气式发动机燃汽轮机。
可承受径向载荷与双向轴向载荷。
单个轴承可代替面对面组合或背对背组合的角接触球轴承。
适用于承受纯轴向载荷或轴向载荷成份较大的联合载荷。
该类轴承承受任何方向的轴向载荷时都能形成其中的一个接触角(α)，因此套圈与球总在任一接触线上的两点接触。

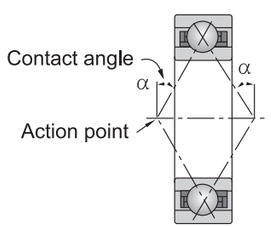
Such bearing is mainly applied to airplane jet engine and internal combustion turbine.

It is capable of bearing radial load and bi-directional axial load. A single bearing can replace angular contact ball bearing with back to back or face to face combination.

It is applicable to bearing pure axial load or combined load with a high axial component.

Such bearing will have a contact angle (α) formed when bearing axial load in any direction, therefore, rings and balls always contact with each other at two points on any contact line.





四点接触球轴承QJ000(176000)型为分离型轴承。具有双半内圈，接触角35°。QJF000(116000)型也是可分离性轴承，具有双半外圈，接触角35°。四点接触球轴承主要用于承受双向轴向载荷，在承受轴向载荷的同时亦可承受径向载荷。
成对安装角接触球轴承
成对安装角接触球轴承按其外圈端面的组合分为三类：
1.背对背配置（DB）
2.面对面配置（DF）
3.串联配置 （DT）
此种轴承能承受以径向载荷为主的径、轴向联合载荷，也可以承受纯径向载荷。除串联配置外，其它配置均可承受双向轴向载荷。
一般由生产厂选配组合或成套提交，安装后有预过盈。套圈和钢球处于轴向预加载荷状态，因而提高了整组轴承作为单个支承的载荷能力和刚度。

Four-point Contact Ball Bearing Model QJ000 (176000) is the separable bearing, with double half inner rings and the contact angle at 35°. Model QJF000 (116000) is also the separable bearing, with double half outer rings and the contact angle at 35°. The four-point contact ball bearing is mainly used to bear the bi-directional axial load, also available to bear the radial load at the same time.

Angular contact ball bearing installed in pairs
Angular contact ball bearing installed in pairs is divided into three categories by the outer ring end face combination:
1. Back to back configuration (DB)
2. Face to face configuration (DF)
3. Serial configuration (DT)

Such bearing can bear combined load in radial, axial directions with the radial load as the main part. It can also bear pure radial load. Besides serial configuration, other configurations can also bear bi-directional axial load.

Usually the manufacturer determines its combination or provides to users in full set. There will be pre-interference and the rings and steel balls in a state of axial preload after installation. As a result, the load bearing capability and rigidity are improved for a whole combination as a single support

当量动载荷
Equivalent dynamic load

接触角为15°的单列角接触球轴承
For single-row angular contact ball bearing at a contact angle 15°

单个轴承或串联配置
In case of single bearing or serial configuration

P=Fr [N]当Fa/Fr≤ e
P=0.44Fr+YFa [N]当Fa/Fr>e

背对背、面对面配置
In case of back to back, face to face configuration
P=Fr+Y1Fa [N]当Fa/Fr≤ e
P=0.72Fr+Y2Fa [N]当Fa/Fr>e

e Y Y1 Y2值见下表
Please refer to the following table for values of e, Y,Y1, Y2

Fa/Cor	e	Y	Y1	Y2
0.015	0.38	1.47	1.65	2.39
0.029	0.40	1.40	1.57	2.28
0.058	0.43	1.30	1.46	2.11
0.087	0.46	1.23	1.38	2.00
0.12	0.47	1.19	1.34	1.93
0.17	0.50	1.12	1.26	1.82
0.29	0.55	1.02	1.14	1.66
0.44	0.56	1.00	1.12	1.63
0.58	0.56	1.00	1.12	1.63

注：Cor为单个轴承的基本额定静载荷。
Note: Cor is the basic rated static load for single bearing.

接触角为25°的单列角接触球轴承
For single-row angular contact ball bearing at a contact angle 25°

单个轴承或串联配置
In case of single bearing or serial configuration
P=Fr [N]当Fa/Fr≤ 0.68
P=0.41Fr+0.87Fa [N]当Fa/Fr > 0.68

背对背、面对面配置
In case of back to back, face to face configuration
P=Fr+0.92Fa [N]当Fa/Fr≤ 0.68
P=0.67Fr+1.41Fa [N]当Fa/Fr > 0.68

接触角为40°的单列角接触球轴承
For single-row angular contact ball bearing at a contact angle 40°

单个轴承或串联配置
In case of single bearing or serial configuration
P=Fr [N]当Fa/Fr≤ 1.14
P=0.35Fr+0.57Fa [N]当Fa/Fr > 1.14

背对背、面对面配置
In case of back to back, face to face configuration
P=Fr+0.55Fa [N]当Fa/Fr≤ 1.14
P=0.57Fr+0.93Fa [N]当Fa/Fr > 1.14

四点接触球轴承
For four-point contact ball bearing

P=Fr+0.66Fa [N]当Fa/Fr≤ 0.95
P=0.6F+1.07Fa [N]当Fa/Fr > 0.95

双列角接触轴承
For double-row angular contact ball bearing

P=Fr+0.78Fa [N]当Fa/Fr≤ 0.8
P=0.63Fr+1.24Fa [N]当Fa/Fr > 0.8

当量静载荷
Equivalent static load

接触角为15°的单列角接触球轴承
For single-row angular contact ball bearing at a contact angle 15°

单个轴承或串联配置
In case of single bearing or serial configuration
Po=0.5Fr+0.46Fa [N]
当Po < Fr 取Po = Fr

背对背、面对面配置
In case of back to back, face to face configuration
Po = Fr+0.92Fa [N]

A

当量静载荷
Equivalent static load

接触角为25°的单列角接触球轴承 For single-row angular contact ball bearing at a contact angle 25°	单个轴承或串联配置 In case of single bearing or serial configuration Po=0.5Fr+0.38Fa [N] 当Po < Fr 取Po = Fr 背对背、面对面配置 In case of back to back, face to face configuration Po = Fr+0.76Fa [N]
接触角为40°的单列角接触球轴承 For single-row angular contact ball bearing at a contact angle 40°	单个轴承或串联配置 In case of single bearing or serial configuration Po=0.5Fr+0.26Fa [N] 当Po < Fr 取Po = Fr 背对背、面对面配置 In case of back to back, face to face configuration Po = Fr+0.52Fa [N]
四点接触球轴承 For four-point contact ball bearing	Po = Fr+0.58Fa [N]
双列角接触球轴承 For double-row angular contact ball bearing	Po = Fr+0.66Fa [N]

两套或两套以上单列角接触球轴承安装在一起作为一个支承整体时，其基本额定动载荷为 $i^{0.7}$ × Cr，基本额定静载荷为 i × Cor(其中 i 为支承整体中单个轴承数： Cr、Cor为单个轴承的基本额定载荷)。极限转速为单列轴承的60%～80%。

When two or more sets of single-row angular contact ball bearing are installed together as an integral support, the basic rated dynamic load is $i^{0.7}$ × Cr, the basic rated static load i× Cor (where i is the number of single bearings in the integral support Cr and Cor are the basic rated load of a single bearing). The rotation speed limit is equivalent to 60%~80% of that of a single bearing.

调心球轴承
Spherical ball bearing

由于外圈滚道面呈球面，具有调心性能，因此可自动调整因轴或外壳的挠曲或不同心引起的轴心不正。

As the outer ring raceway is of spherical surface with spherical feature, it can adjust automatically axial center misalignment as a result of shaft or housing deflection or non-concentricity.

当量动载荷 Equivalent dynamic load	P=Fr+Y1Fa [N] 当Fa/Fr≤ e时 P=0.65Fr+Y2Fa [N] 当Fa/Fr > e时 Y1，Y2和e值列在轴承尺寸表中。 Values of Y1, Y2 and e are shown in the bearing dimension table.
当量静载荷 Equivalent static load	Po=Fr+YoFa [N] Yo值列在轴承尺寸表中。 Values of Y0 are shown in the bearing dimension table.

圆柱滚子轴承
Cylindrical roller bearing

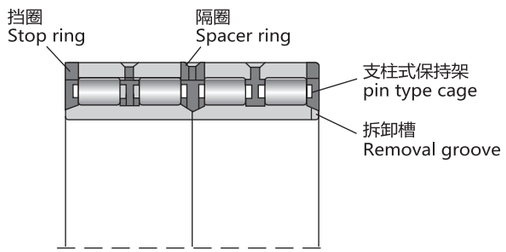
圆柱滚子与滚道呈线接触，承受径向载荷能力大，既适用于承受重载荷与冲击载荷，也适用于高速旋转。N型及NU型可轴向移动，能适应因热膨胀或安装误差引起的轴与外壳相对位置的变化， 最适合用作自由端轴承。NJ型及NF型可承受一定程度的单向轴向载荷NH型及NUP型可承受一定程度的双向轴向载荷。内圈或外圈可分离，便于装拆。
NNU型及NN型抗径向载荷的刚性强，大多用于机床主轴。

For cylindrical roller bearing, the cylindrical rollers are in linear contact with the raceway, with a high capability to bear radial load, which is suitable for both heavy and impact load and high-speed rotation.

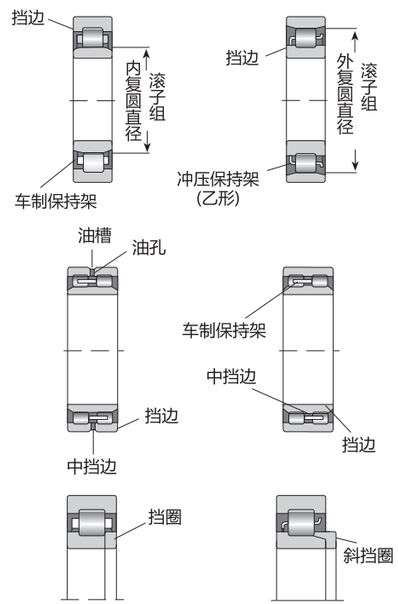
Type N and NU can move axially and be adaptable to change in the relative position between shaft and housing as a result of thermal expansion or installation error, which is best as bearing at free end.

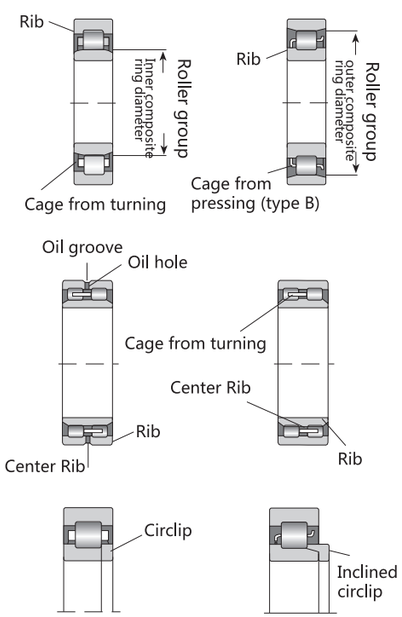
Type NJ and NF can bear certain degree unidirectional axial load. Type NH and NUP can bear certain degree bi-directional axial load.

Inner ring or outer ring is separable to facilitate assembly and disassembly. Type NNU and NN have a high rigidity to resist radial load, which are mostly used for main spindle of machine tool.



当量动载荷 Equivalent dynamic load	P=Fr+YFa [KN]当Fa/Fr≤ e时 P=0.67Fr+YFa [KN]当Fa/Fr > e时 Y和e值请咨询WKB Please consult WKB Bearing for values of Y and e.
当量静载荷 Equivalent static load	Po=Fr+YoFa [KN]Yo值请咨询WKB [KN] Please consult WKB Bearing for values of Y0





FC.FCD.FCDP.型可承受较大径向载荷，主要用于轧机轧辊上。
此类轴承主要用于中型及大型电动机、发电机、内燃机、燃汽轮机、机床主轴、减速装置、装卸搬运机械，各类产业机械。
单列圆柱滚子轴承
NU型和N型允许轴相对于外壳在一定范围内做轴向移动，因此适合于作自由端轴承。
NJ型和NF型可承受一定程度的单向轴向载荷。
NUP型和NFP型可承受一定程度的两个方向的轴向移动，因此适合于作自由端轴承。
双列圆柱滚子轴承
双列圆柱滚子轴承分圆柱孔和圆锥孔两种。
另外还有外圈带油孔和油槽的轴承。
该类轴承大多用于机床主轴，但也可用于其他场合。
四列圆柱滚子轴承
四列圆柱滚子轴承能承受很大的径向载荷和冲击载荷，加工精度高，适用于高速。大多应用于轧机的轧辊上，但也可用于其它场合。

Type FC, FCD,FCDP can bear high radial load and are mainly used on rolls of rolling machines.

Such bearings are mainly for medium and large motors, generators, internal combustion engines, main spindle of machine tool , speed reducers, loading, unloading and handling machineries, various industrial machineries.

Type NU and N allow shaft to move axially within certain range in relation to housing and are therefore suitable for bearing at free end.

Type NJ and NF can bear certain degree unidirectional axial load. Type NUP and NFP can bear certain degree bi-directional axial movement and are therefore suitable for bearing at free end.

Double-row cylindrical roller bearing
Double-row cylindrical roller bearing is divided into such two types as with cylindrical hole and tapered hole.

Besides, there are also bearings with outer rings with oil holes and oil grooves.

Such bearings are mostly used on main spindle of machine tool and also in other occasions.

Four-row cylindrical roller bearing
Four-row cylindrical bearing can bear high radial load and impact load with a high working accuracy, being suitable for high speed. They are mostly used on rolls of rolling machines and also in other occasions.

调心滚子轴承
Spherical roller bearing

该类轴承在球面滚道外圈与双滚道内圈之间装有球面滚子。
由于外圈滚道的圆弧中心与轴承中心一致，具有调心性能，因此可自动调整因轴或外壳的挠曲或不同心引起的轴心不正。
可承受径向载荷与双向轴向载荷。特别是径向载荷能力大，适用于承受重载荷与冲击载荷。
圆锥孔轴承通过使用紧固件或退卸套可便于轴上的装拆。
圆锥孔有以下两种锥度
1:30(辅助代号：K30):适用于24000.24100系列。
1:12(辅助代号:K): 适用于其他系列。
带锥孔的轴承主要通过紧定套或退卸套固定于轴上。
调心滚子轴承在正常载荷及工作条件，内圈转动时，容许存在表中给出的角度偏差。能否完全达到此给定值须依轴承配置的设计及密封类型等条件决定。

Such bearing is installed with spherical rollers between the outer ring for spherical raceway and the inner ring for double raceway.

As the arc center of outer ring raceway coincides with bearing center, having aligning feature, it can adjust automatically axial center misalignment as a result of shaft or housing deflection or non-concentricity.

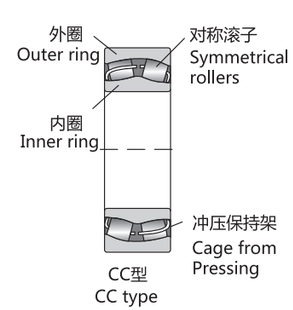
It is capable of bearing axial load and bi-directional axial load. Especially, the radial load bearing capability is so high that it can bear heavy load and impact load.

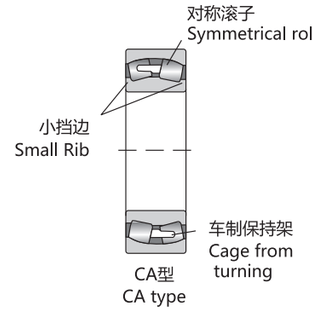
Mounting onto and removal from shaft are facilitated for bearing with tapered hole by using fasteners or withdrawal sleeve.

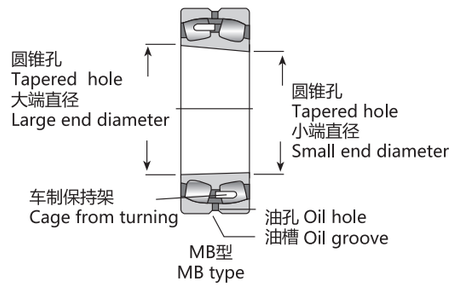
Tapered hole has the following two tapers:
1:30 (auxiliary designation: K30): suitable for series 24000, 24100.
1:12(auxiliary designation: K): suitable for other series.
Bearing with taprered hole is secured onto shaft through adapter sleeve or withdrawal sleeve.

Angle deviations as shown in the table below are allowed for self-aligning roller bearing as inner ring rotates under normal load and working conditions. Whether these given values can be attained is determined based on such conditions as bearing configuration design, seal type, etc.

轴承系列 Bearing series 新代号 Current designation	允许角度偏差 (不超过) Allowed angle deviation (not beyond)
23000 23100 22200 23900	1.5°
22300 24000	2°
23200 24100	2.5°







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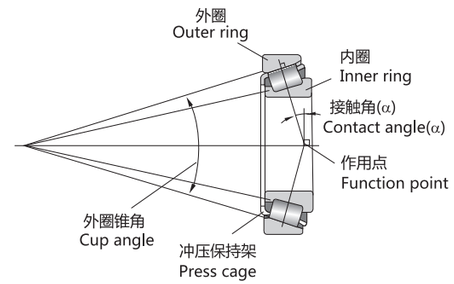
圆锥滚子轴承
Tapered roller bearing

圆锥滚子轴承的内、外圈具有锥形滚道，滚道之间装有锥形滚子。若将锥形面延伸，最终会聚于轴承轴线上一点。圆锥滚子轴承主要用于承受以径向载荷为主的径向、轴向联合载荷。轴承的轴向承载能力由接触角a决定、a越大，轴向承载能力越大。圆锥滚子轴承为分离型轴承、带滚子和保持架的内圈构成内组件，能与外圈分开安装。

The inner ring and outer ring of tapered roller bearing have tapered raceway, and between tapered raceway mounted tapered roller. If stretching the tapered surface, they will focus on a point on the bearing axis. Tapered roller bearing is mainly used for carrying radial and axial combined load which is mainly radial load. The axial load carrying capacity of bearing is determined by contact angle α, the bigger α is, the bigger axial load carrying capacity is. Tapered roller bearing is a separable bearing; inner assembly is consisted of inner ring with roller and cage, which can be mounted with outer assembly separably.

WKB 生产公制、英制的单、双、四列圆锥滚子轴承结构型式

WKB manufacture metric system and British system single row, double row and four row tapered roller bearing units structure.



单列圆锥滚子轴承
Single row tapered roller bearing

此种轴承只能限制轴或外壳的一个方向的轴向位移，承受一个方向的轴向载荷。在径向载荷的作用下， 轴承内产生的轴向力亦须加以平衡。应将两个轴承面对面或背对背配置使用。

The bearing can only limit one direction axial displacement of axis or case shell and carry one direction axial load. With the radial load action, the axial force produced inside bearing should be balanced. Two bearings should be face-to-face mounted or back-to-back mounted.

双列圆锥滚子轴承
Double row tapered roller bearing

此种圆锥轴承在承受径向载荷的同时可承受双向轴向载荷。可在轴承的轴向游隙范围内限制轴或外壳的双向轴向位移。

The tapered bearing can carry radial load as well as bi-directional axial load, and can limit bidirectional axial displacement of axis or case shell within the axial clearance of bearing.

四列圆锥滚子轴承
Four row tapered roller bearing

此种轴承的性能与双列圆锥滚子轴承基本相同，但比双列圆锥滚子轴承承受的径向载荷更大，极限转速稍低，主要用于重型机械，如轧钢机等。

The bearing’ s feature is mostly the same as double row tapered roller bearing, but can and carry more radial load than double row tapered roller bearing and lower limit rotation rate. This type is mainly used in heavy machinery, such as roll mill.

保持架
Cage

圆锥滚子轴承一般采用钢板冲压，筐形保持架，但尺寸较大时，亦采用车制实体支柱保持架。

Tapered roller bearings generally uses pressed steel plate basket cage, also can use turned solid cage if its dimension is bigger.

允许角度误差
Allowable angle error

圆锥滚子轴承一般不允许轴相对外壳孔有倾斜，如有倾斜，最大不得超过 2 '。

Tapered roller bearing generally is inadmissibility inclination between axis and case shell hole. If there is, it can't be bigger than 2'.

游隙
Clearance

单列圆锥滚子轴承仅在安装后才有游隙，并在用另一个以相反方向定位的轴承进行调节后才能确定。双列和四列圆锥滚子轴承游隙可根据用户要求按相应标准提供。

Clearance of single row tapered roller bearing only appear after mounting which can only be determined after adjusted by another right-about localization bearing. The clearance of double-row and four-row tapered roller bearing can be provided with relevant standard according to the requirements of the customers.

当量动载荷 Equivalent dynamic load	P=Fr	[N]Fa/Fr≤ e
	P=0.4Fr+YFa	[N]Fa/Fr>e

单列圆锥滚子轴承成对使用时(基本外形尺寸可不同)，在计算轴承的当量动载荷时，必须计入径向载荷引起的附加轴向力，单列圆锥滚子轴承的附加轴向力S， 可近似按下式计算：

As to paired mounting single row tapered roller bearing (basic dimension could be different), when calculate the equivalent dynamic load of bearing, the additive axial force caused by radial load must be also calculated. The additive axial force s of single row tapered roller bearing can be approximately calculated by the following formula.

$$S=\frac{Fr}{2Y}$$

双列和四列圆锥滚子轴承 Double row and four row tapered roller bearing	P=Fr+Y1Fa	[N] Fa/Fr≤ e
	P=0.67Fr+Y2Fa	[N] Fa/Fr > e

当量静载荷
Equivalent static load

单列圆锥滚子轴承 Single row tapered roller bearing	Po=0.5Fr+YoFa	[N]
	若Po < Fr则取Po=Fr	
双列和四列圆锥滚子轴承 Double row and four row tapered roller bearing	Po=Fr+YoFa	[N]

Fr和Fa均指作用于单列，双列和四列轴承上的总载荷。
Both Fr and Fa are total load acting on single row, double row and four row tapered roller bearing.

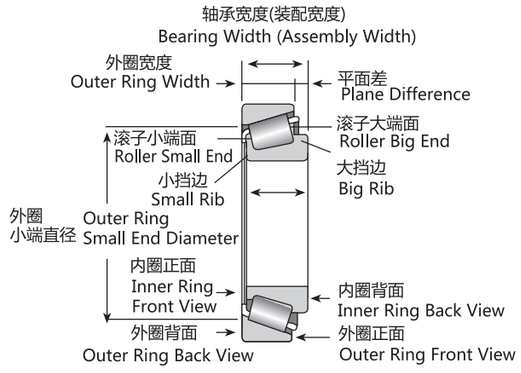
计算系数e、Y、Y1、Y2、Yo列在轴承尺寸表中。
Calculation factors such as e, Y, Y1, Y2, Yo are listed in bearing dimension table.

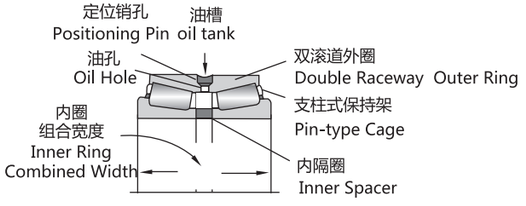
该类轴承还有英制系列产品。
This type of bearing has British system series product.

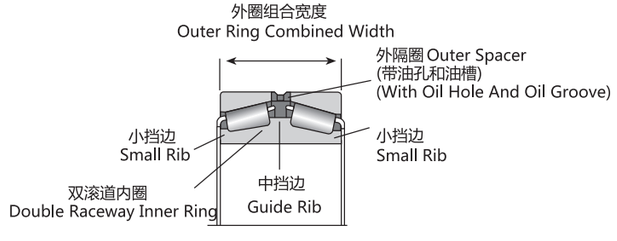
该类轴承主要用途
Main Application

汽车前轮、后轮、变速器、差速器、小齿轮轴，机床主轴，建筑机械，大型农业机械，铁路车辆齿轮减速装置，轧钢机辊颈小减速装置。

Auto front wheel, rear wheel, transmission gear, differential gear, pinion shaft,main spindle of machine tool, construction equipment, large scale agricultural machinery, speed reducer gear of railway vehicles,roll neck mini speed reducer gear of roll mill, etc.





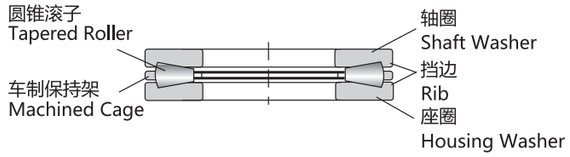


推力圆锥滚子轴承
Thrust tapered roller bearing

该类轴承装有锥形滚子(大端为球面)，滚子由滚道圈(轴圈、座圈)挡边准确引导。
设计上使得轴圈和座圈滚道面以及滚子滚动面的各圆锥面的顶点相交于轴承中心线上的一点。
单向轴承可承受单向轴向载荷。
双向轴承可承受双向轴向载荷。
双向轴承将中圈与轴配合，但由于采用间隙配合， 因此必须用轴套等使中圈轴向定位。
此类轴承主要用途：
单向：起重机吊钩，石油钻机转环。
双向：轧钢机辊颈。

This kind of bearing is equipped with tapered roller(bigger end is spherical)Its roller is led via rib of raceway ring(shaft washer, housing washer).

Design is made to the extent that cones of shaft washer, housing washer raceway and roller surface are intersected at one point of bearing central line.
One-way bearing can bear one-way axial load.
Bidirectional bearing can bear bidirectional axial load.
Bidirectional bearing is used to fit central washer for shaft. While, clearance remains, shaft sleeve must be used to axially positioning the central washer.
Main application of bearing
One-way:crane shackle, swivel of oil drilling machine
Bidirectional:roller neck of rolling mill



推力调心滚子轴承
Thrust spherical roller bearing

该类轴承滚子为球面型，由于座圈滚道面呈球面， 具有调心性能。轴向载荷能力非常大，在承受轴向载荷的同时还可承受若干径向载荷。
推力调心滚子轴承能同时承受轴向和径向载荷，但径向载荷不得超过轴向载荷的55%，这种轴承具有自动调心性能，因此，对同轴度和轴的挠曲不甚敏感。
只要载荷P和Po不超过0.05Co，且轴圈旋转，则轴承允许下表所列的调心角。

Roller of this kind of bearing is spherical. Because housing washer raceway is spherical, it functions self-aligning.
Featuring high capability to bear axial load, this bearing can bear axial load as well as several radial loads at the same time.
Thrust spherical roller bearing can bear axial and radial load, but radial load can not exceed 55% of axial load . This bearing functions self-aligning. Thus, it is not sensitive to coaxality and shaft deformation.
If load P and P0 don’ t exceed 0.05Co, and shaft washer rotate normally,bearing can be adjusted with self-aligning angle in the following table:

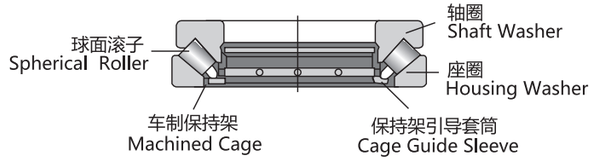
轴承直径系列 Bearing diameter series	调心角 self-aligning angle
200系列 200series	1° ~1.5°
300系列 300series	1.5° ~2°
400系列 400series	2° ~3°

小的数值适用于较大的轴承，而且载荷增大时允许的调心角将会减小。
使用时一般采用油润滑。

Small value is applicable for bigger sized bearing. Allowed self-aligning angle decreases when load increases.
When in operation, lubricant is used generally.

该类轴承主要应用于水力发电机，立式电动机，船舶用螺旋桨轴，塔吊，挤压机等。

This kind of bearing is mainly used for hydro generator, vertical motor, helix marine shaft, tower crane and extrusion machine etc



推力圆柱滚子轴承
Cylindrical roller thrust bearing

由垫圈形滚道圈(轴圈、座圈)与圆柱滚子和保持架组件构成。圆柱滚子采用凸面加工，因此滚子与滚道面之间的压力分布均匀。
可承受单向轴向载荷。
轴向载荷能力大，轴向刚性也强。

Cylindrical roller thrust bearing is composed of washer raceway (shaft washer, house washer) , cylindrical roller and cage parts. The logarithmic crowning of cylindrical roller distributes a uniform pressure between roller and raceway surface.
The bearing can carry one-way axial load.
Big axial load carrying capacity, and strong axial rigidity.

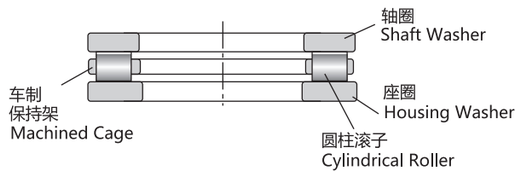
当量动载荷
Equivalent dynamic load

推力圆柱滚子轴承 Thrust cylindrical roller bearing	P=Fa
推力调心滚子轴承 Thrust spherical roller bearing	P=Fa+1.2Fr

当量静载荷
Equivalent static load

推力圆柱滚子轴承 Thrust cylindrical roller bearing	Po=Fa

推力调心滚子轴承
Thrust cylindrical roller bearing
Po=Fa+2.7Fr
该类轴承主要应用于石油钻机，制铁制钢机械。
This type bearing is mainly used in oil well rig, iron and steel manufacture machinery.



主要尺寸
Main dimension

轴承的主要尺寸，是指表示外形轮廓的轴承内径、外径、宽度或高度和倒角尺寸等，是轴承在轴上及外壳内安装时的必需尺寸。
这些主要尺寸已由国际标准(ISO15)标准化了。
国家标准中按向心轴承(圆锥滚子轴承另行规定)和推力轴承的型式分别对主要尺寸做了规定，具体轴承的尺寸都列于后面的产品目录中。

Main dimensions of bearing indicate the bearing bore diameter, outer diameter, width, height and chamfer dimension, etc. of profile, which are the required dimensions when mounting bearing on shaft or inside case shell.

The main dimension is standardized by international standard (ISO15).

National standard specified separately the main dimension of radial bearing " Tapered roller bearing specified separately " and Thrust bearing, dimensions of specific bearing are liseted in following product catalogue.

向心轴承
Radial bearing

(圆锥滚子轴承除外)
向心轴承
(圆锥滚子轴承除外)
d:轴承公称内径
D:轴承公称外径
B:轴承公称宽度
r:内圈及外圈倒角尺寸

(exclusive Tapered Roller Bearing)
Radial bearing
(exclusive tapered roller bearing)
d:Bearing nominal inner diameter
D:Bearing nominal outer diameter
B:Bearing nominal width
r:Chamfer dimension of inner ring and outer ring

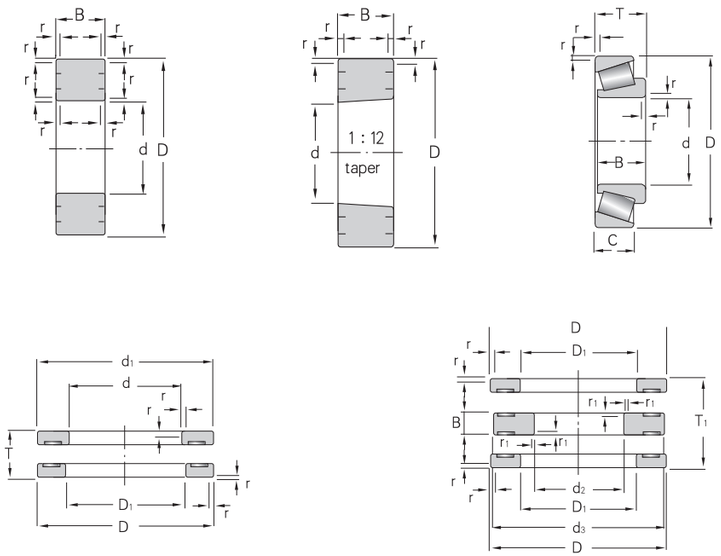
圆锥滚子轴承
Tapered roller bearing

圆锥滚子轴承
d:轴承公称内径
D:轴承公称外径
T:轴承公称宽度(装配宽度)

B:内圈公称宽度
C:外圈公称宽度
r:内圈及外圈倒角尺寸

Tapered roller bearing
d: Bearing nominal inner diameter
D: Bearing nominal outer diameter
T: Bearing nominal width (mounting width)

B: Inner ring nominal width
C: Outer ring nominal width
r: Chamfer dimension of inner ring and outer ring



推力轴承(单向、双向)
Thrust bearing (single row, double row)

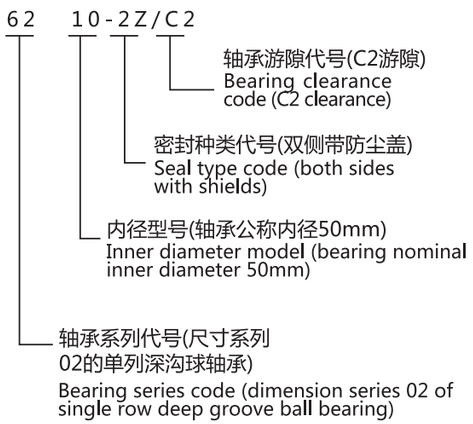
推力轴承(平面座圈型)
d:轴圈公称内径
d1:轴圈公称内外径2)
d2:中圈公称内径
d3:中圈公称外径2)
D:座圈公称外径
D1:座圈公称内径1)
T:单向轴承公称高度
T1:双向轴承公称高度
B:中圈高度
r:轴圈及座圈倒角尺寸1)
r1:中圈倒角尺寸1)

[注]
1)轴承尺寸表列出的是最小值
2)轴承尺寸表列出的是最大值

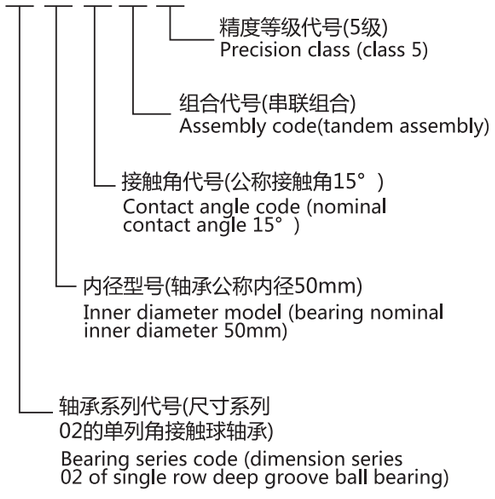
Thrust bearing (plane housing washer model)
d: Shaft washer nominal inner diameter
d1: Shaft washer nominal inner/outer diameter2)
d2: Central washer nominal inner diameter
d3: Central washer nominal outer diameter2)
D: Housing washer nominal outer diameter
D1: Housing washer nominal inner diameter1)
T: Single row bearing nominal height
T1: Double row bearing nominal height
B: Central washer height
r: Shaft washer and housing washer chamfer dimension1)
r1:Central washer chamfer dimension 1)

(Note)
1) Value listed in bearing dimension table is minimum value
2) Value listed in bearing dimension table is maximum value

公称型号示例
Nominal model sample



7 2 1 0 C / D T P 5



轴承代号
Bearing code

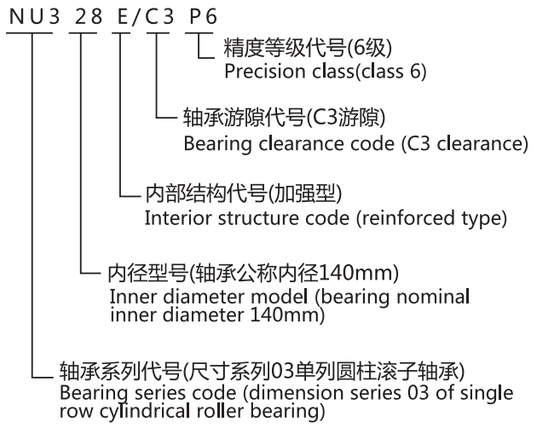
轴承的代号表示轴承的结构型式、主要尺寸、旋转精度、内部游隙等，它由基本代号、前置代号和后置代号构成。
WKB还使用ISO规定以外的后置代号。
表2.1表示基本代号中的轴承系列代号，图2.1表示轴承代号的构成和前置代号、后置代号的定义。

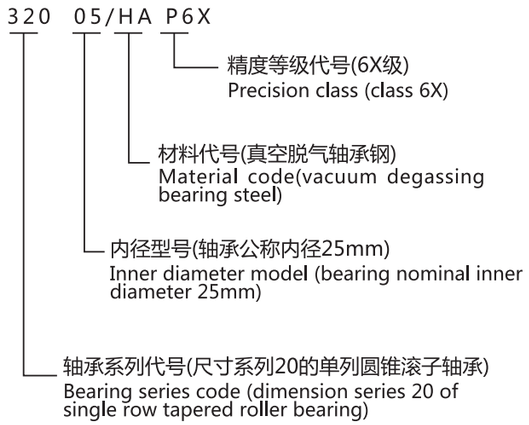
Code of bearing indicates the structure of bearing, main dimension, rotary accuracy , internal clearance, etc. It consists of basic code, prefix and suffix.

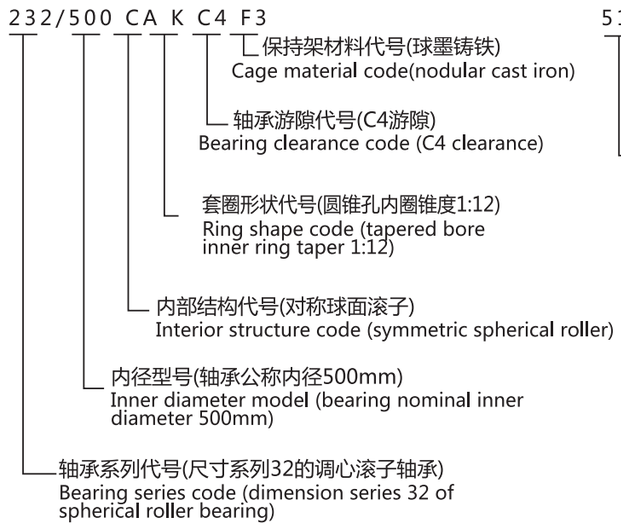
WKB also use suffix code beyond ISO specified.

Sheet 2.1 indicates bearing series code of basic code, diagram 2.1 indicates the structure of bearing code and the definition of prefix and suffix.

公称型号示例
Nominal model sample







轴承系列代号
Bearing series code

轴承型式 Bearing model	轴承系列代号 Bearing series code	类型代号 Type code	尺寸系列代号 Dimension series code
单列 深沟球轴承 Single row deep groove ball bearing	618 619 160 60 62 63 64	6 6 6 6 6 6 6	18 19 (0)0 (1)0 (0)2 (0)3 (0)4
双列 深沟球轴承(有装填槽) Double row deep groove ball bearing (with filing slot)	42 43	4 4	(2)2 (2)3
单列 角接触球轴承 Single row angular contact ball bearing	719 70 72 73 74	7 7 7 7 7	19 (1)0 (0)2 (0)3 (0)4
双列 角接触球轴承(有装填槽) Double row angular contact ball bearing (with filing slot)	32 33		32 33
四点 接触球轴承 Four point contact ball bearing	QJ2 QJ3	QJ	(0)2 (0)3
调心球轴承 Self- aligning ball bearing	12 22 13 23	1 (1) 1 (1)	(0)2 22 (0) 23
单列圆柱滚子轴承 Single row cylindrical roller bearing	NU10 NU2 NU22 NU32 NU3 NU23 NU4	NU NU NU NU NU NU NU	10 (0)2 22 32 (0)3 23 (0)4
双列圆柱滚子轴承 Double row cylindrical roller bearing	NNU49 NN30	NNU NN	49 30

轴承系列代号
Bearing series code

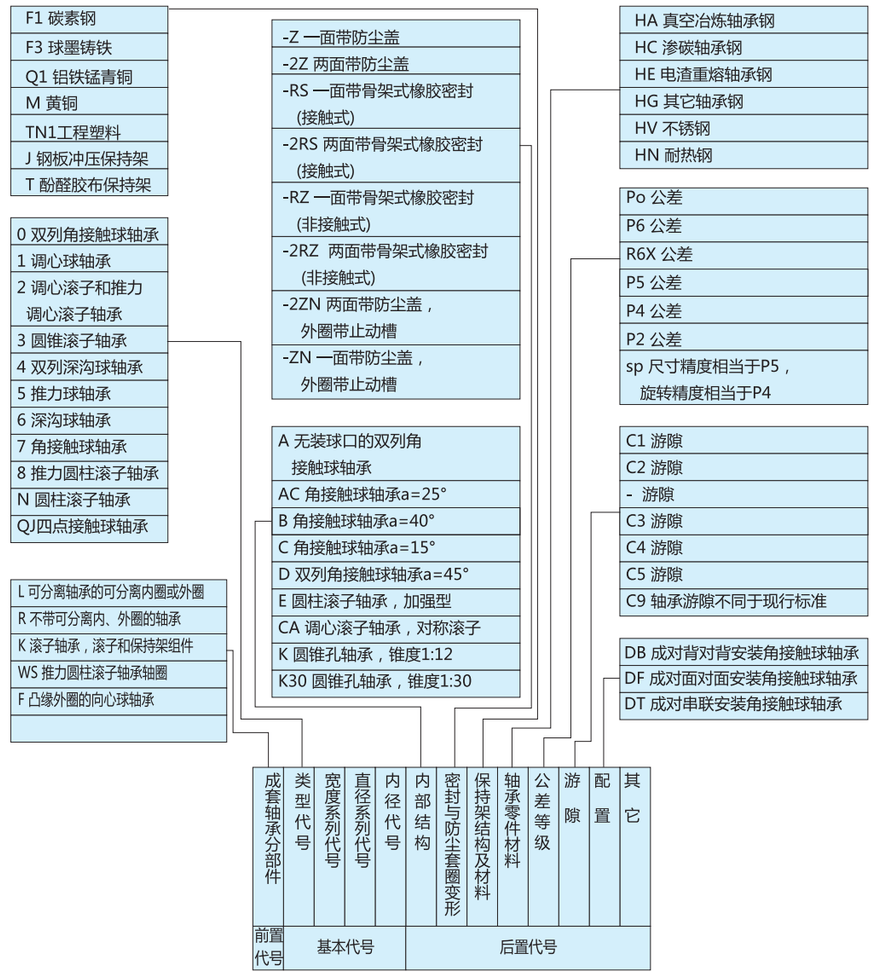
轴承型式 Bearing model	轴承系列代号 Bearing series code	类型代号 Type code	尺寸系列代号 Dimension series code
圆锥滚子轴承 Tapered roller bearing	329 320 330 331 302 322 332 303 313 323	3 3 3 3 3 3 3 3 3 3	29 20 30 31 02 22 32 03 13 23
调心滚子轴承 Spherical roller bearing	239 230 240 231 241 222 232 213 223	2 2 2 2 2 2 2 2 2	39 30 40 31 41 22 32 03 23
单向 平面座圈型 推力球轴承 Single row plane housing washer type thrust ball bearing	511 512 513 514	5 5 5 5	11 12 13 14
单向 调心座圈型 推力球轴承 Single row self aligning housing washer type thrust ball bearing	532 533 534	5 5 5	32 33 34
双向 平面座圈型 推力球轴承 Bidirectional plane housing washer type thrust ball bearing	522 523 524	5 5 5	22 23 24
双向 调心座圈型 推力球轴承 Bidirectional self aligning housing washer type thrust ball bearing	542 543 544	5 5 5	42 43 44
推力调心 滚子轴承 Thrust spherical roller bearing	292 293 294	2 2 2	92 93 94

表示的宽度系列代号在轴承系列代号中省略。
Indicates the width series code which omitted in bearing series code

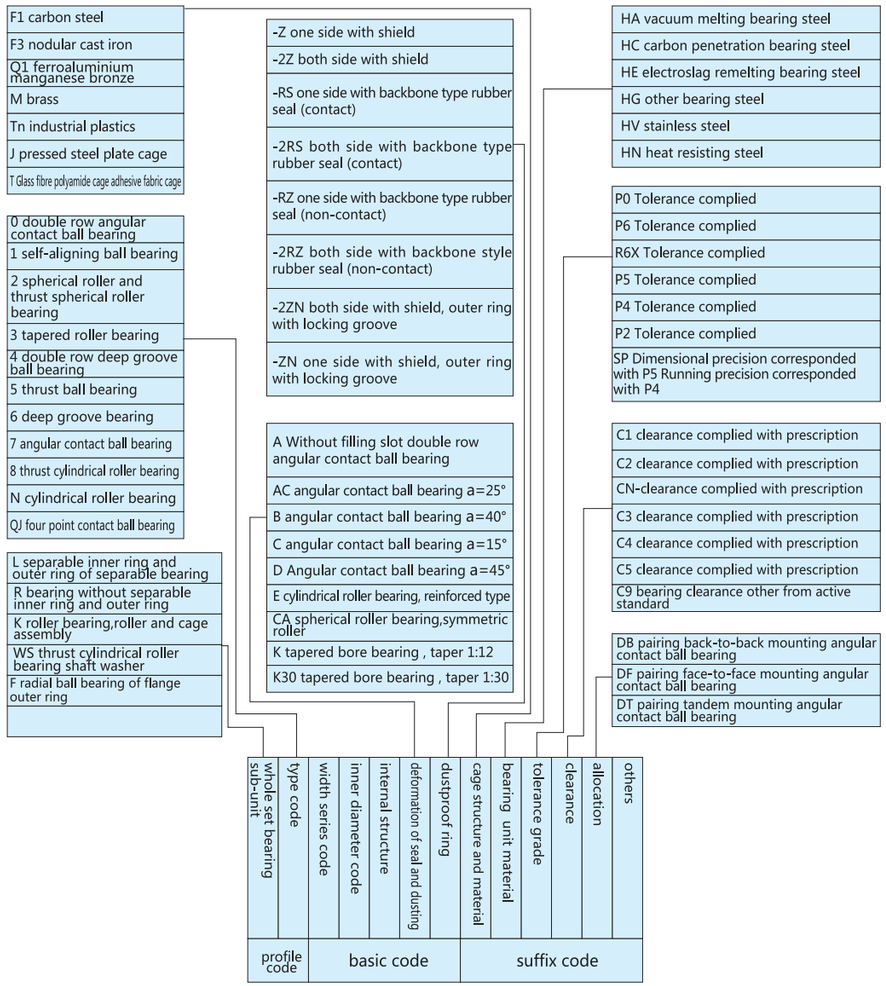
圆柱滚子轴承
Cylindrical Roller Bearing

除NU型外，还有NJ、NUP、N、NF、NH各型。
Besides type NU, cylindrical roller bearing also includes type NJ, NUP, N, NH.

WKB 轴承代号



WKB bearing code



轴承的精度与等级
Bearing precision and grade

滚动轴承的精度分(主要)尺寸精度与旋转精度。
精度等级已标准化，分为0级、6X级、P6级、P5级、P4级、P2级六个等级。

精度从0级起依次提高，对于一般用途0级已足够,但在用于表3.1所示条件或场合时，需要5级或更高的精度。
以上的精度等级虽然是以ISO标准为基准制定的， 但其称呼在各国标准中有所不同。

Accuracy of roller bearing is described (mainly) by dimensional accuracy and rotating accuracy .

Accuracy grade has been standardized, described by grade 0, grade 6X, grade P6, grade P5, grade P4 and grade P2 totally 6 grades.
Accuracy increases progressively from grade 0, Grade 0 is enough for general use, but in case of condition and situation listed in sheet 3.1, it needs grade 5 or higher grade accuracy.

Although accuracy grade above are specified based on ISO standard, its designation may be varied in different country's standard.

表3.2列出了各种轴承型式所适用的精度等级。
尺寸精度(与轴及外壳安装有关的项目)
内径、外径、宽度及装配宽度的允许偏差
滚子组内复圆直径及外复圆直径的允许偏差
倒角尺寸的允许界限值
宽度的允许变动量
圆锥孔的允许偏差和允许变动量

旋转精度(与旋转体跳动有关的项目)，
内圈及外圈的允许径向跳动和轴向跳动，
内圈的允许横向跳动，
外径面倾斜度的允许变动量，
推力轴承滚道厚度的允许变动量，
各类轴承的尺寸精度与旋转精度如
表4-1～4-19所示，
倒角尺寸界限值如表4-20～4-21所示。

Sheet 3.2 lists the precision grade applied to different bearing types
Dimensional precision (relevant to shaft and case shell mounting)
Permissible variation of inner diameter, outer diameter, width and assembly width
Permissible variation of roller set diameter under rollers and roller set diameter over rollers
Permissible limit value of chamfer dimension
Permissible variant of width
Permissible variation and permissible variant of tapered bore
Rotating precision (article relevant to rotary body runout)
Permissible radial runout and axial runout of inner ring and outer ring
Permissible horizontal runout of inner ring
Permissible variant of outer diameter surface gradient
Permissible thickness variant of thrust bearing raceway
Dimensional precision and running precision of different forms of bearing described from sheet 4-1 to sheet 4-19.
Limit value of chamfer dimension is described from sheet 4-20 to sheet 4-21.

表3.1精度轴承用例
Sheet 3.1 Sample of precision bearing

性能要求 Performance requirement	用 例 Sample	适用精度等级 Precision grade applied
要求旋转体具有高跳动精度 High requirement of rotary body runout precision	音响，影像机器主轴(录像机，录音机) 雷达，抛物面天线转轴 机床主轴 电子计算机，磁盘主轴 铝箔辊颈 多辊轧钢机支承轴承 Sounding, Chief axis of video machine (Video recorder, Sound recorder) Radar, Shaft of parabolic antenna Main spindle of machine tool Electronic computer, Chief axis of disc Aluminum foil roll neck Multilevel steel rolling block bearing	P5,P4 P4 P5,P4,P2,ABEC9 P5,P4,P2,ABEC9 P5 P4
高速旋转 High-rotating	增强器 喷气式发动机主轴，辅机 离心分离机 液化天然气泵 涡轮分子泵主轴，保护轴承 机床主轴 张紧轮 Enhancer Chief axis of jet engine, Assisting locomotive Centrifugal separator LNG pump Chief axis of turbo molecular pump, Safeguard bearing Main spindle of machine tool Tension pulley	P5,P4 P5,P4 P5,P4 P5 P5,P4 P5,P4,P2,ABEC9 P5,P4
要求摩擦及摩擦变化小 Less friction and less variation of friction required	控制机器 (同步马达、伺服马达，陀螺万向架) 计量仪表 机床主轴 Controlling machine (Synchronous motor, Serve motor, Whirligig gimbal mount) Metering device Main spindle of machine tool	P4,ABMA 7P P5 P5,P4,P2,ABEC9

表3.2轴承类型与适用精度等级
Sheet 3.2 Bearing types and precision grade applied to each other

轴承型式 Bearing type		适用标准 Applied standard	适用精度等级 Applied precision grade						参照表 Reference sheet
深沟球轴承 Deep groove bearing		ISO	0级		6级	5级	4级	2级	
角接触球轴承 Angular contact ball bearing			0级		6级	5级	4级	2级	
调心球轴承 Spherical ball bearing			0级						表3.3
圆柱滚子轴承 Cylindrical roller bearing			0级		6级	5级	4级	2级	
圆锥滚子轴承 tapered roller bearing	公制系列(单列) metric series(single row)	ISO SB/T53419-94 SB/CO/T10-89	0级	6X级	6级	5级	4级		表3.4
	公制系列(双列、四列) metric series(double row four row)		0级						
	英制系列 British series		Class4		Class2	Class3	Class0	Class00	
调心滚子轴承 Spherical roller bearing		ISO	0级						表3.3
推力球轴承 Thrust ball bearing			0级		6级	5级	4级		表3.5
推力调心滚子轴承 Thrust spherical roller bearing			0级						表3.6

公差
Tolerance

公差
Tolerance

ISO规定了轴承的尺寸公差旋转公差。ISO标准规定了关于尺寸和公差定义。
符合公差等级PN(普通级公差)的轴承能够满足机械典型运用的质量要求。
机床和测量仪器等设备对工作精度、转速和平稳性有很高的要求，这时候可选用P6、P6X。（达不到要求，无需采用）
除了标准中规定的公差等级的轴承之外，WKB还生产标准中没有的P4S、SP(超高精度)和UP(特超高精度)公差等级的轴承。

ISO specifies the dimension tolerance and rotation tolerance. ISO standard specifies the definition of dimension and tolerance.

Bearing complied with grade PN tolerance (normal tolerance) can meet the quality requirement of typical machine operating.

Devices such as machine tool, measuring instrument, requires high operating precision , rotation rate and stability, so as to choose P6, P6X. (Needn’ t choose if not required)

Besides the bearings at tolerance grades stipulated in the standards, WKB also manufactures those at P4S, SP (super high precision) and UP (ultra super high precision) tolerance grades not stipulated in the standards.

公差符号
Tolerance symbol

内径
Inner diameter

d　轴承公称内径（锥形孔时为最小理论径）
dS　在单一平面上测得的内径（单一内径）
dmp 轴承孔平均直径:单一径向平面(横截面)内圆柱形轴承孔最大和最小的算术平均值
　　锥形孔小端理论平均直径;实测最大和最小直径的算术平均值
d1mp 锥形孔大端理论平均直径;实测最大和最小直径的算术平均值
△ dmp=dmp-d
　单一内径直径偏差
△ ds=ds-d
　单一内径直径偏差
△ dlmp=dlmp-d1
　圆锥孔较大端平均直径与公称直径之差
Vdp　内径变动量;圆柱形孔单一径向平面(横截面)上的最大直径与最小直径之差
Vdmp=dmpmax-dmpmin
　平均内径变动量;轴承内径最大与最小平均直径之差

d Bearing nominal inner diameter(tapered hole will be minimum theoretical diameter)
dS Inner diameter(single inner diameter)measured in single plane
1.Mean diameter of bearing hole:arithmetical average value of the maximum and minimum value of cylindrical bearing bore hole in single radial plane(cross-section)
2.Theoretical mean diameter of tapered bore hole tip end :Arithmetical average value of the maximum and minimum measured value of diameter
d1mp Theoretical average diameter of tapered bore hole big end:Arithmetical average value of the maximum and minimum measured value of diameter
△ dmp=dmp-d
Diameter deviation of single inner diameter
△ ds=ds-d
Diameter deviation of single inner diameter
△ d1mp=d1mp-d1
Difference between mean diameter and nominal diameter of tapered bore big end
Vdp variant of inner diameter: Difference between the maximum diameter and minimum diameter of cylindrical bore hole in single radial plane (cross-section) Vdmp=dmpmax-dmpmin
Variant of mean inner diameter: Difference between the maximum mean diameter and minimum mean diameter of bearing inner diameter.

外径
Outer diameter

D　公称外径
DS 单一位置测得的外径
dmp 平均外径;单一径向平面上最大和最小外径的算术平均值
△ Dmp=Dmp-D
　单一平面平均外径偏差
△ Ds=Ds-D
　单一外径与公称外径之差
VDp 外径变动量;单一径向平面上外径的最大与最小值之差
VDmp=Dmpmax-Dmpnin
　平均外径变动量;最大与最小平均外径之差

D Nominal outer diameter
DS Outer diameter measured on single position
Dmp Mean outer diameter: arithmetical average value of the maximum and minimum diameter of outer diameter on single radial plane
△ Dmp=Dmp-D
　Deviation of average outer diameter on single plane
△ Ds=Ds-D
　Difference between single outer diameter and nominal outer diameter
VDp variant of outer diameter: difference between the maximum value and minimum value of outer diameter on single radial plane
VDmp=Dmpmax-Dmpmin
Variant of mean outer diameter: difference between the maximum mean diameter and minimum mean diameter of outer diameter.

宽度和高度
Width and height

Bs、Cs 套圈单一宽度（内圈和外圈）
▵ Bs=Bs-B,▵ Cs=Cs-C
单一宽度偏差（内圈和外圈）：套圈单一宽度与公称宽度之差
VBS=Bsmax-Bsmin,VCS=Csmax-Csmin
内圈和外圈宽度变动量；最大与最小套圈单一宽度之差
T1s 圆锥滚子轴承单一总宽度
T18 外圈有挡边的圆锥滚子轴承单一总宽度
T2s 内圈有挡边的圆锥滚子轴承单一总宽度
▵ ts=Ts-T,▵ tls-Tls-Tl,▵ T2s=T2
圆锥滚子轴承单一总宽度偏差；单一a）标准中推力轴承的总高度用T表示。总宽度与公称宽度之差a）Hs，Hls，H2s，H3s，H4s

Bs, Cs Ring single width (inner ring and outer ring)
△Bs=Bs-B, △Cs=Cs-C
Single width deviation (inner ring and outer ring): Difference between single width and nominal width of ring
VBS=Bsmax-Bsmin,VCS=Csmax-Csmin
T1s Single overall width of tapered roller bearing
T18 Single overall width of tapered roller bearing which has outer ring with rib
T2 Single overall width of tapered roller bearing which has inner ring with rib
△ts=Ts-T, △t1s=T1s-T1, △T2s=T2
Single overall width deviation of tapered roller bearing: Total height of thrust bearing in standard is indicated by T, a difference between overall and nominal width single-a))Hs,H1s, H2s, H3s, H4s

推力轴承单一总高度
Single total height of thrust bearing

α ）▵ Hs=Hs-H,▵ Hls=Hls-H1,▵ H2s=H2s-Hs,... ...
推力轴承单一总高度的偏差：单一总高度与公称高度之差
旋转精度
Kia 成套轴承内圈的径向跳动
Kea 成套轴承外圈的径向跳动
Sd 内圈基准端面（背面）对内孔的跳动
SD 外径表面母线对基准端面（背面）的倾斜度变动量（端面跳动）
Sia 成套轴承内圈端面（背面）对滚道的跳动（轴向跳动）
Sea 成套轴承外圈端面（背面）对滚道的跳动（轴向跳动）
Si 轴圈滚道对底面厚度的变动量（推力轴承的轴向跳动）
Se 座圈滚道对底面厚度的变动量（推力轴承的轴向跳动）

α ）▵ Hs=Hs-H,▵ Hls=Hls-H1,▵ H2s=H2s-Hs,... ...
Variant of single total height of thrust bearing
Running Accuracy
Kia Radial runout of whole set bearing inner ring
Kea Radial runout of whole set bearing outer ring
Sd Runout between datum end face (back) inner ring and hole
SD Lean variant between outer diameter surface generatrix and datum end face (back) (end face runout)
Sia Runout between inner ring end face (back) and raceway of whole set bearing (radial runout)
Sea Runout between outer ring end face (back) and raceway of whole set bearing (axial runout)
Si Variant of shaft washer raceway to subface thickness (axial runout of thrust bearing)
Se Variant of housing washer raceway to subface thickness (axial runout of thrust bearing)

Kia　成套轴承内圈的径向跳动
Kea　成套轴承外圈的径向跳动
Sd　内圈基准端面（背面）对内孔的跳动
SD　外径表面母线对基准端面（背面）的倾斜度变动量
SD1　外径表面母线对凸缘背面的倾斜度变动量
Sia　成套轴承内圈端面（背面）对滚道的跳动
Sea　成套轴承外圈端面（背面）对滚道的跳动
Seal　成套轴承凸缘背面对滚道的跳动
Si　轴圈滚道对底面厚度变动量（用于推力轴承）
Se　座圈滚道对底面厚度变动量（用于推力轴承）
T　圆锥滚子轴承公称宽度
△ TS　圆锥滚子轴承实际宽度偏差
T1　圆锥滚子轴承内组件与标准外圈组成轴承的公称宽度
△ T1s T1的实际偏差
T2　圆锥滚子轴承外圈与标准内组件组成轴承的公称宽度T2的实际测差
△ T2　T2实测偏差

Kia Radial runout of whole set bearing inner ring
Kea Radial runout of whole set bearing outer ring
Sd Runout between datum end face (back) inner ring and hole
SD Lean variant between outer diameter surface generatrix and datum end face (back)
SD1 Lean variant between outer diameter surface generatrix and flange back face
Sia Runout between inner ring end face (back) and raceway of whole set bearing
Sea Runout between outer ring end face (back) and raceway of whole set bearing
Sea1 Runout between flange back face and raceway of whole set bearing
Si Variant of shaft washer raceway to subface thickness (of thrust bearing)
Se Variant of housing washer raceway to subface thickness (of thrust bearing)
T Tapered roller bearing nominal width
△ TS Tapered roller bearing actual width deviation
T1 Tapered roller bearing interior assembly and standard outer ring constitute nominal width of bearing
△ T1S Actual deviation of T1
T2 Tapered roller bearing outer ring and standard interior assembly constitute deviation of bearing nominal width T2
△ T2 T2 Actual measurement deviation

4.2各类轴承公差表
4.2 Bearing Tolerance Table

P0级向心轴承公差(圆锥滚子轴承除外)
Tolerance of class-P0 radial bearing (excluding tapered roller bearing)

表4-1
Table 4-1　　内圈 Inner Ring　　单位 Unit:：μm

d mm		△ dmp		Vdsp 直径系列 Diameter Series 8,9 0,1 2,3,4			Vdmp	△ Bs				VBS	Kia
								正常Normal		修正 Modification			
超过 Over	到 To	上 Upper	下 Lower	最大 Max.	最大 Max.	最大 Max.	最大 Max.	上 Upper	下 Lower	上 Upper	下 Lower	最大 Max.	最大 Max.
80	120	0	-20	25	25	15	15	0	-200	0	-380	25	25
120	180	0	-25	31	31	19	19	0	-250	0	-500	30	30
180	250	0	-30	38	38	23	23	0	-300	0	-500	30	40
250	315	0	-35	44	44	26	26	0	-350	0	-500	35	50
315	400	0	-40	50	50	30	30	0	-400	0	-630	40	60
400	500	0	-45	56	56	34	34	0	-450			50	65
500	630	0	-50	63	63	38	38	0	-500			60	70
630	800	0	-75					0	-750			70	80
800	1000	0	-100					0	-1000			80	90
1000	1250	0	-125					0	-1250			100	100
1250	1600	0	-160					0	-1600			120	120

P0级向心轴承公差（圆锥滚子轴承除外）
Tolerance of class-P0 radial bearing (excluding tapered roller bearing)

表4-2
Table 4-2　　外圈 Outer Ring　　单位 Unit: : μm

D mm		△ Dmp		VDsp 开型轴承 Open Bearing 闭型轴承 Capped Bearing 直径系列 Diameter Series			VDmp	△ cs △ c1s	Vcs Vc1s	Kea
				8,9	0,1	2,3,4				
超过 Over	到 To	上 Upper	下 Lower	最大 Max.	最大 Max.	最大 Max.	最大 Max.			最大 Max.
80	120	0	-15	19	19	11	11	与同一轴承内圈的△ Bs, △ BIs, VBS,的数值相同 Same as the values of △ Bs, △ BIs and VBs for the inner ring of the same bearing		35
120	150	0	-18	23	23	14	14			40
150	180	0	-25	31	31	19	19			45
180	250	0	-30	38	38	23	23			50
250	315	0	-35	44	44	26	26			60
315	400	0	-40	50	50	30	30			70
400	500	0	-45	56	56	34	34			80
500	630	0	-50	63	63	38	38			100
630	800	0	-75	94	94	55	55			120
800	1000	0	-100	125	125	75	75			140
1000	1250	0	-125							160
1250	1600	0	-160							190

P6级向心轴承公差（圆锥滚子轴承除外）
Tolerance of class-P6 radial bearing (excluding tapered roller bearing)

表4-3
Table 4-3　　内圈 Inner Ring　　单位 Unit: : μm

d mm		△ dmp		Vdsp 直径系列 Diameter Series			Vdmp	△ Bs				VBs	Kia
				8,9	0,1	2,3,4		正常 Normal		修正 Modification			
超过 Over	到 To	上 Upper	下 Lower	最大 Max.	最大 Max.	最大 Max.		上 Upper	下 Lower	上 Upper	下 Lower	最大 Max.	最大 Max.
80	120	0	-15	19	19	11	11	0	-200	0	-380	25	13
120	180	0	-18	23	23	14	14	0	-250	0	-500	30	18
180	250	0	-22	28	28	17	17	0	-300	0	-500	30	20
250	315	0	-25	31	31	19	19	0	-350	0	-500	35	25
315	400	0	-30	38	38	23	23	0	-400	0	-630	40	30
400	500	0	-35	44	44	26	26	0	-450			45	35
500	630	0	-40	50	50	30	30	0	-500			50	40
630	800	0	-50					0	-750			55	45
800	1000	0	-60					0	-1000			60	50
1000	1250	0	-75					0	-1250			70	70
1250	1600	0	-90					0	-1600			70	80

P6级向心轴承公差（圆锥滚子轴承除外）
Tolerance of class-P6 radial bearing (excluding tapered roller bearing)

表4-4
Table 4-4　　外圈 Ou er Ring　　单位 Unit: : μm

D mm		△ Dmp		VDSp 开型轴承 Open Bearing 闭型轴承 Capped Bearing 直径系列 Diameter Series			VDmp	△ cs △ c1s	Vcs Vc1s	Kea
超过 Over	到 To	上 Upper	下 Lower	8,9 最大 Max.	0,1 最大 Max.	2,3,4 最大 Max.	最大 Max.			最大 Max.
80	120	0	-13	16	16	10	10	与同一轴承内圈的△ Bs, △ BIs,Vbs,的数值相同 Same as the values of △ Bs, △ BIs and VBs for the inner ring of the same bearing		18
120	150	0	-15	19	19	11	11			20
150	180	0	-18	23	23	14	14			23
180	250	0	-20	25	25	15	15			25
250	315	0	-25	31	31	19	19			30
315	400	0	-28	35	35	21	21			35
400	500	0	-33	41	41	25	25			40
500	630	0	-38	48	48	29	29			50
630	800	0	-45	56	56	34	34			60
800	1000	0	-60	75	75	45	45			70
1000	1250	0	-75							80

P5级向心轴承公差（圆锥滚子轴承除外）
Tolerance of class-P5 radial bearing (excluding tapered roller bearing)

表4-5
Table 4-5　　内圈 Inner Ring　　单位 Unit: : μm

d mm		△ dmp		Vdsp 直径系列 Diameter Series		Vdmp	△ Bs		△ BI		VBs	Kia	Sd	Sia
				7,8,9	0,1,2,3,4									
超过 Over	到 To	上 Upper	下 Lower	最大 Max.	最大 Max.	最大 Max.	上 Upper	下 Lower	上 Upper	下 Lower	最大 Max.	最大 Max.	最大 Max.	最大 Max.
80	120	0	-10	10	8	5	0	-200	0	-380	7	6	9	9
120	180	0	-13	13	10	7	0	-250	0	-380	8	8	10	10
180	250	0	-15	15	12	8	0	-300	0	-500	10	10	11	13
250	315	0	-18	18	14	9	0	-350	0	-500	13	13	13	15
315	400	0	-23	23	18	12	0	-400	0	-630	15	15	15	20
400	500	0	-28				0	-450			18	17	18	23
500	630	0	-35				0	-500			20	19	20	25
630	800	0	-45				0	-750			26	22	26	30

P5级向心轴承公差（圆锥滚子轴承除外）
Tolerance of class-P6 radial bearing (excluding tapered roller bearing)

表4-6
Table 4-6 外圈 Outer Ring 单位 Unit: : μm

D mm		△ D_{mp}		V_{Dsp} 直径系列 Diameter Series 7,8,9	0,1,2,3,4	V_{Dmp}	△ C_s	V_{Cs}	K_{ea}	SD	S_{ea} [2]
超过 Over	到 To	上 Upper	下 Lower	最大 Max.	最大 Max.	最大 Max.	最大 Max.	最大 Max.	最大 Max.	最大 Max.	最大 Max.
80	120	0	-10	10	8	5	与同一轴承内圈圈 △ Bs △ Bls 数值相同 Same asthe values of △ Bs and△ Bls for the inner ring of the same bearing	8	10	9	11
120	150	0	-11	11	8	6		8	11	10	13
150	180	0	-13	13	10	7		8	13	10	14
180	250	0	-15	15	11	8		10	15	11	15
250	315	0	-18	18	14	9		11	18	13	18
315	400	0	-20	20	15	10		13	20	13	20
400	500	0	-23	23	17	12		15	23	15	23
500	630	0	-28	28	21	14		18	25	18	25
630	800	0	-35	35	26	18		20	30	20	30
800	1000	0	-50					25	35	30	35

1)不适用于具有密封或防尘盖的闭型轴承
2)仅适用于深沟和角接触轴承

1)Not applicable to the capped bearing with seal or dust cap
2)Only applicable to deep-groove bearing and angular contact bearing

P0级圆锥滚子轴承公差(公制)
Tolerance of class-P0 tapered roller bearing (metric system)

表4-7
Table 4-7 内圈和轴承组件宽度 Inner Ring and Bearing Assembly Width 单位 Unit: : μm

d mm		△ d_{mp}		△ d_{sp}	V_{dmp}	△ B_s		K_{ia}	△ T_s		△ $T1_s$		△ $T2_s$	
超过 Over	到 To	上 Upper	下 Lower	最大 Max.	最大 Max.	上 Upper	下 Lower	最大 Max.	上 Upper	下 Lower	上 Upper	下 Lower	上 Upper	下 Lower
80	120	0	-20	20	15	0	-200	30	+200	-200	+100	-100	+100	-100
120	180	0	-25	25	19	0	-250	35	+350	-250	+150	-150	+200	-100
180	250	0	-30	30	23	0	-300	50	+350	-250	+150	-150	+200	-100
250	315	0	-35	35	26	0	-350	60	+350	-250	+150	-150	+200	-100
315	400	0	-40	40	30	0	-400	70	+400	-400	+200	-200	+200	-200
400	500	0	-45	45	34	0	-450	80	+450	-450				
500	630	0	-60	60	40	0	-500	90	+500	-500				
630	800	0	-75	75	45	0	-750	100	+600	-600				
800	1000	0	-100	100	55	0	-1000	115	+750	-750				
1000	1250	0	-125			0	-1250	130	+900	-900				
1250	1600	0	-160			0	-1600	150	+1050	-1050				
1600	2000	0	-200			0	-2000	170	+1200	-1200				

P0级圆锥滚子轴承公差(公制)
Tolerance of class-P0 tapered roller bearing (metric system)

表4-8
Table 4-8 外圈 Outer Ring 单位 Unit:：μm

D mm		△ Dmp		△ Dsp	VDmp	△ Cs	Kea
超过 Over	到 To	上 Upper	下 Lower	最大 Max.	最大 Max.		最大 Max.
80	120	0	-18	18	14		35
120	150	0	-20	20	15		40
150	180	0	-25	25	19		45
180	250	0	-30	30	23		50
250	315	0	-35	35	26		60
315	400	0	-40	40	30		70
400	500	0	-45	45	34		80
500	630	0	-50	60	38		100
630	800	0	-75	80	55		120
800	1000	0	-100	100			140
1000	1250	0	-125	130			160
1250	1600	0	-160	170			180
1600	2000	0	-200				200
2000	2500	0	-250				220

与同一轴承内圈△ Bs的数值相同

Same as the value of △ Bs for the inner ring of the same bearing

P5级圆锥滚子轴承公差（公制）
Tolerance of class-P5 tapered roller bearing (metric system)

表4-9
Table 4-9 内圈和轴承组件宽度 Inner Ring and Bearing Assembly Width 单位 Unit:：μm

d mm		△ dmp		Vdsp	Vdmp	△ Bs		Kia	Sd	△ Ts	
超过 Over	到 To	上 Upper	下 Lower	最大 Max.	最大 Max.	上 Upper	下 Lower	最大 Max.	最大 Max.	上 Upper	下 Lower
80	120	0	-15	11	8	0	-400	8	9	+200	-200
120	180	0	-18	14	9	0	-500	11	10	+350	-250
180	250	0	-22	17	11	0	-600	13	11	+350	-250
250	315	0	-25	19	13	0	-700	13	13	+350	-250
315	400	0	-30	23	15	0	-800	15	15	+400	-400
400	500	0	-35	28	17	0	-900	20	17	+450	-450
500	630	0	-40	35	20	0	-1100	25	20	+500	-500
630	800	0	-50	45	25	0	-1600	30	25	+600	-600
800	1000	0	-60	60	30	0	-2000	37	30	+750	-750

P5级圆锥滚子轴承公差（公制）
Tolerance of class-P5 tapered roller bearing (metric system)

表4-10
Table 4-10

外圈 Outer Ring

单位 Unit: : μm

D mm		△ Dmp		V_{Dsp}	V_{Dmp}	△ Cs		K_{ea}	S_D
超过 Over	到 To	上 Upper	下 Lower	最大 Max.	最大 Max.	上 Upper	下 Lower	最大 Max.	最大 Max.
80	120	0	-13	10	7			10	9
120	150	0	-15	11	8			11	10
150	180	0	-18	14	9			13	10
180	250	0	-20	15	10			15	11
250	315	0	-25	19	13	与同一轴承内圈△ Bs 的数值相同 Same as the value of △ Bs for the inner ring of the same bearing		18	13
315	400	0	-28	22	14			20	13
400	500	0	-33	26	17			24	15
500	630	0	-38	30	20			30	18
630	800	0	-45	38	25			36	25
800	1000	0	-60	50	30			43	30
1000	1250	0	-80	65	38			52	38
1250	1600	0	-100	90	50			62	50

英制圆锥滚子轴承公差(4级、2级、3级；0级和00级公差)
Tolerance of tapered roller bearing in British System (Tolerances for class-4, class-2, class-3, class-0 and class-00)

表4-11
Table 4-11

内 圈 Inner Ring

单位 Unit: : μm

适用轴承型式 Applicable Bearing Type	轴承公称内径 Nominal Bearing Inner Diameter d mm		单一内径的偏差 Deviation of Single Inner Diameter △ Ds									
			4级 Class-4		2级 Class-2		3级 Class-3		0级 Class-0		00级 Class-00	
	超过 Over	到 To	上 Upper	下 Lower	上 Upper	下 Lower	上 Upper	下 Lower	上 Upper	下 Lower	上 Upper	下 Lower
全型式 All types		76.2	+13	0	+13	0	+13	0	+13	0	+8	0
	76.2	266.7	+25	0	+25	0	+13	0	+13	0	+8	0
	266.7	304.8	+25	0	+25	0	+13	0	+13	0	+8	0
	304.8	609.6	+51	0	+51	0	+25	0				
	609.6	914.4	+76	0			+38	0				
	914.4	1219.2	+102	0			+51	0				
	1219.2		+127	0			+76	0				

表4-12
Table 4-12

外 圈 Outer Ring

单位 Unit: : μm

适用轴承型式 Applicable Bearing Type	轴承公称外径 Nominal Bearing Outer Diameter D mm		单一内外的偏差 Deviation of Single Outer Diameter △ Ds									
			4级 Class-4		2级 Class-2		3级 Class-3		0级 Class-0		00级 Class-00	
	超过 Over	到 To	上 Upper	下 Lower	上 Upper	下 Lower	上 Upper	下 Lower	上 Upper	下 Lower	上 Upper	下 Lower
全型式 All types		266.7	+25	0	+25	0	+13	0	+13	0	+8	0
	266.7	304.8	+25	0	+25	0	+13	0	+13	0	+8	0
	304.8	609.6	+51	0	+51	0	+25	0				
	609.6	914.4	+76	0	+76	0	+38	0				
	914.4	1219.2	+102	0			+51	0				
	1219.2		+127	0			+76	0				

表4-13
Table 4-13

径向跳动 Radial Runout

单位 Unit: : μm

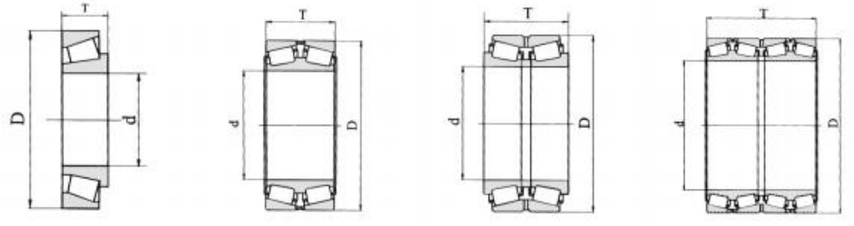
适用轴承型式 Applicable Bearing Type	轴承公称内径或外径 Nominal Bearing Inner or Outer Diameter d/D mm		内圈及外圈的径向跳动 Radial Runout of Inner and Outer Rings K_{ia} K_{ea}				
			4级 Class-4	2级 Class-2	3级 Class-3	0级 Class-0	00级 Class-00
	超过 Over	到 To	最大 Max.	最大 Max.	最大 Max.	最大 Max.	最大 Max.
全型式 All types		266.7	51	38	8	4	2
	266.7	304.8	51	38	8	4	2
	304.8	609.6	51	38	18		
	609.6	914.4	76	51	51		
	914.4	1219.2	76		76		
	1219.2		76		76		

表4-14
Table 4-14

轴承实际宽度与标准内组件组合宽度
Actual Bearing Width or Deviation from Standard Inner Assembly Width

适用轴承形式 Applicable Bearing Type	轴承公称内径 Nominal Inner Diameter of Bearing d mm		轴承公称外径 Nominal Outer Diameter of Bearing D mm		轴承实际宽度或与标准内组件组合宽度的偏差 Actual Bearing Width or Deviation from Standard Inner Assembly Width							
					4级 Class-4		2级 Class-2		3级 Class-3		0级 Class-0	
	超过 Over	到 To	上 Upper	下 Lower	上 Upper	下 Lower	上 Upper	下 Lower	上 Upper	下 Lower	上 Upper	下 Lower
单列 Single-row		101.6			+203	0	+203	0	+203	-203	+203	-203
	101.6	266.7			+356	-254	+203	0	+203	-203	+203	-203
	266.7	304.8			+356	-254	+203	0	+203	-203	+203	-203
	304.8	609.6		508.0			+381	-381	+203	-203		
	304.8	609.6	508.0				+381	-381	+381	-381		
	609.6				+381	-381			+381	-381		
双列 Double-row		101.6			+406	0	+406	0	+406	-406	+406	-406
	101.6	266.7			+711	-508	+406	-203	+406	-406	+406	-406
	267.7	304.8			+711	-508	+406	-203	+406	-406	+406	-406
	304.8	609.6		508.0			+762	-762	+406	-406		
	304.8	609.6	508.0				+762	-762	+762	-762		
	609.6				+762	-762			+762	-762		
双列 Double-row		127.0					+254	0	+254	0		
	127.0						+762	0	+762	0		
四列 Four-row	全尺寸范围 Full-size scope				+1524	-1524	+1524	-1524	+1524	-1524	+1524	-1524

适用于0级的轴承
Applicable to bearing of Class-0.



推力轴承公差
Tolerance of Thrust Bearing

表4-15
Table 4-15

轴 圈 Shaft Washer

单位 Unit: : μm

d mm 超过 Over	d mm 到 To	△ dmp 公差等级 Class of Tolerance P0,P6,P5 上 Upper	下 Lower	V_{dp} P0,P6,P5 最大 Max.	S_i P0 最大 Max.	S_i P6 最大 Max.	S_i P5 最大 Max.
80	120	0	-20	15	15	8	4
120	180	0	-25	19	15	9	5
180	250	0	-30	23	20	10	5
250	315	0	-35	26	25	13	7
315	400	0	-40	30	30	15	7
400	500	0	-45	34	30	18	9
500	630	0	-50	38	35	21	11
630	800	0	-75		40	25	13
800	1000	0	-100		45	30	15
1000	1250	0	-125		50	35	18

数值不适合球面滚子轴承。对双向轴承采用单列数据。
Values are not applicable to spherical roller bearing. Single-row data are adopted for bi-directional bearing.

推力轴承公差
Tolerance of Thrust Bearing

表4-16
Table 4-16

座 圈 Housing Washer

单位 Unit: : μm

D mm 超过 Over	D mm 到 To	△ Dmp 公差等级 Class of Tolerance P0,P6,P5 上 Upper	下 Lower	V_{Dp} P0,P6,P5 最大 Max.	S_e
80	120	0	-22	17	
120	180	0	-25	19	
180	250	0	-30	23	
250	315	0	-35	26	与同一轴承轴圈 S_i 的数值相同 Same as the value of Si for the shaft washer of the same bearing
315	400	0	-40	30	
400	500	0	-45	34	
500	630	0	-50	38	
630	800	0	-75	55	
800	1000	0	-100	75	
1000	1250	0	-125		
1250	1600	0	-160		

锥形内孔公差，锥度1：12
Tolerance of Taper Bore, in taper of 1:12

表4-17
Table 4-17

单位 Unit:：μm

d mm		Δdmp 公差等级 Class of Tolerance P0,P6		V_{dp}[1)]	Δd1mp—Δdmp		Δdlmp P5		V_{dp}[1)]	Δd1mp—Δdmp	
超过 Over	到 To	上 Upper	下 Lower	最大 Max.	高 High	低 Low	上 Upper	下 Lower	最大 Max.	上 Upper	下 Lower
80	120	+35	0	25	+35	0	+22	0	22	+22	0
120	180	+40	0	31	+40	0	+25	0	25	+25	0
180	250	+46	0	38	+46	0	+29	0	29	+29	0
250	315	+52	0	44	+52	0	+32	0	32	+32	0
315	400	+57	0	50	+57	0	+36	0	36	+36	0
400	500	+63	0	56	+63	0	+40	0		+40	0
500	630	+70	0		+70	0	+44	0		+44	0
630	800	+80	0		+80	0	+50	0		+50	0
800	1000	+90	0		+90	0	+56	0		+56	0
1000	1250	+105	0		+105	0	+66	0		+66	0

适用于内孔之任意单一径向平面
Applicable to any single radialplane of bore

锥形内孔公差，锥度1：30
Tolerance of Taper Bore, in taper of 1:30

表4-18
Table 4-18

单位 Unit:：μm

d mm		Δdmp 公差等级 Class of Tolerance P0		V_{dp}[1)]	Δd1mp—Δdmp	
超过 Over	到 To	上 Upper	下 Lower	最大 Max.	高 High	低 Low
80	120	+20	0	22	+35	0
120	180	+25	0	40	+40	0
180	250	+30	0	46	+46	0
250	315	+35	0	52	+52	0
315	400	+40	0	57	+57	0
400	500	+45	0	63	+63	0
500	630	+50	0	70	+70	0
630	800	+75	0		+100	0
800	1000	+100	0		+100	0
1000	1250	+125	0		+115	0
1250	1600	+160	0		+125	0
1600	2000	+200	0		+150	0

适用于内孔之任意单一径向平面
Applicable to any single radialplane of bore

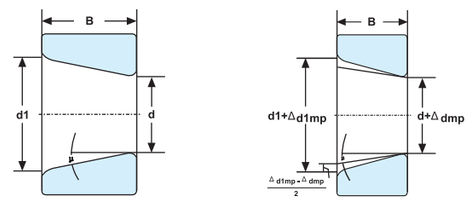


图4.1
Fig. 4.1

圆锥孔　公称半锥度
α =2*23' 9,4"(锥度1:12)
α =0*57' 17,4"(锥度1:30)
圆锥孔大端理论基本直径d1:
$d1=d+\frac{1}{12}B$(锥度1:12)
$d1=d+\frac{1}{30}B$(锥度1:30)

Tapered bore
Nominal semi-taper
α =2*23′ 9, 4″ (in taper of 1:12)
α =0*57′ 17, 4″ (in taper of 1:30)
Theoretical basic diameter d1 at big end of tapered bore:
$d1=d+\frac{1}{12}B$(in taper of 1:12)
$d1=d+\frac{1}{30}B$(in taper of 1:30)

向心轴承倒角
Chamfer of Radial Bearing

表4-19
Table 4-19

Rmin 或 r_{1min}	轴承公称内径 Nominal Inner Diameter of Bearing d mm 超过 Over	到 To	径向 Radial r_{max}	轴向 Axial r_{1max}
0.3	40		0.8	1
0.6		40	1	2
	40		1.3	2
1		50	1.5	3
	50		1.9	3
1.1		120	2	3.5
	120		2.5	4
1.5		120	2.3	4
	120		3	5
2		80	3	4.5
	80	220	3.5	5
	220		3.8	6
2.1		280	4	6.5
	280		4.5	7
2.5		100	3.8	6
	100	280	4.5	6
	280		5	7
3		280	5	8
	280		5.5	8
4			6.5	9
5			8	10
6			10	13
7.5			12.5	17
9.5			15	19

公制圆锥滚子轴承倒角
Chamfer of Tapered Roller Bearing in Metric System

表4-20
Table 4-20

Rmin 或 r_{1min}	轴承公称内径 Nominal Inner Diameter of Bearing d mm 超过 Over	到 To	径向 Radial r_{max}	轴向 Axial r_{1max}
1.5		120	2.3	3
	120	250	2.8	3.5
	250		3.5	4
2		120	2.8	4
	120	250	3.5	4.5
	250		4	5
2.5		120	3.5	5
	120	250	4	5.5
	250		4.5	6
3		120	4	5.5
	120	250	4.5	6.5
	250	400	5	7
	400		5.5	7.5
4		120	5	7
	120	250	5.5	7.5
	250	400	6	8
	400		6.5	8.5
5		180	6.5	8
	180		7.5	9
6		180	7.5	10
	180		9	11
7.5			12.5	17
9.5			15	19

圆锥滚子轴承倒角(英制尺寸)
Chamfer of Tapered Roller Bearing (in British System)

表4-21 Table 4-21

min	内圈公称孔径 Nominal Diameter of Inner Ring		最大值 Max.		外圈公称外径 Nominal Diameter of Outer Ring		最大值 Max.	
r_{smin}	d 超过 Over	到 To	r1 max	r2 max	D 超过 Over	到 To	r3 max	r4 max
mm	mm		mm	mm	mm	mm		
见轴承表 see the bearing table		50.8	rsmin+0.4	rsmin+0.9		101.6	rsmin+0.6	rsmin+1.1
	50.8	101.6	rsmin+0.5	rsmin+1.3	101.6	168.3	rsmin+0.6	rsmin+1.2
	101.6	254	rsmin+0.6	rsmin+1.8	168.3	266.7	rsmin+0.8	rsmin+1.4
					266.7	355.6	rsmin+1.7	rsmin+1.7
1.0	254		1.9	3	355.6		1.9	3
1.5	254		3.5	4	355.6		3.5	4
2.5	254		4.5	6	355.6		4.5	6
3.0	254		5.5	7.5	355.6		5.5	7.5
3.3	254		6.5	9	355.6		6.5	9
3.5	254		6.5	9	355.6		6.5	9
6.4	254		12.5	17	355.6		12.5	17
3.5	254		15	19	355.6		15	19
9.7	254		15	19	355.6		15	19
19	254		25	38	355.6		25	38

内部游隙
Internal Clearance

轴承原始游隙的定义
Definition of original bearing internal clearance

轴承原始游隙,是指轴承在没有安装之前内圈、外圈、滚动体之间的间隙量。即将内圈或外圈一方固定，将另一方在径向方向的移动量称为径向游隙，在轴向方向的移动量称为轴向游隙。

The original bearing internal clearance refers to the clearance among the inner ring, the outer ring and rolling elements of bearing before installation.If either the inner ring or the outer ring is fixed, the amount of radial movement of the other ring is called radial internal clearance and that of axial movement of it is callled axial internal clearance.

游隙的选择
Selection of clearance

由于轴承在安装时内圈经过盈配合后，轴承的原始游隙会相应减少，轴承承受载荷后轴承的内部游隙又会相应的增加，当轴承运行时轴承内部产生温升，轴承的内、外圈的膨胀不同，轴承的内部游隙相应减少。所以，轴承工作游隙值按下式计算：

At the installation of bearing, after the inner ring has undergone the interference fit, the original bearing internal clearance will decrease correspondingly; after the bearing has carried the load, the internal clearance of bearing will increase correspondingly; and when there is a temperature rise occurred in the bearing interior at running and the difference in expansion of bearing inner and outer rings, the internal clearance of bearing will decrease correspondingly. Therefore, the working internal clearance of bearing shall be calculated according to the following formulas:

$$U=U_O-(\delta_f+\delta_t)+\delta_w \quad (11)$$

式中:U-轴承的工作游隙

U_O -轴承的内部原始游隙

$\delta_f=\delta_{fo}+\delta_{fi}$

δ_{fo}-轴承外圈与外壳配合的游隙减少量

δ_{fi}-轴与轴承内圈配合的游隙减少量

δ_t-内、外圈温差产生的游隙减少量

δ_w-轴承载荷对游隙的增加量

$$U=U_O-(\delta_f+\delta_t)+\delta_w \quad (11)$$

Where:U-Working internal clearance of bearing

U_O-Origional internal clearance of bearing

$\delta_f=\delta_{fo}+\delta_{fi}$

δ_{fo}-Inernal clearance decrease of fit between bearing outer ring and bearing shell

δ_{fi}-Internal clearance decrease of fit between shaft and bearing inner ring

δ_t-Internal clearance decrease due to temperature difference between inner and outer rings

δ_w-Increase of internal clearance caused by bearing load carrying

轴承的工作游隙，理论上略为负数时，疲劳寿命最长，但实际上保持这种理想状态是很困难的。

Theoretically,when the working internal clearance of bearing is negative slightly, the fatigue life is maximum; while, actually, it is very difficult to maintain such and ideal state.

一般来说，选择轴承的工作游隙略大于零好些，这样可以获得较理想的疲劳寿命和运转效果。
但对于一些较特殊的场合，则应选择大于或小于0组游隙以适应使用的要求。

Generally speaking, the working internal clearance of bearing selected is better to be more than zero, so that the comparatively ideal fatigue life and running effects would be achieved. However, in some particular occasion, it is required to select the internal clearance more than or less than Group-0 to meet the requirements of application.

游隙选择示例
Example of Internal Clearance Selection

表5-1
Table 5-1

使用条件 Service Condition	用途 Purpose	示例 Example
重载荷或冲击载荷且套圈配合过盈大 Heavy load or impact load, and large bearing race interference fit	轧钢机辊颈（圆柱轴承）铁路车辆、车轴 Roll neck of mill (cylindrical bearing), railway vehicle and axle shaft	C3
振动或冲击载荷且内外圈均为过盈配合 Shocking or impact load, with interference fit at both inner and outer rings	振动筛/铁路车辆主电机 拖拉机末级减速装置 Vibrating screen/ master motor of railway vehicle End-class reduction gear of tractor	C3 C4/C3 C4
轴与内圈受到加热 Both the shaft and the inner ring are heated	造纸烘干机/轧钢机辊道辊子 Paper-making drier/ rolling mill table rolls	C3 C4/C3
内外圈均为间隙配合 Both inner and outer rings are clearance fit	轧钢机辊颈 Roll neck of mill	C2

圆柱滚子轴承径向游隙
Radial Internal Clearance of Cylindrical Roller Bearing

表5-2
Table 5-2

单位 Unit:：μm

公称内径 Nominal Diameter d mm 超过 Over	到 To	2组 Class-2 最小 Min	2组 Class-2 最大 Max	0组 Class-0 最小 Min	0组 Class-0 最大 Max	3组 Class-3 最小 Min	3组 Class-3 最大 Max	4组 Class-4 最小 Min	4组 Class-4 最大 Max	5组 Class-5 最小 Min	5组 Class-5 最大 Max
80	100	15	50	50	85	75	110	105	140	155	190
100	120	15	55	50	90	85	125	125	165	180	220
120	140	15	60	60	105	100	145	145	190	200	245
140	160	20	70	70	120	115	165	165	215	225	275
160	180	25	75	75	125	120	170	170	220	250	300
180	200	35	90	90	145	140	195	195	250	275	330
200	225	45	105	105	165	160	220	220	280	305	365
225	250	45	110	110	175	170	235	235	300	330	395
250	280	55	125	125	195	190	260	260	330	370	440
280	315	55	130	130	205	200	275	275	350	410	485
315	355	65	145	145	225	225	305	305	385	455	535
355	400	100	190	190	280	280	370	370	460	510	600
400	450	110	210	210	310	310	410	410	510	565	665
450	500	110	220	220	330	330	440	440	550	625	735
500	560	120	240	240	360	360	480	480	600		
560	630	140	260	260	380	380	500	500	620		
630	710	145	285	285	425	425	565	565	705		
710	800	150	310	310	470	470	630	630	790		
800	900	180	350	350	520	520	690	690	860		
900	1000	200	390	390	580	580	770	770	960		
1000	1120	220	430	430	640	640	850	850	1060		
1120	1250	230	470	470	710	710	950	950	1190		
1250	1400	270	530	530	790	790	1050	1050	1310		

四点接触球轴承轴向游隙
Radial Internal Clearance of Four-point Contact Ball Bearing

表5-3
Table 5-3

单位 Unit: : μm

公称内径 Nominal Diameter d mm		2组 Class-2		0组 Class-0		3组 Class-3		4组 Class-4	
超过 Over	到 To	最小 Min	最大 Max	最小 Min	最大 Max	最小 Min	最大 Max	最小 Min	最大 Max
80	100	56	116	96	156	136	196	176	236
100	140	66	136	116	176	156	216	196	256
140	180	76	156	136	196	176	236	216	276
180	220	96	176	156	216	196	256	236	296
220	260	115	195	175	235	215	295	275	335
260	300	135	215	195	275	255	335	295	355

双列角接触球轴承轴向游隙
Axial Internal Clearance of Double-row Angular Contact Ball Bearing

表5-4
Table 5-4

单位 Unit: : μm

公称内径 Nominal Inner Diameter d mm		2组 Class-2		0组 Class-0	
超过 Over	到 To	最小 Min	最大 Max	最小 Min	最大 Max
100	140	70	140	120	180
140	180	80	160	140	200
180	220	100	180	160	220
220	260	120	200	180	240
260	300	140	220	200	280
300	355	160	240	220	300
355	400	180	270	250	330
400	450	200	290	270	360
450	500	220	310	290	390
500	560	240	330	310	420
560	630	260	360	340	450
630	710	280	390	370	490
710	800	300	420	400	540
800	900	330	450	440	590
900	1000	360	500	480	630

深沟球轴承径向游隙
Radial Internal Clearance of Deep-groove Ball Bearing

表5-5
Table 5-5

单位 Unit: : μm

公称内径 Nominal Inner Diameter d mm		2组 Class-2		0组 Class-0		3组 Class-3		4组 Class-4		5组 Class-5	
超过 Over	到 To	最小 Min	最大 Max	最小 Min	最大 Max	最小 Min	最大 Max	最小 Min	最大 Max	最小 Min	最大 Max
80	100	1	18	12	36	30	58	53	84	75	120
100	120	2	20	15	41	36	66	61	97	90	140
120	140	2	23	18	48	41	81	71	114	105	160
140	160	2	23	18	53	46	91	81	130	120	180
160	180	2	25	20	61	53	102	91	147	135	200
180	200	2	30	25	71	63	117	107	163	150	230
200	225	2	35	25	85	75	140	125	195	175	265
225	250	2	40	30	95	85	160	145	225	205	300
250	280	2	45	35	105	90	170	155	245	225	340
280	315	2	55	40	115	100	190	175	270	245	370
315	355	3	60	45	125	110	210	195	300	275	410
355	400	3	70	55	145	130	240	225	340	315	460
400	450	3	80	60	170	150	270	250	380	350	510
450	500	3	90	70	190	170	300	280	420	390	570
500	560	10	100	80	210	190	330	310	470	440	630
560	630	10	110	90	230	210	360	340	520	490	690
630	710	20	130	110	260	240	400	380	570	540	760
710	800	20	140	120	290	270	450	430	630	600	840
800	900	20	160	140	320	300	500	480	700	670	940
900	1000	20	170	150	350	330	550	530	770	740	1040
1000	1120	20	180	160	380	360	600	580	850	820	1150
1120	1250	20	190	170	410	390	650	630	920	890	1260

圆柱孔调心滚子轴承径向游隙
Internal Clearance of Cylindrical-bore Spherical Roller Bearing

表5-6
Table 5-6

单位 Unit:：μm

公称内径 Nominal Inner Diameter d mm		2组 Class-2		0组 Class-0		3组 Class-3		4组 Class-4		5组 Class-5	
超过 Over	到 To	最小 Min	最大 Max	最小 Min	最大 Max	最小 Min	最大 Max	最小 Min	最大 Max	最小 Min	最大 Max
80	100	35	60	60	100	100	135	135	180	180	225
100	120	40	75	75	120	120	160	160	210	210	260
120	140	50	95	95	145	145	190	190	240	240	300
140	160	60	110	110	170	170	220	220	280	280	350
160	180	65	120	120	180	180	240	240	310	310	390
180	200	70	130	130	200	200	260	260	340	340	430
200	225	80	140	140	220	220	290	290	380	380	470
225	250	90	150	150	240	240	320	320	420	420	520
250	280	100	170	170	260	260	350	350	460	460	570
280	315	110	190	190	280	280	370	370	500	500	630
315	355	120	200	200	310	310	410	410	550	550	690
355	400	130	220	220	340	340	450	450	600	600	750
400	450	140	240	240	370	370	500	500	660	660	820
450	503	140	260	260	410	410	550	550	720	720	900
500	560	150	280	280	440	440	600	600	780	780	1000
560	630	170	310	310	480	480	650	650	850	850	1100
630	710	190	350	350	530	530	700	700	920	920	1190
710	800	210	390	390	580	580	770	770	1010	1010	1300
800	900	230	430	430	650	650	860	860	1120	1120	1440
900	1000	260	480	480	710	710	930	930	1220	1220	1570
1000	1120	290	530	530	780	780	1020	1020	1330	1330	1720
1120	1250	320	580	580	860	860	1120	1120	1460	1460	1870

圆锥孔调心滚子轴承径向游隙
Radial Internal Clearance of Tapered-bore Spherical Roller Bearing

表5-7
Table 5-7

单位 Unit:：μm

公称内径 Nominal Inner Diameter d mm		2组 Class-2		0组 Class-0		3组 Class-3		4组 Class-4		5组 Class-5	
超过 Over	到 To	最小 Min	最大 Max	最小 Min	最大 Max	最小 Min	最大 Max	最小 Min	最大 Max	最小 Min	最大 Max
80	100	55	80	80	110	110	140	140	180	180	230
100	120	65	100	100	135	135	170	170	220	220	280
120	140	80	120	120	160	160	200	200	260	260	330
140	160	90	130	130	180	180	230	230	300	300	380
160	180	100	140	140	200	200	260	260	340	340	430
180	200	110	160	160	220	220	290	290	370	370	470
200	225	120	180	180	250	250	320	320	410	410	520
225	250	140	200	200	270	270	350	350	450	450	570
250	280	150	220	220	300	300	390	390	490	490	620
280	315	170	240	240	330	330	430	430	540	540	680
315	355	190	270	270	360	360	470	470	590	590	740
355	400	210	300	300	400	400	520	520	650	650	820
400	450	230	330	330	440	440	570	570	720	720	910
450	500	260	370	370	490	490	630	630	790	790	1000
500	560	290	410	410	540	540	680	680	870	870	1100
560	630	320	460	460	600	600	760	760	980	980	1230
630	710	350	510	510	670	670	850	850	1090	1090	1360
710	800	390	570	570	750	750	960	960	1220	1220	1500
800	900	440	640	640	840	840	1070	1070	1370	1370	1690
900	1000	490	710	710	930	930	1190	1190	1520	1520	1860

双列和四列圆锥滚子轴承径向游隙
Radial Internal Clearance of Double-row and Four-row Tapered Roller Bearing

表5-8
Table 5-8

单位 Unit: : μm

公称内径 Nominal Inner Diameter d mm		1组 Class-1		2组 Class-2		0组 Class-0		3组 Class-3		4组 Class-4		5组 Class-5	
超过 Over	到 To	最小 Min	最大 Max	最小 Min	最大 Max	最小 Min	最大 Max	最小 Min	最大 Max	最小 Min	最大 Max	最小 Min	最大 Max
80	100	0	20	20	45	45	70	70	100	100	130	130	170
100	120	0	25	25	50	50	80	80	110	110	150	150	200
120	140	0	30	30	60	60	90	90	120	120	170	170	230
140	160	0	30	30	65	65	100	100	140	140	190	190	260
160	180	0	35	35	70	70	110	110	150	150	210	210	280
180	200	0	40	40	80	80	120	120	170	170	230	230	310
200	225	0	40	40	90	90	140	140	190	190	260	260	340
225	250	0	50	50	100	100	150	150	210	210	290	290	380
250	280	0	50	50	110	110	170	170	230	230	320	320	420
280	315	0	60	60	120	120	180	180	250	250	350	350	460
315	355	0	70	70	140	140	210	210	280	280	390	390	510
355	400	0	70	70	150	150	230	230	310	310	440	440	580
400	450	0	80	80	170	170	260	260	350	350	490	490	650
450	500	0	90	90	190	190	290	290	390	390	540	540	720
500	560	0	100	100	210	210	320	320	430	430	590	590	790
560	630	0	110	110	230	230	350	350	480	480	660	660	880
630	710	0	130	130	260	260	400	400	540	540	740	740	910
710	800	0	140	140	290	290	450	450	610	610	830	830	1100
800	900	0	160	160	330	330	500	500	670	670	920	920	1240
900	1000	0	180	180	360	360	540	540	720	720	980	980	1300
1000	1120	0	200	200	400	400	600	600	820				
1120	1250	0	220	220	450	450	670	670	900				

轴承的预载荷
Pre-loading of bearing

根据轴承使用的用途，有时需对轴承施加一定的预载荷，使轴承内部处于负游隙状态。 这种方法称预载荷，多用于角接触球轴承及圆锥滚子轴承。

Certain pre-load may be applied on the bearing as required pursuit to the purpose of bearing sometimes, so as to enable the bearing interior to be in the state of negative internal clearance, whose method is called as pre-loading, mostly applied to angular contact ball bearing and tapered roller bearing.

预载荷的目的
Objective of pre-loading

轴承施加预载荷之后，在滚动体与套圈接触点上总是保持一种预压力，使轴承在载荷下不产生游隙，提高轴抗径向及轴向位移的刚性、旋转精度与定位精度、抑制振动及噪声；同时还制约滚动体的公转滑动、自转滑动，减少擦伤。

除此之外，推力球轴承、推力滚子轴承用于横向轴时，为使滚动体保持正确位置，也要采用预载荷。这点对于轧钢机轧辊轴向固定端的定位轴承非常重要。

对轴承施加预载荷的一般方法，是在相对的两套轴承间施加轴向载荷，使轴承内外圈产生相对的轴向位移。通常可分定位预载荷和定压预载荷两种。

Upon the application of pre-load on the bearing, a pre-compression will always maintained at the contact point between rolling element and bearing race, so as to ensure no internal clearance of bearing generated under load, improve the rigidity of radial and axial movement, rotation precision and positioning precision, suppress vibration and noise, restrain the revolving and spinning slide of rolling element and reduce the abrasion.

In addition, when the thrust ball bearing and the thrust roller one are used on axial shaft, it is required to adopt the pre-load to keep the rolling element at the correct position, which is very important for the locating bearing at the axial fixed end of rolling mill roll.

The method for applying the pre-load to the bearing is, to apply the axial load between the relative two sets of bearings so as to enable bearing inner and outer rings to generate the relative axial displacement. It includes locating pre-loading and constant-pressure pre-loading.

轴向预载荷 Axial pre-loading

定位预载荷

定位预载荷是指轴承的轴向位置在使用过程中保持不变的一种轴向预载荷方式，如图(5.1)所示，可以通过调整两轴承之间的间距套筒的宽度以获得一定的预紧量。

Locating pre-loading

Locating pre-loading refers to the axial pre-loading mode that the axial position of bearing maintains unchanged in the service process, as indicated in Fig. (5.1), with certain pre-tensing amount achieved via regulating the width of space sleeve between two bearings.

定压预载荷

定压预载荷是指使轴承的轴向预载荷在使用中保持不变的一种轴向预紧方式。如（图5.2）所示，可以通过调整弹簧的压缩量以获得一定的预紧量。

Constant-pressure pre-loading

Constant-pressure pre-loading refers to the axial pre-tension mode that the axial pre-load of bearing maintains unchanged in the service process, as indicated in Fig. (5.2), with certain pre-tensing amount achieved via regulating the amount of spring compression.

径向预载荷 Radial pre-loading

径向预紧是径向预载荷的一种方式，径向预载荷是利用过盈配合使轴承内圈膨胀，消除径向游隙，使轴承处于预紧状态的一种预紧方法。

径向预载荷的目的是为了增加载荷区内的滚动体数，提高支承刚度。在高速圆柱滚子轴承中，径向预紧可以减少在离心力作用下，滚动体与滚道打滑的现象。圆锥形内孔的轴承，用锁紧母调整内圈与紧定套的相对位置，减少轴承的径向游隙，实现径向预紧。圆锥形内孔轴向位移量与内部游隙的变动量的关系列于表5-9中。

As a radial pre-tensing mode, radial pre-loading is a pre-tensing method of taking advantage of interference fit to make the bearing inner ring expand and eliminate the radial internal clearance.

The objective of radial pre-loading is to increase the quantity of rolling elements in the load area and improve the rigidity of support. In the high-speed cylindrical roller bearing, the radial pre-tensing can reduce the phenomenon of sliding between the rolling element and the bearing race under the effect of centrifugal force. As for the tapered-bore bearing, the radial pre-tensing is achieved by regulating the relative position of inner ring and adapter sleeve with locking for the sake of reducing the radial internal clearance of bearing. The relationship between the axial displacement of tapered bore and the variation of internal clearance is indicated in Table 5-9.

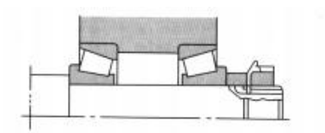


图5.1 定位预载荷示意图
Fig.5.1 Schematic Drawing of Locating Pre-loading

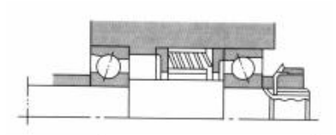


图5.2 定压预载荷示意图
Fig.5.2 Schematic Drawing of Constant-pressure Pre-loading

圆锥形内孔轴向移动量与轴承内部的游隙变动量的关系
Relationship between Axial Displacement of Tapered Bore and Variation of Internal Clearance

表5-9
Table 5-9

单位 Unit:：μm

公称内径 Nominal Inner Diameter d mm		径向游隙减少量 Decrease in Radial Internal Clearance		轴向方向的压入量 Amount of Axial Press-in				最小残留游隙 Min. Residual Internal Clearance		
				内孔圆锥度 Bore Conicity at 1:12		内孔圆锥度 Bore Conicity at 1:30				
超过 Over	以下 Below	最小 Min	最大 Max	最小 Min	最大 Max	最小 Min	最大 Max	C0	C3	C4
30	40	0.020	0.025	0.35	0.40			0.015	0.025	0.040
40	50	0.025	0.030	0.40	0.45			0.020	0.030	0.050
50	65	0.030	0.040	0.45	0.60			0.025	0.035	0.055
65	80	0.040	0.050	0.60	0.75			0.025	0.040	0.070
80	100	0.045	0.060	0.70	0.90	1.70	2.20	0.035	0.050	0.080
100	120	0.050	0.070	0.75	1.10	1.90	2.70	0.050	0.065	0.100
120	140	0.065	0.090	1.10	1.40	2.70	3.50	0.055	0.080	0.110
140	160	0.075	0.100	1.20	1.60	3.00	4.00	0.055	0.090	0.130
160	180	0.080	0.110	1.30	1.70	3.20	4.20	0.060	0.100	0.150
180	200	0.090	0.130	1.40	2.00	3.50	5.00	0.070	0.100	0.160
200	225	0.100	0.140	1.60	2.20	4.00	5.50	0.080	0.120	0.180
225	250	0.110	0.150	1.70	2.40	4.20	6.00	0.090	0.130	0.200
250	280	0.120	0.170	1.90	2.70	4.70	6.70	0.100	0.140	0.220
280	315	0.130	0.190	2.00	3.00	5.00	7.50	0.110	0.150	0.240
315	355	0.150	0.210	2.40	3.30	6.00	8.20	0.120	0.170	0.260
355	400	0.170	0.230	2.60	3.60	6.50	9.00	0.130	0.190	0.290
400	450	0.200	0.260	3.10	4.00	7.70	10.0	0.130	0.200	0.310
450	500	0.210	0.280	3.30	4.40	8.20	11.0	0.160	0.230	0.350
500	560	0.240	0.320	3.70	5.00	9.20	12.5	0.170	0.250	0.360
560	630	0.260	0.350	4.00	5.40	10.0	13.5	0.200	0.290	0.410
630	710	0.300	0.400	4.60	6.20	11.5	15.5	0.210	0.310	0.450
710	800	0.340	0.450	5.30	7.00	13.3	17.5	0.230	0.350	0.510
800	900	0.370	0.500	5.70	7.80	14.3	19.5	0.270	0.390	0.570
900	1000	0.410	0.550	6.30	8.50	15.8	21.0	0.300	0.430	0.640
1000	1120	0.450	0.600	6.80	9.00	17.0	23.0	0.320	0480	0.700

轴承套圈和滚动体用材料
Materials for bearing race and rolling element

根据国家标准及轴承使用要求，目前用于轴承套圈及滚动体的材料有高碳铬轴承钢、渗碳轴承钢、高温轴承钢、不锈钢等，这些材料按各自不同的特点而被用于不同场合。
表5-6为高碳铬轴承钢，应用于普通的场合，其用量最大，约占材料总用量的80%以上。

Pursuit to national standards and bearing service requirements, materials currently used for bearing race and rolling element are high carbon chromium bearing steel, carburized bearing steel, high-temperature bearing steel and stainless steel etc., which are applied to different occasions according to their respective characteristics.
Table 5-6 is high carbon chromium bearing steel, applied to general occasion, of which the consumption is the most, approximately accounting for over 80% of the total material consumption.

表6-1
Table 6-1

材料代号 Material designation	特点及用途 Features and uses	技术特性 Technical features
GCr15	用于普通场合，用量最大 Used in ordinary occasions with the highest consumption	有效壁厚在18mm以下 淬回火硬度HRC59～64 Effective wall thickness below 18mm Hardening and tempering hardness HRC59-64
GCr18Mo	贝氏体钢、耐冲击场合使用 Bainitic steel for use in impact resistant occasions	有效壁厚在18～30mm之间 淬回火硬度HRC58～62 Effective wall thickness between 18-30mm Hardening and tempering hardness HRC58-62
GCr15SiMn	普通场合使用、用于大型轴承 For large bearings in ordinary occasions	有效壁厚在18mm以上 淬回火硬度HRC58～63 Effective wall thickness over 18mm Hardening and tempering hardness HRC58-63

表6-2
Table 6-2

材料代号 Material designation	特点及用途 Features and uses	技术特性 Technical features
G20CrNi2MoA	用于耐冲击场合、中小轴承浅层渗碳 Used in impact resistant occasions, superficial carburizing for medium and small bearings	有效渗层深< 2.5mm 淬回火硬度HRC59～64 Effective carburizing depth < 2.5mm Hardening and tempering hardness HRC59-64
G20Cr2Ni4A	用于耐冲击场合、中大型轴承深层渗碳 For use in impact resistant occasions, deep carburizing for medium and large bearings	有效渗层深≥ 2.5mm 淬回火硬度HRC58～63 Effective carburizing depth ≥ 2.5mm Hardening and tempering hardness HRC58-63

高温轴承及不锈钢轴承用材料在本样本中没有列出
Materials for high temperature and stainless steel bearings are not shown here.

6.2保持架材料列于表6-3
Materials for cage in 6.2 are shown in Table 6-3.

表6-3
Table 6-3

材料代号 Material designation	特点及用途 Features and uses	技术特性 Technical features
08AL或10	钢板冲压型保持架、用于中小型圆锥轴承 Cage from pressed steel used for medium and small tapered bearings	易于冲压成型、重量轻 Easy to form by pressing, light weight
ZCuZn40Pb2	用于大部分轧机轴承及其他中小型轴承 For most roller bearings and other medium and small bearings	易于切削、摩擦系数低、强度适中 Easy for turning, with low frictional coefficient, moderate strength
ZCuA110Fe3Mn2	用于高温轴承 For use with high temperature bearings	易于切削、强度高、耐磨性好 Easy for turning, high strength, good wearability
20	用于强冲击、重载荷工况下 For strong impact, heavy load conditions	强度高、切削性不好 High strength, low machinability

径向轴承的配合
Fit of radial bearing

选择合适的配合将对轴承的运转可靠性和寿命有很大影响，下面将推荐一些场合的配合选择方法。

Selection of proper fit will have a substantial influence on bearing service reliability and life. Methods to select fit in some occasions are recommended below.

轴与外壳孔的尺寸公差与配合关系

Dimensional tolerances and fit relation between shaft and housing hole

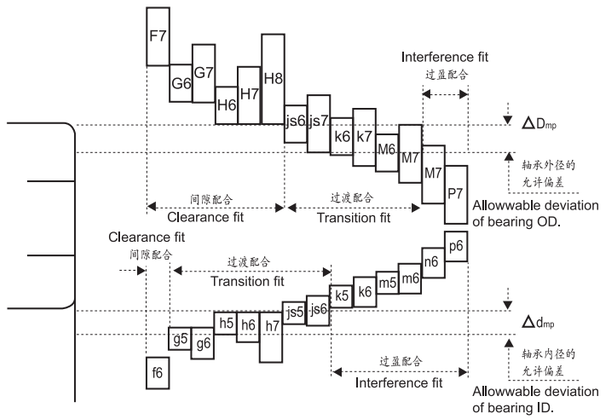


图7.1 轴和外壳孔的尺寸公差与配合的关系（0级公差的轴承）

Figure 7.1 Dimensional tolerances and fit relation between shaft and housing hole (class 0 tolerance)

载荷的性质与配合的关系
Relation between load features and fit

表7-1
Table 7-1

旋转分区 Rotation zoning	载荷方向 Load direction	载荷性质 Load feature	配合 Fit		示例 Example
			内圈与轴 Inner ring and shaft	外圈与壳 Outer ring and shaft	
内圈旋转，外圈静止 Inner ring rotating, outer ring at rest	固 定 Fixed	内圈旋转载荷外圈静止载荷 Rotating load for inner ring, static load for outer ring	需要过盈配合k.m.n.p.r Interference fit necessary k.m.n.p.r	间隙配合F.G.H.Js Clearance fit F.G.H.js	轧钢机辊颈,正齿轮装置、电动机 Roll neck of steel rolling machine, spur gear assembly, motor
内圈静止，外圈旋转 Inner ring at rest, outer ring rotating	旋转（与外圈一起旋转） Rotating(with outer ring)				平衡差的车轮 Wheel with balance difference
内圈静止，外圈旋转 Inner ring at rest, outer ring rotating	固 定 Fixed	内圈静止载荷外圈旋转载荷 Static load for inner ring, rotating load for outer ring	间隙配合f.g.h.js Clearance fit f.g.h.js	需要过盈配合K.M.N.P Interference fit necessary K.M.N.P	带固定轴的行走轮和滑轮 Travel wheel and pulley with fixed shaft
内圈旋转，外圈静止 Inner ring rotating, outer ring at rest	旋转（与内圈一起旋转） Rotating (with inner ring)				振动筛 Vibrating screen
不定 Not certain	旋转或固定 Rotating or fixed	不定向载荷 Load in uncertain direction	过盈配合 Interference fit	过盈配合 Interference fit	曲轴 Crank shaft

表7-2 向心轴承（0级、6级）与轴的推荐配合
Table 7-2 Recommended fit of radial bearing (Class 0 and 6) and shaft

条件 Conditions		球轴承 Ball bearing	圆柱滚子轴承 圆锥滚子轴承 Cylindrical roller bearing taper roller bearing	调心滚子轴承 Self-aligning roller bearing	轴的公差带 Shaft and tolerance zone	备注 Remark	应用参考 References
		轴径 Shaft dia（mm）					
		最小 Min 最大 Max	最小 Min 最大 Max	最小 Min 最大 Max			
内圈旋转载荷或不定向载荷 Rotary or non-directional load of inner ring	轻载荷或变动载荷 Light or varying load	18 18 100 100 200	40 40 140 140 200		h5 js6 k6 m6		电气器具机床泵鼓风机搬运车等 Electric appliance, machine tool pump, air blower etc.
	一般载荷 Normal load	18 18 100 100 140 140 200 200 280	40 40 40 100 100 140 140 200 280 400	40 40 65 65 100 100 140 140 250 280 500	js5 k5 m5 m6 n6 p6 r6	对于单列角接触球轴承及圆锥滚子轴承，因不需考虑配合引起的内部游隙的变化，因此可用m6代替k5、m5 For the single row angular contact ball bearing and the taper roller bearing, you may substitute m6 for k5, m5 because it is not necessary to consider the internal clearance	电动机汽轮机内燃机木工机械等 Motor, steam turbine, combustion engine and woodworking machinery etc.
	重载荷或冲击载荷 Heavy load or shock load		50 140 140 200 200	50 100 100 140 140 200 200	n6 p6 r6 r7	需要内部游隙大于标准游隙的轴承 Require the bearing whose internal clearance is bigger than the standard one	铁路车辆车轴 铁路车辆主电支机等 Axle shaft and main motor of railway vehicles etc,
内圈静止载荷 Static load of inner ring	内圈必须易于在轴上移动 Must be easy for the inner ring to move on the shaft				g6	精确性要求高时，采用g5，对于大型轴承，为便于移动，也可采用f6。 For high precision, choose g5; for large bearings, f6 is also applicable.	带固定轴的车轮等 Wheel with fixed shaft etc.
	内圈不需要易于在轴上移动 Unnecessary for the inner ring to move on the shaft easily				h6	精确性要求高时采用h5 For high precision, choose h5	张紧轮、滑轮等 Tensioner and pulley etc.
仅中心轴向载荷 Only central axial load					js6		
圆锥孔轴承（0级精度）(带紧固件或退卸套）		Tapered-bore bearing (precision 0) (with the fastener or withdrawal sleeve)					
任意载荷 Any load		全部轴颈 All shaft neck		H9/IT5[2)]	传动轴等可采用10/IT17[2)] Drive shaft may adopt 10/IT17[2)]		

1）轻载荷、一般载荷以及重载荷是径向当量动载荷（Pr）分别是对应轴承的径向基本额定动载荷（Cr）的不超过6%，超过6%到12%以及超过12%的载荷
2）IT5及IT17表示轴的圆形公差、圆柱度公差等形位公差等形位公差必须分别在IT5及IT7的公差范围内。IT5及IT7的标准公差数值请参阅附录

1) Light load, normal load and heavy load respectively refer to the loads whose radial equivalent dynamic loads (Pr) are no more than 6%, more than 6%-12% and over 12% of the radial basic rated dynamic loads (Cr) of the corresponding bearings.
2) IT5 and IT17 mean that the geometric tolerance such as the circular and cylindricity tolerances must be within the tolerance scope of IT5 and IT7. For the standard tolerance values of IT5 and IT7, refer to the annex.

表7-3 向心轴承（0级、6级）与外壳的推荐配合
Table 7-3 Recommended fit of radial bearing (Class 0 and 6) and casing

条件 Conditions				外壳孔的公差带 Tolerance zone of casing hole	备注 Remark	应用参考 References
外壳 Casing		载荷种类 Load type	外圈能否轴向移动 Whether the outer ring can move axially			
整体型或双半型 The whole or two halves type	外圈静止载荷 Static load of outer ring	任意载荷 Arbitrary load	易于移动 Easy to move	H7	对于大型轴承或外圈与外壳的温度差大时，也可采用G7 For the large bearing or when temp. difference between the outer ring and casing is big, G7 may be adopted.	一般轴承装置，铁路车辆车轴承轴箱、传动装置等 Common bearing device, housing of railway vehicle bearings, driving device.
		轻载荷或一般载荷 Light or normal load		H8		
		轴与内圈温度高 Shaft and inner ring at high temp.		G8	对于大型轴承或外圈与外壳的温度差大时，也可采和G8 For the large bearing or when temp. difference between the outer ring and casing is big, G8 may be adopted.	干燥缸体等 Dry cylinder etc.
		要求在轻载荷或一般载荷下做高精度旋转 Require the rotation with high precision under light or common load	原则上不能移动 Can not move in principle	K6	主要适用于滚子轴承 Mainly applicable to the roller bearings	
			能移动 Can move	JS6	主要适用于球轴承 Mainly applicable to the ball bearings	
		要求低噪音旋转 Require the rotation with low noise	易于移动 Easy to move	H6		
整体型 The whole type	不定向载荷 Non-directional load	轻载荷或一般载荷 Light or normal load	一般能移动 Usually can move	Js7	精确性要求高时，用Js6、K6代替Js7、K7 When high precision is required, replace Js7 K7 with Js6 K6.	电动机、泵、曲轴的主轴承等 Main bearing of the motor, pump and crank shaft etc.
		一般载荷或重载荷 Common or heavy load	原则上不能移动 Can not move in principle	K7		
		强烈冲击载荷 Severe shock load	不能移动 Can not move	M7		铁路车辆主电动机等 Main motor etc of railway vehicles
	外圈旋转载荷 Rotary load of outer ring	轻载荷或变化载荷 Light or variant load	不能移动 Can not move	M7		传动带轮,索道滑轮张紧轮等 Driving pulley, cableway pulley and tensioner etc.
		一般载荷或重载荷 Normal or heavy load		N7	主要适用于球轴承 Mainly applicable to the ball bearings	装有球轴承的轮毂 Hub with ball bearing
		薄壁外壳且为重载荷或强烈冲击载荷 With thin wall and heavy load or severe shock load		P7	主要适用于滚子轴承 Mainly applicable to the roller bearings	装有滚子轴承的轮毂连杆大端的轴承等 Hub with roller bearing and bearing at big end of connecting rod

1）载荷的分类参照表57的注1）
[备注]1、本表适用于铸铁或钢制外壳
2、轴承仅承受中心轴向载荷时，应选择使外圈与外壳之间具有径向间隙的公差带

1) For the load classification, refer to Note 1) of Table 57
[Note] 1. This table is applicable to the cast iron or steel casing
2. When the bearing only bears the central axial load, choose the tolerance zone where the outer ring and the casing have the radial clearance.

7.2英制圆锥滚子轴承的配合（轴承的公差等级：4级、2级）
7.2 Fit of British system tapered roller bearing (tolerance grade: Grade 4 and 2)

表7-4
Table 7-4

与轴的配合公差值表 Tolerance table for fit of shaft

单位 Unit:：μm

载荷条件 Loading conditions		轴承公称内径 Bearing nominal inner diameter d(mm)		轴承单一内径偏差 Deviation of bearing single inner diameter △ds		轴径的偏差 Deviation of shaft diameter		备注 Remark
		超过 Over	到 Up to	上 Upper	下 Lower	上 Upper	下 Lower	
内圈旋转载荷 Rotary load of inner ring	一般载荷 Normal load		76.2	+13	0	+38	+25	
		76.2	304.8	+25	0	+64	+38	
		304.8	609.6	+51	0	+127	+76	
		609.6	914.4	+76	0	+190	+114	
	重载荷及冲击载荷、高速旋转 Heavy and shock load,high rotation		76.2	+13	0	使平均过盈为0.005Xd(mm)的偏差值 The deviation making the average interference 0.005Xd (mm)		一般使用在内部游隙大于标准游隙的轴承 Bearings with inner clearance bigger than standard clearance are adopted
		76.2	304.8	+25	0			
		304.8	609.6	+51	0			
		609.6	914.4	+76	0			
外圈旋转载荷 Rotary load of outer ring	一般载荷(无冲击） Normal load (without shock)		76.2	+13	0	+13	0	
		76.2	304.8	+25	0	+25	0	
		304.8	609.6	+51	0	+51	0	
		609.6	914.4	+76	0	+76	0	
	一般载荷（无冲击） Normal load (without shock)		76.2	+13	0	0	-13	内圈能轴向移动 Inner ring can move axially
		76.2	304.8	+25	0	0	-25	
		304.8	609.6	+51	0	0	-51	
		609.6	914.4	+76	0	0	-76	
	重载荷及冲击载荷、高速旋转 Heavy and shock load, high rotation		76.2	+13	0	使平均过盈为0.0005Xd(mm)的偏差值 The deviation making the average interference 0.005Xd (mm)		一般使用在内部游隙大于标准游隙的轴承 Bearings with inner clearance bigger than standard clearance are adopted
		76.2	304.8	+25	0			
		304.8	609.6	+51	0			
		609.6	914.4	+76	0			

表7-5 与外壳孔的配合公差值表
Table 7-5 Tolerance table for fit with the casing hole

单位 Unit: : μm

载荷条件 Loading conditions		轴承公称外径 Bearing nominal outer diameter D(mm)		轴承单一外径的偏差 Deviation of bearing single outer diameter△ Ds		外壳孔的偏差 Deviation of casing hole		备注 Remark
		超过 Over	到 Up to	上 Upper	下 Lower	上 Upper	下 Lower	
内圈旋转载荷 Rotary load of inner ring	用于自由端或固定端 For the free or fixed end	76.2	76.2	+25	0	+76	+51	外圈易于轴向移动 The outer ring is easy to move axially
		127.0	127.0	+25	0	+76	+51	
		304.8	304.8	+25	0	+76	+51	
		609.6	609.6	+51	0	+152	+102	
			914.4	+76	0	+229	+152	
	外圈的轴向位置能调整 The axial position of outer ring can be adjusted	76.2	76.2	+25	0	+25	0	外圈能轴向移动 The outer ring can move axially
		127.0	127.0	+25	0	+25	0	
		304.8	304.8	+25	0	+51	0	
		609.6	609.6	+51	0	+76	+25	
			914.4	+76	0	+127	+51	
	外圈的轴向位置不能调整 The axial position of outer ring cannot be adjusted	76.2	76.2	+25	0	-13	-38	外圈轴向固定 The outer ring is fixed axially
		127.0	127.0	+25	0	-25	-51	
		304.8	304.8	+25	0	-25	-51	
		609.6	609.6	+51	0	-25	-76	
			914.4	+76	0	-25	-102	
外圈旋转载荷 Rotary load of outer ring	外圈的轴向位置不能调整 The axial position of outer ring cannot be adjusted	76.2	76.2	+25	0	-13	-38	外圈轴向固定 The outer ring is fixed axially
		127.0	127.0	+25	0	-25	-51	
		304.8	304.8	+25	0	-25	-51	
		609.6	609.6	+51	0	-25	-76	
			914.4	+76	0	-25	-102	

轧机用四列圆柱滚子轴承的推荐配合
Recommended fit for four-row cylindrical roller bearing for the rolling mill application

表7-6 Table 7-6 (内圈为过盈配合) (Inner ring is interference fit)

单位 Unit: : μm

内圈与辊颈(轴) Inner ring and roll neck (shaft)						外圈与箱体（外壳） Outer ring and housing (casing)					
轴承公称内径 Bearing nominal inner diameter d(mm)		单一平面平均内径的偏差 Average inner diameter deviation in single plane △ dmp		辊颈直径的偏差 Deviation of roll neck diameter		轴承公称外径 Nominal bearing outer diameter		单一平面平均内径的偏差 Average inner diameter deviation in single plane △ dmp		箱体内径的偏差 Inner diameter deviation of housing	
超过 Over	到 Up to	上 Upper	下 Lower	上 Upper	下 Lower	超过 Over	到 Up to	上 Upper	下 Lower	上 Upper	下 Lower
80	120	0	-20	+59	+37	120	150	0	-18	+40	0
120	180	0	-25	+68	+43	150	180	0	-25	+40	0(H7)
180	250	0	-30	+79	+50	180	250	0	-30	+45	0
250	315	0	-35	+88	+56	250	315	0	-35	+52	0
315	400	0	-40	+98	+62	315	400	0	-40	+57	0(H7)
400	500	0	-45	+108	+68	400	500	0	-45	+63	0
500	560	0	-50	+194	+150	500	630	0	-50	+146	+76(H7)
550	630	0	-50	+199	+155						
630	710	0	-75	+225	+175					+92	+22(G7)
710	800	0	-75	+235	+185	630	800	0	-75	+160	+80(F7)
800	900	0	-100	+266	+210						
900	1000	0	-100	+276	+220					+104	+24(G7)
1000	1120	0	-125	+315	+250	800	1000	0	-100	+176	+86(F7)
1120	1250	0	-125	+326	+260						
		0								+116	+26(G7)
						1000	1250	0	-125	+203	+98(F7)
										+133	+28(G7)
						1250	1600	0	-160	+235	+110(F7)
										+155	+30(G7)

[注]上表中的推荐配合为一般的估计值,为防止内圈蠕变,WKB根据不同的轴承材料及使用条件制定了不同的推荐配合,使用此表时请与WKB联系。

[Note] The recommended fits in the above table are the normally estimated values. In order to prevent the inner ring creeping, WKB made different recommendation in accordance with the bearing materials and application conditions. Please contact us if you need this table.

轧机辊颈用公制四列圆锥滚子轴承的推荐配合
Recommended fit of metric system four-row tapered roller bearing for the roll neck use

表7-7　Table 7-7　　单位 Unit:：μm

内圈与辊颈(轴) Inner ring and roll neck (shaft)						外圈与箱体（外壳） Outer ring and housing (casing)					
轴承公称内径 Bearing nominal inner diameter d (mm)		单一平面平均内径的偏差 Average inner diameter deviation in single plane △ dmp		辊颈直径的偏差 Deviation of roll neck diameter		轴承公称外径 Bearing nominal outer diameter D(mm)		单一平面平均外径的偏差 Average outer diameter deviation in single plane △ Dmp		箱体内径的偏差 Inner diameter deviation of housing	
超过 Over	到 Up to	上 Upper	下 Lower	上 Upper	下 Lower	超过 Over	到 Up to	上 Upper	下 Lower	上 Upper	下 Lower
80	120	0	-20	-120	-150	120	150	0	-18	+57	+25
120	180	0	-25	-150	-175	150	180	0	-25	+100	+50
180	250	0	-30	-175	-200	180	250	0	-30	+120	+50
250	315	0	-35	-210	-250	250	315	0	-35	+115	+50
315	400	0	-40	-240	-300	315	400	0	-40	+110	+50
400	500	0	-45	-245	-300	400	500	0	-45	+105	+50
500	630	0	-50	-250	-300	500	630	0	-50	+100	+50
630	800	0	-75	-325	-400	630	800	0	-75	+150	+75
800	1000	0	-100	-350	-425	800	1000	0	-100	+150	+75
1000	1250	0	-125	-425	-500	1000	1250	0	-125	+175	+100
1250	1600	0	-160	-510	-600	1250	1600	0	-160	+215	+125
		0				1600	2000	0	-200	+250	+150

轧机辊颈用英制四列圆锥滚子轴承的推荐配合
Recommended fit of British system four-row tapered roller bearing for the roll neck use

表7-8　Table 7-8　　单位 Unit:：μm

内圈与辊颈(轴) Inner ring and roll neck (shaft)						外圈与箱体（外壳） Outer ring and housing (casing)					
轴承公称内径 Bearing nominal inner diameter d(mm)		单一平面平均内径的偏差 Average inner diameter deviation in single plane △ dmp		辊颈直径的偏差 Deviation of roll neck diameter		轴承公称外径 Bearing nominal outer diameter D(mm)		单一平面平均外径的偏差 Average outer diameter deviation in single plane △ Dmp		箱体内径的偏差 Inner diameter deviation of housing	
超过 Over	到 Up to	上 Upper	下 Lower	上 Upper	下 Lower	超过 Over	到 Up to	上 Upper	下 Lower	上 Upper	下 Lower
76.2	101.6	+25	0	-75	-100		304.8	+25	0	+75	+50
101.2	127	+25	0	-100	-125	304.8	609.6	+51	0	+150	+100
127	152.4	+25	0	-125	-150	609.6	914.4	+76	0	+225	+150
152.4	203.4	+25	0	-150	-175	914.4	1219.2	+102	0	+300	+200
203.4	304.8	+25	0	-175	-200	1219.2	1524.0	+127	0	+375	+250
304.8	609.6	+51	0	-200	-250	1524.0		+127	0	+450	+300
609.6	914.4	+75	0	-250	-325						
914.4	1219.2	+102	0	-300	-400						
1219.2		+127	0	-375	-475						

推力轴承的配合
Fit of thrust bearing

推力轴承轴圈与轴的配合
Fit of shaft washer and shaft of thrust bearing

表7-9
Table 7-9

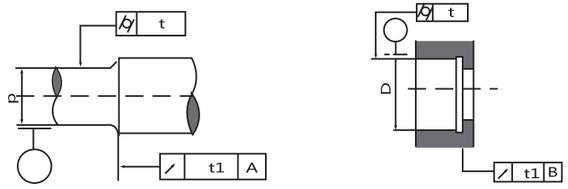
条　　件 Conditions		轴径 Shaft dia mm 超过 Over	轴径 Shaft dia mm 到 Up to	轴的公差带 Tolerance zone of shaft	备注 Remark
中心轴向载荷(对普通的推力轴承) Central axial load (for the common thrust bearing)		全部轴径 All shaft diameters		js6	也可采用 h6 h6 is also applicable
合成载荷(对技术工程) Resultant load (for technical engineering)	轴圈静止载荷 Static load of shaft washer	全部轴径 All shaft diameters		js6	
	轴圈旋转载荷或不定向载荷 Rotary or non-directional load of shaft washer	200 400		k6 m6 n6	也可以分别用js6、k6、m6代替k6、m6、n6 js6, k6 and m6 are also applicable, as substituting of k6, m6 and n6 respectively

推力轴承座圈与外壳的推荐配合
Recommended fit of housing washer and casing of thrust bearing

表7-10
Table 7-10

条　　件 Conditions		外壳孔的公差带 Tolerance zone of casing hole	备　注 Remark
中心轴向载荷(对普通的推力轴承) Central axial load (for common thrust bearing)			选择使座圈与外壳之间具有径向间隙的合适公差带 Choose the proper tolerance zone where the housing washer and the casing have radial clearance.
		H8	推力球轴承具精度要求高 The thrust ball bearing requires high precision
合成载荷(对技术工程) Resultant load (technical engineering)	座圈静止载荷 Static load of housing washer	H7	
	座圈旋转载荷或不定向载荷 Rotary or non-directional load of housing washer	K7	一般使用条件 Normal use conditions
		M7	径向载荷较大 Big radial load

轴与外壳孔的形位公差
Geometric tolerance of shaft and casing hole



轴与外壳孔的公差
Tolerance of shaft and casing hole

轴与外壳孔的形位公差
Geometric tolerance of shaft and casing hole

表7-11
Table 7-11

公称尺寸 Nominal dim mm		圆柱度 Cylindricity t						端面圆跳动 Surface runout t1					
		轴颈 Shaft neck			外壳孔 Casing hole			轴颈 Shaft neck			外壳孔 Casing hole		
		轴承公差等级 Bearing tolerance grade											
		P0	P6	P5	P0	P6	P5	P0	P6	P5	P0	P6	P5
超过 Over	到 Up to	最大 Maximum											
30	50	4	2.5	1.5	7	4	2.5	12	8	5	20	12	5
50	80	5	3	2	8	5	3	15	10	6	25	15	6
80	120	6	4	2.5	10	6	4	15	10	6	25	15	6
120	180	8	5	3.5	12	8	5	20	12	8	30	20	8
180	250	10	7	4.5	14	10	7	20	12	8	30	20	8
250	315	12	8	6	16	12	8	25	15	10	40	25	10
315	400	13	9	7	18	13	9	25	15	10	40	25	10
400	500	15	10	8	20	15	10	25	15	10	40	25	10

轴承润滑的目的是减少轴承内部摩擦及磨损,防止烧伤,使滚动表面及滑动表面间形成油膜。因此，轧机轴承的润滑应达到如下的效果：
在轴承内部减少滚动体、套圈和保持架间的金属接触，减少轴承摩擦及磨损。
使滚动表面及滑动表面间形成良好的油膜厚度，以便延长轴承的疲劳寿命。
特别是当润滑选择正确，润滑剂足够清洁时金属表面间形成弹性流体动力润滑油膜，轴承使用寿命可以远远超过计算寿命。
稀油循环润滑可以有效地排出摩擦所产生的磨粒，脂润滑还可以起到良好的防尘密封作用。

The bearing lubrication aims to reduce the internal friction and abrasion, prevent the burning and offer oil film between the rolling and sliding surfaces, thus the following effects can be realized:

Reduce the metal contact among the rolling body, the ring and the cage and reduce the bearing friction and abrasion.

Offer proper oil film between the rolling and sliding surfaces to prolong the fatigue life of the bearing.

Especially if the lubricant is proper and clean enough, the elastic fluid lubricant film is generated between the metal surfaces, which can greatly prolong the service life of the bearing.

The cycled lubrication with thin oil can effectively get rid of the rubbed particles. The grease lubrication also has the function of dustproof and sealing.

润滑剂的选择要点
Keys for choosing lubricant

润滑剂一般分为润滑脂和润滑油两种，润滑剂的选择原则一般为：中低速运转，重载荷的工况用润滑脂；中高转速、中轻载荷的工况用润滑油，高转速的工况有的使用油气润滑。 对于轧辊轴承多选用润滑脂润滑，只有高速时采用油润滑，特别高的速度才采用油气润滑。
在大多数的应用场合，轧机轴承采用脂润滑可以获得较正常的运行效果，与油润滑相比脂润滑具有容易保留润滑脂在轴承的配置中，特别是倾斜及垂直轴安置的轴承，脂润滑可以有效地防止外界异物、水或水气的入侵，同时也具有润滑系统及润滑辅助设备简单的优点， 因此在轴承润滑设计的首先应考虑选用脂润滑。

The lubricant mainly includes the lubricating grease and oil. The choice generally shall follow these principles: choose the grease for the medium and low rotation and heavy load; choose the oil for the medium and high rotation and medium and light load and sometime choose the oil mist for the high rotation; usually choose the grease for the roll bearing, oil only at high rotation and oil mist at the extra-high rotation. In most cases, the rolling mill bearing can run normally with the grease lubrication. Compared to the oil, the grease lubrication is more likely to remain the grease in the bearing fittings, especially for the bearings with slanted and vertical shafts. The grease lubrication can effectively prevent the foreign matters, water or vapor from entering. Furthermore, its lubrication system and auxiliary devices are easier. Therefore, the grease lubrication shall be first considered in the design of bearing lubrication.

润滑脂的选择要点
Keys for choosing lubricating grease

转速越高 应用针入度大的脂
环境温度低 应用针入度大的脂
环境温度高 应用滴点较高的脂
要有较强的抗水能力
脂的洁净度、防腐性、含水量、分油量均应在控制指标内

High rotation: choose the grease with high penetration
Low ambient temperature: choose the grease with high penetration
High ambient temperature: choose the grease with high drop point
Require strong water resistance.
The cleanness, anti-corrosion, moisture and oil separation capacity shall be controlled within the specified indexes.

润滑脂的选择主要根据轴承的结构类型和工作条件，诸如工作温度、载荷的大小、速度参数（dmn值）等。图8.1是按轴承的载荷及速度来划分润滑脂的选用范围：
Ka=1适用于球轴承、角接触球轴承、四点接触球轴承、调心球轴承及圆柱滚子轴承。
Ka=2适用于调心滚子轴承、圆锥滚子轴承及滚针轴承。
Ka=3适用于推力圆柱滚子轴承及无保持架满圆柱滚子轴承。

To choose the lubricating grease, the following shall be considered: the bearing structure and service conditions, e.g. the working temperature, the load, the speed parameters (dmn) etc. Figure 8.1 shows the choice scope divided in accordance with the bearing load and rotation.
Ka=1, applicable to the ball bearing, angular contact ball bearing, four-point contact ball bearing, self-aligning ball bearing and cylindrical roller bearing.
Ka=2, applicable to the spherical roller bearing, tapered roller bearing and needle bearing.
Ka=3, applicable to the thrust cylindrical roller bearing and full complement cylindrical roller bearing without cage.

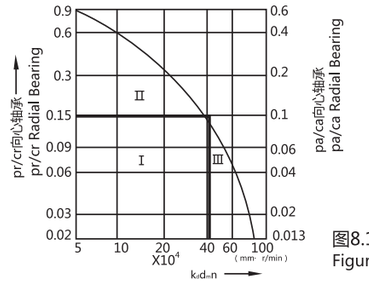


图8.1润滑脂的选择
Figure 8.1 Choice of Lubricating Grease

（Ⅰ）区常用区域，选用一般润滑脂；
（Ⅱ）区高压区域，选用极压润滑脂；
（Ⅲ）区高压、高速区域，选用高压、高速润滑脂；

(Ⅰ)The common zone: choose the common grease;
(Ⅱ)The high-pressure zone: choose the extreme-pressure grease;
(Ⅲ)The high-pressure and high-speed zone: choose the high-pressure and high-speed grease;

润滑的方法
Lubrication method

润滑油的选择要点
Keys for choosing lubricating oil

润滑油的选择主要基于润滑油的粘度，以保证在工作温度下能为轴承提供足够的润滑， 润滑油的粘度与温度有关，为了能在滚动体与滚道接触区形成足够的油膜厚度，润滑油必须在工作温度下不致丧失其最低粘度，因此在选用润滑油时，必须选用在工作温度下粘度高于最小的动力粘度（V1）的润滑油，可以延长轴承使用寿命，但由于增加粘度会引起轴承温度的升高，因此，以这种方法来改善润滑实际上是有限的。
若粘度比V/V1<1（V为40℃时的动力粘度），则可使用含EP（极压添加剂）的润滑油，若V/V1<0.4,则必须使用含有EP添加剂的润滑油,在中型或大型滚子轴承中,若V/V1＞1,使用含有EP添加剂的润滑油,可以提高运行可靠性,必须明白不是所有的EP添加剂都能对轴承有益，对于极低或极高的转速，或者复杂的载荷状况，或不正常的润滑条件时润滑选择，请向WKB咨询。

Choose the oil mainly based upon the viscosity so that sufficient lubrication can be provided to the bearing at the working temperature. The viscosity has relation with the temperature. In order to ensure the sufficient width of the oil film between the rolling body and the raceway, the oil shall not lose its minimum viscosity at the working temperature. Therefore choose the oil whose viscosity at the working temperature is higher than the minimum kinetic viscosity (V1), which can prolong the service life of the bearing. However, increasing the viscosity will raise the bearing temperature. Therefore it is not so ideal to improve the lubrication.

If V/V1<1 (V is the kinetic viscosity at 40℃), you may choose the lubricating oil containing EP (extreme-pressure agent); if V/V1<0.4, you must choose the foresaid oil; for the medium or large roller bearing, if V/V1>1, using this oil can enhance the running reliability. Not all the EP agents are beneficial to the bearings. For the lubrication at the extreme low or high rotation, complicated loading or unusual lubrication conditions, please contact with WKB.

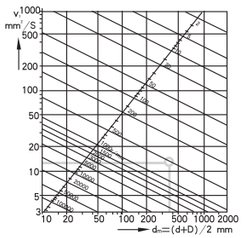


图8.2
Figure 8.2

脂润滑方法
Grease lubrication method

脂润滑的方法一般是润滑剂在轴承安装时注入，注入量应随转速的增高而减少，过多的注入量会引起轴承的温升发热，旋转阻力矩增大和油脂泄漏，污染环境，最终会导致脂的润滑功能下降和老化。一般润滑脂的初次注入量，可以根据轴承脂润滑的许用极限转速ng和轴承的实际转速n的比值来确定。
当：ng/n<1.25建议润滑脂的注入量占轴承的内部自由空间的1/3
1.25< ng/n<5建议润滑脂的注入量占轴承的内部自由空间的1/3-2/3
ng/n＞5建议润滑脂的注入量占轴承的内部自由空间的2/3以上
一般轧机轴承的润滑脂初次注入量G可按公式（12）计算，
$G=0.9(1/3\sim2/3)[0.7854(D2-d2)BX10-3-M/(7.8X10^{-3})]$ (12)式中G-注脂量gm
D轴承外径mm
d轴承内径mm
B-轴承宽度mm
M-轴承重量kg
润滑脂的添加周期可参考图8.4推荐值

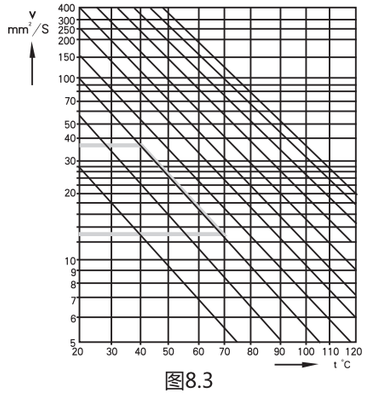


图8.3
Figure 8.3

Usually inject with the bearing installation and the volume shall be reduced with the acceleration of rotation. The over injection may result in the temperature rising of the shaft, the increasing of the rotary resistance moment, leakage, pollution and finally the function reduction and aging of the grease. Usually the initial injection volume may be determined in accordance with the ratio of the allowable limit rotation (ng) to the actual rotation (n).
If ng/n <1.25, recommend the volume takes up 1/3 of the internal free space;
1.25<ng/n<5, recommend the volume takes up 1/3~2/3 of the internal free space;
ng/n>5, recommend the volume takes up over 2/3 of the internal free space.
For the initial injection volume of the common rolling mill bearings G, you may calculate according to the formula (12)
$G=0.9(1/3\sim2/3)[0.7854(D2-d2)]B*10-3-M/(7.8*10^{-3})]$
In which:
G: grease injection volume in unit of gm
D: bearing outer diameter in unit of mm
d: bearing inner diameter in unit of mm
B: bearing width in unit of mm
M: bearing weight in unit of kg
For the injection cycle, refer to the recommended value in Figure 8.4.

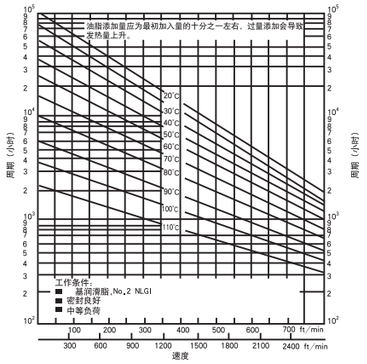


图8.4
Figure 8.4

当选择润滑脂时,锂基脂有较好的抗水性,滴点较高(190～250℃),可用于潮湿和水淋部位,由高级脂肪酸与无机酸组成的复合锂基脂0#、1#脂用于集中润滑，适用于轧制速度小于30m/s的轴承；2#、3#脂用于非集中润滑系统，如线材轧机、高温电机、输送辊道；2#脂适用于轧制速度小于20m/s，3#适用于12m/s以下。
国内生产的多效锂基脂，在耐温特性、抗挤压、耐水、防蚀、粘附力等方面均比较好。
国内生产的通用锂基脂，极压锂基脂，极压复合锂基脂及耐油密封润滑脂均性能较好，可以选择使用。
国内生产的轧辊轴承润滑脂是由高级脂肪酸和增效剂复合而成的多元复合锂基脂，是轧辊轴承理想的润滑脂。推荐使用。

Lithium based grease has strong water resistance and high drop point (190~250℃), applicable to the damp and water drenching places. The complex lithium based greases 0# and 1# composed of high-class fatty acid and inorganic acid are applicable to the bearing whose rolling speed is under 30m/s; 2# and 3# greases are applicable to the non-centralized lubrication system, e.g. the wire mill, the high-temperature motor and the roll gang; 2# grease is applicable to that with rolling speed under 20m/s and 3# to that under 12m/s.

The multi-functional lithium-based grease made in China works well with regard to the high temperature resistance, the extrusion resistance, corrosion resistance and adhesion etc.

The general lithium based grease, the extreme-pressure lithium based grease, the extreme-pressure complex lithium based grease and the oil-resistant packing grease made in Chinas all work well.
The roll bearing grease made in China is the complex lithium based grease composed of the high-class fatty acid and synergist, which is ideal for the roller bearing. Recommend it.

极压复合锂基脂
EP complex lithium-based grease

表8-1
Table 8-1

项目 Items	质量指标 Quality index					试验方法 Test method
	00号	0号	1号	2号	3 号	
工作针入度1/10mm，Worked penetration 1/10mm	400-430	355-385	310-340	265-295	220-250	
延长工作针入度(十万次)，1/10mm,不大于 Prolonged worked penetration (100,000times), 1/10mm, ≤	460	420	390	360	330	ISO
滴点℃，不低于 Drop point ≥ ℃	185	220	250	260	260	ISO
分油量%不大于 Oil separation capacity % ≤	/	/	/	15	15	ISO
蒸发量(180℃)不大于 Evaporation capacity (180℃),≤	5	5	5	5	5	SH/T0337
腐蚀(45号钢片,100℃,3h) Corrosion (45# sheet steel, 100℃, 3h)	合格Qualified	合格Qualified	合格Qualified	合格Qualified	合格Qualified	SH/T0331
相似粘度(-20℃，10s-1，Pa.s不大于 Apparent viscosity(-20 ℃, 10s-1, Pa.s ≤	/	/	1200	1500	1700	SH/T0048
机械杂质,颗数 / cm3,直径24～75 / um,不多于 Mechanical impurities particles/cm3,dia. 24~75/um,≤	3000	3000	3000	3000	3000	SH/T0336
直径75～124um,不多于 Dia. 75~124um, ≤	500	500	500	500	500	
直径大于等于125um Dia. ≥ 125um	无 None	无 None	无 None	无 None	无 None	
最大无卡咬负荷Pa,N不小于 Max. nonseizure load Pa, N ≥	785	785	785	785	785	SH/T0202

A

轧辊轴承润滑脂
Grease for rolling mill bearing

表8-2
Table 8.2

项 目 Items		质量指标 Quality index 00	0	1	2	3	试验方法 Test method
外观 Appearance		棕黄色到棕黑色 From brown yellow to brown black					目测 Visual
针入度(25℃150g)1/10mm Penetration (25℃ 150g) 1/10mm		400-430	355-385	310-340	265-295	220-250	ISO
滴点℃≥ Drop point ℃≥		135	140	220	250	250	ISO
腐蚀(T62,100℃,24h) Corrosion (T62, 100℃, 24h)		合格Qualified	合格Qualified	合格Qualified	合格Qualified	合格Qualified	ISO 乙法 Method B
灰分% Ash %		5.0	5.0	5.0	5.0	5.0	SY2703
水分% Moisture %		痕迹Residue	痕迹Residue	痕迹Residue	痕迹Residue	痕迹Residue	ISO
蒸发量(98.9℃22h)≤ Evaporation capacity (98.9℃ 22h)≤		3.0	3.0	2.0	2.0	2.0	ISO
水淋流失量,%(38℃Clh)≤ Drenching loss, % (38℃, 1h) ≤		6.0	6.0	5.0	5.0	5.0	SY2718
抗擦能力ok值N≥ Anti-scuffing OK value N≥		156	156	156	156	156	ZBE36020
延长工作针入度(10万次-60万次后差值)≤ penetration (difference after 100,000-600,000 times)≤				± 30	± 30	± 30	ISO
钢网分油量(100℃24h)% ≤ Oil separation capacity (steel mesh, 100 ℃, 24h)% ≤				10	5	5	ZBE36016
显微镜杂质,个/cm Impurities under microscope, pcs/cm	25um以上 Over 25um	3000	3000	3000	3000	3000	SY2721
	75um以上 Over 75um	500	500	500	500	500	
	125um以上 Over 125um	0	0	0	0	0	

油润滑方法
Oil lubrication method

油润滑的方法较多,如压力循环供油润滑、滴注式润滑、飞溅式润滑、油浴润滑、循环油润滑、油气润滑等，可根据使用场合的不同而选择。

Forced circulated supply, instillation, splashing, bathing, circulation oil lubrication and oil mist lubrication etc. Depend on the use conditions.

轧机轴承密封的原则
Principles for sealing of rolling mill bearing

轧机轴承密封有两种形式：接触式密封和非接触式密封密封两种形式的使用条件的区分是：
高转速、高温工作条件下，应使用非接触式密封；
中低转速、常温工作条件下，应使用接触式密封；
周围环境有液体、杂质、浸蚀性气体等必须使用接触式密封；
使用稀油作润滑剂必须使用接触式密封。
使用密封装置应考虑摩擦发热问题及拆装与维护方便。

The sealing has two modes, namely the contact sealing and non-contact sealing.
Their difference in the use conditions are as follows:
Under the work conditions with high rotation and temperature, choose the non-contact one;
Under the working conditions with medium and low rotation and normal temperature, choose the contact one;
If there is liquid, impurities or corrosive air etc, you must choose the contact one;
For the thin oil, choose the contact one.
To choose the sealing device, the friction and heat generation as well as the disassembly and maintenance shall be considered.

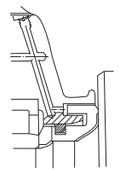


图9.1
Figure 9.1

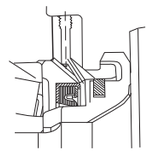


图9.2
Figure 9.2

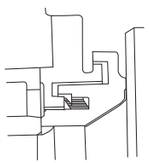


图9.3
Figure 9.3

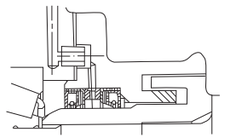


图9.4
Figure 9.4

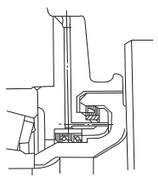


图9.5
Figure 9.5

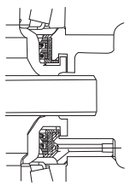


图9.6
Figure 9.6

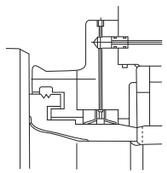


图9.7
Figure 9.7

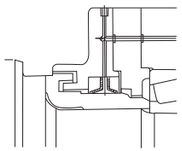


图9.8
Figure 9.8

轧机轴承的密封
Sealing of rolling mill bearing

轧辊轴承欲达到长寿命，有效的轴承密封是十分必要的。油封必须能有效防止轧制铁皮， 水乳液及其它杂质污染物进入轴承内腔，同时也要能防止润滑剂外漏。
轧辊轴承常用的密封形式迷宫、O形环密封、轴向密封环（V型）、径向密封环、金属制的活塞环等。
轧辊轴承密封的选择，应考虑的因素有轧制速度、密封结构、润滑类型和运行温度。
（图9.1、9.2、9.3）为迷宫、V型密封、径向密封环及排水环的综合运用。
（图9.4、9.5）为多重径向密封及迷宫组成的密封部位，可完全阻挡水的进入。立辊机密封部位的设计，其迷宫口必须向下（图9.6）。一般情况下，径向密封唇的指向应一个指向轴承内腔，一个指向外部，以防止脂的外泄和水的进入。通常密封环之间应填充润滑脂（见图9.7、9.8）。
热带钢轧机润滑剂的泄漏，不影响被轧制的材料的质量，而冷轧带钢则要避免润滑剂的泄漏，因为任何泄漏都会污染材料的表面。因此，径向密封环的唇部必须指向轴承。
密封唇滑动表面必须光滑 ，轧辊端部外倒角应圆滑过渡，防止轧辊装卸时碰伤密封唇。
自带密封的轧机轴承，其密封圈的主要功能是防水，它不可能替代传统式的密封件，只能是给轧机轴承增加一层辅助的密封，尽管如此，它对改善轧机轴承的工作环境非常有效。

Effective sealing is very necessary for the long service life of the roll bearing. The oil seal must prevent the iron scrap, water miscible liquid or other impurities from entering the bearing cavity and prevent the lubricant from leaking in the meantime.
The popular sealing modes include labyrinth, O-ring, axial seal ring (V-shape), radial seal ring and metal piston ring etc.
To choose the seal for the roller bearing, take the rolling speed, sealing structure, lubrication type and running temperature etc into account.
(Figure 9.1, 9.2 and 9.3) are the integrated application of labyrinth, V-shape seal, radial seal ring and drainage ring etc.
(Figure 9.4 and 9.5) are the sealing position composed of multiple radial sealing and labyrinth, absolutely prevent the water penetration. For the sealing part of the vertical mill, the labyrinth port must be downward (Figure 9.6). Usually one radial seal lip points toward the bearing cavity and the other toward the outside, in case of grease leakage and water penetration. Where between the seal rings shall be injected the grease (Figure 9.7 and 9.8).
The leakage of grease of hot strip mill will not influence the quality of the materials rolled. However, the cold strip mill shall prevent the leakage of grease, for any leakage will pollute the material surface. Therefore, the lip of radial seal ring shall point toward the bearing.
The sliding surface of seal slip must be smooth. The transition of outer chamfering at the roll end must be smooth, in case that the seal slip is damaged when loading and unloading the roll.
For the mill bearing self equipped with the sealing, the main function of its seal ring is waterproof. It can not substitute for the traditional sealing member and it only add one assistant sealing to the mill bearing. Anyway, it is effective to improve the working environment of the mill bearing.

轴承保管和存放
Bearing storage

轧机轴承是一种精密、昂贵的机械配件，对轴承的保管、存放、操作均有较严格的要求：
1）轴承仓库应清洁、凉爽和干燥。最佳温度在10-25℃之间， 最高不得超过30℃，最低不得低于4℃，否则，应采取调温措施。
2）轴承应放在离地面0.2m的铺有防潮纸或塑料布的架子上,特大型的轧机轴承应存放在托盘上,异物、脏物不得进入仓库内；
3）轴承安装与拆卸应由受过培训的钳工操作；
4）操作时应使用清洁的行之有效的装卸工具。

Rolling mill bearing is a kind of precise and expensive mechanical fitting, thus it must be stored and operated carefully.
1) The warehouse must be clean, cool and dry. The best temperature ranges from 10 to 25℃. The temperature shall not be over 30℃ or under 4℃, otherwise adjustment shall be made.
2) The bearings shall be placed on the shelf covered with waterproof paper or plastics, 0.2m above the ground. Super large bearings shall be placed on the tray and the warehouse must be free of foreign matters and dust.
3) The installation and disassembly shall be done by the trained fitter.
4) Use the clean and effective tools.

安装前轴承和辊颈的准备工作
Preparation of bearing and roll neck before the installation

1）轴承安装前不得启封；
2）轴颈应当检验，以确信安装部位尺寸在要求公差范围内；
3）轴箱应保持清洁，箱孔应检查，确信在公差范围内；
4）确保其它零件没有不正常现象，无损坏。

1) Do not remove the packing before the bearing installation;
2) Check the roll neck to ensure the installation size is within the tolerance;
3) The shaft housing must be clean, and check whether the housing hole is within the tolerance scope;
4) Ensure that no other parts are damaged.

轴承安装与拆卸的步骤
Steps of bearing installation and disassembly

大尺寸四列圆柱滚子轴承（紧配合）
Large four-row cylindrical roller bearing (close fit)

安装步骤
1）在油槽中加热（或电感加热）内圈，油槽的油温达到100℃即可。内圈在油槽中应加热20-30分钟为好，加热后的内径增大量按下式计算：
△ d=12.5X10-6（13） Dd=12.5× 10^{-6}△ td
式中：△ d-内圈内径加热后的增大量（mm）
△ t-油温与室温之差（℃）
2）用干净抹布擦去辊颈表面上的油层；
3）迅速吊起已加热的内圈，将有标记“A”的侧面朝上；迅速用干净抹布擦去内圈两侧面及内孔表面上的残留油迹，然后快速将内圈装在辊颈上；
4）待冷却后用百分片（即厚薄规）检查此内圈与轴肩定位环之间不得有间隙（见图10.1）；

Installation steps
1) Heat the inner ring in the oil groove (or inductance heat) to 100℃ of oil in oil groove. The inner ring shall be heated in the oil groove for 20 or 30 minutes. The inner diameter increase after heating shall be calculated with the following formula:
△ d=12.5× 10^{-6} (13) △ d=12.5× 10^{-6}△ td
in which △ d - inner diameter increase after heating (mm)
△ t - difference between the oil temperature and room temperature (℃)
2) Use the clean cloth to wipe away the oil on the roll neck surface;
3) Rapidly hoist the heated inner ring and place the side with “A” upward; rapidly use the clean cloth to wipe away the oil residue on the two sides of the inner ring and on the inner hole surface and rapidly mount the inner ring on the roll neck;
4) Check whether there is clearance between this inner ring and the locating ring of shaft shoulder with the thickness gauge after cooling (see Figure 10.1)

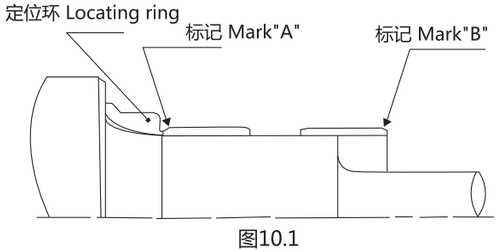


图10.1
Figure 10.1

5）同样方法安装另一内圈，有标记“B”的侧面在外，两内圈必须互相紧密接触；
6）将密封圈压入轴箱后端面，轴箱后端面朝下放平（见图10.2）；

5) Install the other inner ring with the same method and place the side with “B” outward. The two inner rings must contact each other closely;
6) Press the seal ring to the rear surface of the housing and the rear end face shall be placed flat and downward (see Figure 10.2);

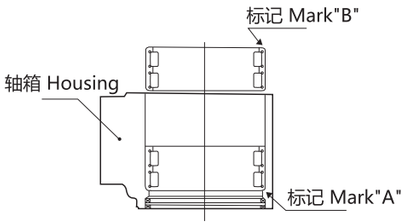


图10.2 Figure 10.2

7）必须确认每一加油孔要畅通无阻，并须去掉轴箱加油孔边缘的毛刺；
8）轴箱内孔表面必须擦干净并涂上薄层润滑油膜；
9）确认好内圈组件端面的系列标记号；
10）用清洁抹布擦去外圈组件上多余的防锈油；
11）在所有滚动体表面上涂上足够的润滑油脂；
12）将吊环螺栓拧入保持架端面起吊丝孔内，并用钢丝绳将有标记“A”的外圈组件垂直向下装入轴箱，装入时注意切勿倾斜；
13）装入时如发生卡住或倾斜可有铜锤或铜棒敲击外组件的外圈端面，但要注意不能敲击滚动体及保持架，防止将铜屑及其脏、杂物掉入轴承内；
14）外组件下端面与轴箱接触面之间不应有间隙；

7) Make sure that each filling aperture shall be smooth and remove the burrs surrounded.
8) Wipe the shaft housing inner holes clean and spread the thin lubricating film;
9) Confirm the series number on the end face of inner ring assemblies;
10) Wipe away the extra rust proof oil on the outer ring assemblies with clean cloth;
11) Spread sufficient grease on the surfaces of all rolling bodies;
12) Screw the eye bolt into the hole on the cage face and vertically put the outer ring assemblies with “A” to the housing with the wire rope. Do not tilt.
13) If trapped or tilted during the installation, tap the outer ring face of the outer assemblies with copper hammer or bar. Do not tap the rolling body and cage in case that copper scale or other impurities fall to the bearing;
14) There shall be no clearance between the lower face of the outer assemblies and the housing contact;

15）用同样方法安装有标记“B”的另一外圈组件，标记“B”应朝上；
16）两外圈组件之间应无间隙；
17）前端盖应紧贴轴承侧面，不合适时可用垫片调节；
18）最后装上止推卡环；
19）将轧辊水平方向放好，然后用适宜的工具水平吊起内已装有轴承外组件的轴箱；
20）要注意箱体与轧辊二者之间在同心后，然后慢慢地将箱体套在轧辊上，同时必须小心不要碰伤滚道与滚子，如有轻微碰伤可用油石轻轻修磨平滑（见图10.3）；

15) Install the other outer assemblies with “B” with the same method and that with “B” shall face up.
16) There shall be no clearance between the two outer ring assemblies;
17) The front end cover shall be close to the bearing side. Adjust with the washer.
18) Finally install the thrust remaining ring;
19) Horizontally place the roll and hoist the housing where the outer assemblies are put in with appropriate tools;
20) After the housing body and the roll are aligned, slowly cover the roll with the housing. Do not damage the raceway and roller. If slightly damaged, grind gently with the oil stone (see Figure 10.3);

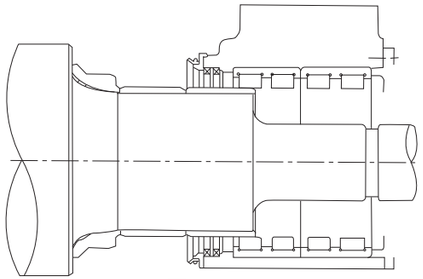


图10.3 Figure 10.3

21）在正确地装入键、止推环和其它零件后，拧紧调节螺母和压盖；
22）最后在确认箱体在轧辊上回转灵活，如不灵活时要拆下检查其原因；

21) After properly installing the key, thrust ring and other parts, screw the nut and gland tightly;
22) Finally make sure that the mill roll moves flexibly on the housing. Otherwise disassemble to have a check;

拆卸 Disassembly

1）拆卸的顺序正好与安装相反。先从轧辊上拆下轴箱并朝上放置；
2）用适宜的工具拆下前端盖吊起外环组件（见图10.4）；
3）将上外圈组件吊起至外组件加油孔与轴箱端面对齐并能从轴箱侧面看见油孔；
4）用销轴插入三油孔后，固定上外圈组件；
5）将下外圈组件推下；
6）先吊出上外圈组件，后再吊出下外圈组件；
7）请注意不要使卸下的轴承与其它零件混杂，还要注意保持架的侧面螺孔不能作为起吊外组件用（安装时可用）；

1) The sequence of disassembly is contrary to that of installation. First dismount the housing from the mill roll and place it facing up;
2) Disassemble the outer ring assemblies at the front end cover with appropriate tools (see Figure 10.4);
3) Hoist the upper outer ring assemblies until the filling aperture is aligned with the housing end face and the aperture can be seen from the housing side;
4) Insert the wrists into three apertures and fix the upper outer ring assemblies;
5) Push off the lower outer ring assemblies;
6) First hoist the upper outer ring assemblies and then the lower ones;
7) Do not mix the bearing with other parts and do not use the side bolt hole of the cage as the external hoisting part (it is allowed during the installation);

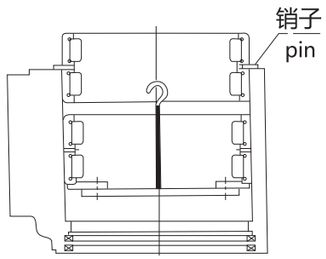


图10.4 Figure 10.4

小尺寸四列圆柱滚子轴承（紧配合）
Small four-row cylindrical roller bearing (close fit)

安装 Installation

1）先将轴肩定位环在油槽中加热；
2）取出轴肩定位环，用洁净抹布迅速抹去内孔表面的油迹；
3）将轴肩定位环一步安装到位；
4）要注意在轴肩定位环冷却后，其侧面与轧辊大直径端面之间不能留有间隙，这一点极为重要（见图10.5）
5）加热内圈，其油温约为100℃--120℃；
6）取出加热的内圈并用洁净抹布擦去内孔表面及两侧面的油迹；
7）将内圈装入轴颈要一次到位，要注意标记“A”必须位于轧辊直径一侧；
8）注意内圈在冷却后，有标记“A”的侧面与轴肩定位环之间不能留有间隙；
9）同时必须确认润滑油应畅通无阻地通过轴箱与轴承组件之间的油孔，要除掉轴箱加油孔边缘的毛刺；
10）密封垫片的两侧面浸油后装入后端盖（见图10.6）；
11）拧紧后端盖螺栓；
12）轴箱垂直放置，轴箱后端朝下放平；
13）擦净轴箱内孔表面并涂上薄薄的一层油脂；
14）确认好外圈组件上的系列标记号；
15）用洁净抹布擦去外圈组件上多余的防锈油脂；

1) Heat the locating ring of shaft shoulder in the oil groove;
2) Bring out the ring and rapidly wipe away the oil residue on the surface of inner hole with clean cloth;
3) Completely install the ring;
4) After it is cooled, there shall be no clearance between its side and the big-diameter end face of the mill roll. This point is very important (see Figure 10.5)
5) Heat the inner ring and the oil temperature shall be 100 ℃ to 120℃
6)Bring out the ring and rapidly wipe away the oil residue on the surface of inner hole and two sides with clean cloth;
7) Completely install the ring to the shaft neck and the mark “A” shall be at the side with the diameter of mill roll;
8) After the ring is cooled, there shall be no clearance between the side with “A” and the locating ring of shaft shoulder;
9) Make sure that the lubricant can smoothly pass through the aperture between the housing and the bearing assemblies and remove the burrs surrounded;
10) After oil impregnate of two sides, the sealing washer shall be installed to the rear end cover (see Figure 10.6)
11) Screw the bolts on the rear end cover tightly;
12) Place the housing vertically and make its rear downward and flat;
13) Wipe the housing inner holes and spread thin lubricating film;
14) Confirm the series number on the outer ring assemblies;
(15) Wipe away the extra rust proof oil on the outer ring assemblies with clean cloth;

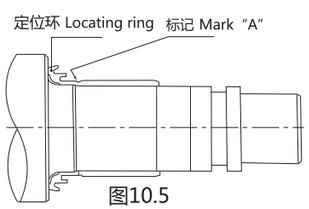


图10.5
Figure 10.5

16）在所有滚动表面上涂上足够的润滑油脂；
17）用工具或用手将带有标记“A”的外圈组件侧面先装入轴箱内，操作时外组件不允许倾斜，标志“A”侧面向下；
18）操作时如外组件卡住，可用铜锤或铜棒敲击外圈侧面而装入。但要注意不要将铜屑及其它脏杂物掉入轴承内；
19）要检查外组件下端面与轴箱接触面之间不应留有间隙；
20）用同样步骤适用于端面有标记“B”的另一外圈组件。要注意标记“B”侧面必须朝上；
21）应检查两外圈组件之间不应有间隙；
22）在轴箱操作侧安装双列或双联角接触球轴承时要注意成对特性，不可搞错；
23）单列向心球轴承安装在传动侧；
24）拧紧前端3或4枚螺栓，并用厚薄规检测轴承箱和前端盖之间的间隙；
25）插入厚度为测量间隙1.1-1.2倍的垫片,装上前端盖然后均匀的拧紧紧固螺钉；
26）轧辊在水平位置放好后，用适宜的工具吊起轴箱；
27）仔细注意箱体与轧辊二者之间同心后，再慢慢地将箱体导入轧辊上，同时必须小心不要碰伤滚道和滚子，如有可用油石修磨滚道和滚子碰伤处；
28）在正确装好键、止推环和其它零件之后，即可完全拧紧调整螺栓（见图10.7）；
29）最后确认轴箱在轧辊上灵活回转，如不灵活要拆下检查其故障原因；

16) Apply sufficient grease on all rolling surfaces;
17) First install the outer ring assembly with marking “A” in the shaft housing with a tool or manually. No outer ring assembly inclination is allowed during operation. The side of marking “A” faces downward;
18) In case of outer ring assembly being stuck, knock the side of outer ring with a copper hammer or bar. Do not let any copper chip and other dirty and foreign matters drop into the bearing;
19) Check that there is no clearance between the contact surface of the lower end face of outer ring assembly and shaft housing;
20) The same steps as mentioned above apply to another outer ring assembly with marking “B”. Make sure that side “B” must face upward;
21) Check that there is no clearance between two outer ring assemblies;
22) Take care of the pairing feature when installing any double-row or double angular contact ball bearing on the operating side of the shaft housing. Don’t operate wrongly;
23) A single-row radial ball bearing should be installed on the drive side;
24) Tighten 3 or 4 bolts in front end and measure with a thickness gauge the clearance between the bearing housing and front end cover;
25) Insert a gasket in a thickness 1.1 to 1.2 times of the measured clearance, place the front end cover and tighten evenly the securing screws;
26) After the roll is placed properly in horizontal position, lift the shaft housing with a right tool;
27) Take a good care and as soon as concentricity is attained between housing and roll, guide slowly the housing onto the roll and be careful not to damage the raceway and rolls from knocking. If possible, trim any damage from knocking on raceway and rolls with an oil hone;
28) After key, thrust ring and other parts are properly installed, tighten completely the adjusting bolts (as shown in Figure 10.7);
29) Finally confirm that the shaft housing can move freely on the roll. If not, remove to check for the reason.

拆卸 Removal

1）拆卸的顺序与安装顺序相反。先从轧辊上拆下轴箱，并将轴箱前端盖朝上安放；
2）取去前端盖，用适宜工具完全托住滚子端面；
3）慢慢吊起外圈组件。请注意不要使卸下的轴承与其它零件混杂。当采用油雾润滑时，切不可在轴箱内安装外圈组件时损坏外径表面上的“O”型密封圈，并注意调节好轴箱与外圈组件二者之间的同心（见图10.8）；

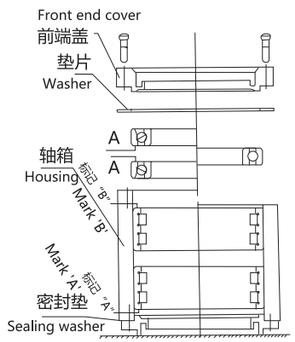


图10.6 Figure 10.6

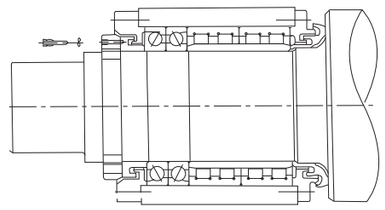


图10.7 Figure 10.7

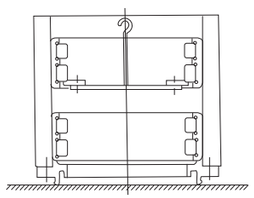


图10.8 Figure 10.8

1) Removal is in the reverse order of installation. Remove the shaft housing from the roll first and place the front end cover of the shaft housing in such a manner that it faces upward;
2) Remove the front end cover and support completely the end face of roller with a proper tool;
3) Lift slowly the outer ring assembly. Do not mingle any bearing removed with other parts. When using oil mist lubrication, don’ t damage the O-ring on OD surface when installing the outer ring assembly in the shaft housing. Take care of concentricity adjustment between the shaft housing and outer ring assembly (as shown in Figure 10.8).

检查与维护 Inspection and maintenance

由于高载荷运行，为了减少由于轴承疲劳或润滑失效而引起的损坏，检查维护周期一般为3-6个月。从轴箱内拆卸轴承之前，轴箱外部应先清除所有氧化皮铁锈和其它脏物。卸下的轴承要进行清洗。经清洗后的轴承首先应进行目测检查。
1）滚子可通过转动来检查，不必从保持架内拆下；
2）在检查过程中，如滚道上发现有微小剥落或损伤，这往往可以不认为是损坏报废的理由，可用油石修磨剥落损伤的表面后，继续使用。如果在外圈滚道上的剥落是轻微的，则可以通过改变载荷区的办法仍可继续使用；
3）滚道与滚子表面上的锈蚀可用金钢砂布或油石除掉。

Due to operation at high load, the inspection and maintenance period is usually 3 to 6 months with a view to reducing any damage resulting from bearing fatigue or lubrication failure. Before removing any bearing from internal shaft housing, iron scaling and other dirty matters should be cleared from external shaft housing. Any bearing removed should be cleaned. Visual inspection should be performed first for any bearing cleaned.
1) Rollers inspection is achievable by rotating with no removal from internal cage necessary;
2) If any minor peeling or damage is found during inspection, this is often not considered as a reason for scrapping due to damage. Service can be continued after the surface with any such peeling or damage is repaired with an oil hone. If any peeling on outer ring raceway is mild, service can be continued by changing the load zone; 3) Any rust on raceway and roller surface can be removed with an emery cloth or oil hone.

感应加热器 Induction heater

轧辊辊颈轴承安装拆卸可采用电感加热器，四列圆柱滚子轴承内圈与辊颈为过盈配合，使用感应加热器使内圈产生感应电流，生热，尺寸胀大，达到迅速安装与拆卸之目的。
常用手提式感应加热器，此类感应加热器可调节尺寸范围，使用较为方便。
固定式电感应加热器适用于大型轴承，使用时需要使用吊车或运送工具。
低压感应加热器，此感应加热器的线圈以水冷却，在技术上是先进的.
图10.11所示加热两个内圈，在3.5分钟内加热到100℃,将内圈置于轴颈端部,待加热达到安装温度后,连同加热器一起推向安装部位。
如图10.12所示，当轴颈为阶梯状时，可使用一安装套做引导。

An induction heater can be used for installing and removing roll neck bearing. Interference fit is provided between the inner ring of four-row cylindrical roller bearing and roller journal. Use an induction heater to produce induced current, generate heat in an inner ring and make it expand in size, achieving the purpose of rapid installation and removal. A protable induction heater with an adjustable size range is often used, which is very convenient. Fixed type electric induction heater applies to large bearings, and a crane or carrying tool is necessary when it is used.
Low voltage induction heater. The coil of this kind of heater is water-cooled and advanced in technology, which is as shown in Figure 10.9, 10.10.
As shown in Figure 10.11, two inner rings are heated to 100℃ in 3.5 minutes. Place an inner ring at the end of a journal and push them together with the heater toward the location of installation when being heated to the temperature necessary for installation.
As shown in Figure 10.12, an installation sleeve can be used as a guide when the journal is in step form.

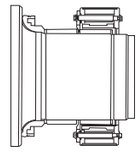


图10.9 Figure 10.9

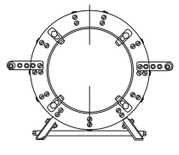


图10.10 Figure 10.10

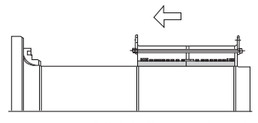


图10.11 Figure 10.11

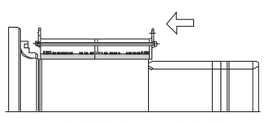


图10.12 Figure 10.12

感应加热器引起轴承和轧辊带磁，在安装后必须退磁，操作方法是将加热器套在轴承上并接通电源， 然后慢慢地移开1-2M长，由于距离增加，磁场强度减小，当磁场的影响十分微弱时，轴承零件达到充分退磁。也有些感应加热器带有自动退磁功能，因此，经感应加热的轴承不会产生剩磁现象。

An induction heater may lead to magnetized bearing and roll, which must be demagnetized after installation. The operating procedure is to put such heater on bearing and power on. Then take slowly away for 1-2M. As the distance increases, the magnetic field becomes less in strength. When the influence of the magnetic field becomes very weak, bearing parts are sufficiently demagnetized. Some induction heaters have automatic demagnetizing function, so there will be no remnant magnetism in bearings heated with such heaters.

失效形式：外圈碎裂
失效原因：1.轴承座内径磨损，与轴承外径配合不好
2.密封不好，冷却水及异物侵入轴承内部
3.轴承承受非正常冲击载荷或轧制负荷过大

Failure mode: The outer ring broke
Failure Reasons:
1. Housings inner diameter worn, with bad fit with bearing outer diameter
2. Seal badly, cooling water and foreign body penetrated internal bearings
3. Bearings withstand shock loads irregular or excessive loads rolling

失效形式：保持架断裂
失效原因：1.轴承安装不正确造成保持架变形
2.保持架与滚子内径发生干涉
3.滚道局部位置卡滚子造成穿柱受力过大

Failure mode: Cage broke
Failure Reasons:
1. Bearing incorrect installation caused deformation cage
2. Cage and roller diameter occurred interference
3. Local position of raceway traps the roller and causes excessive force

失效形式：内圈碎裂
失效原因：1.辊径磨损与轴承内径配合过松
2.轴承安装时端面未压紧
3.辊径与轴承内径过盈过大
4.冲击负荷过大

Failure mode: Inner ring broke
Failure Reasons:
1. Roll diameter worn out, excessively fit with bearing inner diameter
2. End face not pressed firmly during the bearing mounting
3. Excessive interference between roll diameter and bearing inner diameter
4. Excessive shock load

失效形式：滚子碎裂
失效原因：1.非正常轧制力过大，造成冲击载荷过大
2.滚子原材料不合格，有材料裂纹

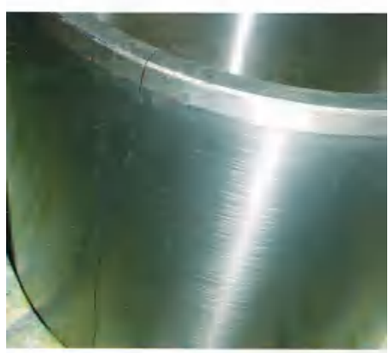
Failure mode: Roller broke
Failure Reasons:
1. Non-normal rolling, excessive, causing excessive impact load
2. Roller substandard raw materials, materials cracking

失效形式：接触疲劳
失效原因：1.润滑条件不好，轴承内部进入微小异物
2.轴承硬度低或轴承零件间硬度不匹配

Failure mode: Contact fatigue
Failure Reasons:
1. Poor lubrication, small foreign body into the internal
2. Bearing low hardness or bearing components not match in hardness

失效形式：磨损失效
失效原因：1.有异物进入滚道，轴承清洁度不够
2.润滑条件严重恶化，局部磨擦生热产生粘着磨损

Failure mode: Wear-out failure
Failure Reasons:
1. With the entry of foreign matter into raceway, the bearings cleanliness is not enough
2. Lubrication condition seriously deteriorated, local friction heat generated adhesive wear



失效形式：轴承裂
失效原因：轴承磨削裂纹

Failure mode: Bearing crack
Failure Reasons: Bearing with grinding cracks

失效形式：挡边碎裂
失效原因：1.轴承安装不当，挡边受较大冲击载荷
2.挡边有磨削裂纹

Failure mode: Rib fracture
Failure Reasons:
1. Bearing improper installation, ribs by the heavier impact load
2. Ribs with grinding cracks